Optimal Care in Childbirth

The Case for a Physiologic Approach

Henci Goer
and
Amy Romano
MSN, CNM

"Goer and Romano have given the maternity care community a gift in their robust examination and synthesis of the evidence supporting best ways to achieve optimal, physiologic birth for women and infants."

Holly Powell Kennedy, PhD, CNM, FACNM, FAAN
Varney Professor of Midwifery, Yale University

"This book is about evidence with attitude. Meticulously referenced, it addresses all the main issues that must be faced if our dysfunctional maternity care system is to be challenged and changed. The central debates in the field are dissected to allow the reader to understand why the existing methodologies often are incapable of disentangling the disputes, leaving the field open to powerful professional interest group biases and conflicts of interest. It is not pretty stuff but much needed."

Michael C. Klein, MD, CCFP, FAAP
Emeritus Professor of Family Practice and Pediatrics

"Exceptional for its academic excellence, broad perspective, and wisdom, this book provides an encyclopedic examination of the scientific literature on childbirth. Goer and Romano paint a grim picture as they guide us through the confusing maze of science, rhetoric, opinion, special interests, and clashing values that shape maternity care today. At the same time, their astute criticism reveals what it will take to fix our broken system. This should be a textbook for everyone in maternity care!"

Penny Simkin, PT
author of *The Birth Partner: A Guide to Childbirth for Dads, Doulas, and all Other Labor Companions;* co-author of *The Labor Progress Handbook*

"Kudos to Henci Goer and Amy Romano, who have produced this comprehensive and authoritative review and analysis of what the obstetric evidence does and does not support. Given the soaring rates of medical intervention in birth, this case for an optimal approach could not be more timely!"

Ina May Gaskin, MA, CPM, PhD (Hon.)

"Goer and Romano have written a 'must read' book. The authors delineate the medical management model from the physiologic care model and use the evidence to ascertain how well each model measures up against this standard. Using careful and powerful writing, Goer and Romano provide the reader with the arguments needed to promulgate optimal care in childbirth."

Helen Varney Burst, CNM, MSN, FACNM
original author of *Varney's Midwifery*

"*Optimal Care in Childbirth* presents compelling evidence for the value and importance of a physiologic approach to childbirth and provides a clear, exhaustive guide for making sense of the research in the context of the current maternity care system. This long awaited book is a marvel. It is a 'must have' resource not just for childbirth educators, nurses, obstetricians, and women, but for hospital administrators, insurance companies, and policy makers."

Judith Lothian, PhD, RN, LCCE
Seton Hall University College of Nursing

"An invaluable resource for those who want to reform maternity care! It rigorously and skillfully analyzes the evidence base for physiologic care and powerfully argues how the medical management model has gone wrong."

Diony Young
author and consultant in maternal health

"This book shines a clear, reasoned light on the inherent irrationality and harmful practices of our current medical management approach to birth in the U.S., and offers a handbook of hope, tools, and skills to change agents working to reclaim the humanity of birth."

Mary Lawlor, CPM, LM, MA
Executive Director, National Association of Certified Professional Midwives

"The balance between the mini-reviews of the science, the practical steps women and health care providers can take to support physiological birth, and the honesty in how the authors address the complex and dynamic nature of giving birth in the U.S., makes this book a must read for everyone involved in providing maternity care services."

Lisa Kane Low, PhD, CNM, FACNM
University of Michigan

"As midwives we support transformation, both in our deeply personal work with mothers and babies and as advocates for a new vision for U.S. maternity care. This book is a primer for success in both the professional and political arenas midwives navigate every day."

Brynne Potter, CPM
North American Registry of Midwives Board of Directors

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The Case for a Physiologic Approach

Henci Goer
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Dedicated to the memory of Phil Hall, M.D.,
an obstetrician as witty as he was wise.

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All women deserve access to high-quality, comprehensive, coordinated, and cost-effective care in the communities where they live, with informed choice among appropriate caregivers, care practices, and birth settings.

Maureen Corry, "Transforming Maternity Care," 2010

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Authorship

While we worked together on all chapters, pooling knowledge and sources, brainstorming content, and peer editing each other's work, one of us had primary authorship for each chapter. Here is who took responsibility for which chapter: Goer had chapters 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16, and 18. Romano had chapters 8, 13, 17, 19, 20, and 21. Romano authored the appendices on maternal mental health and not-so-optimal-babies, and the three introductory chapters were written jointly.

ACRONYMS AND ABBREVIATIONS

ACNM: American College of Nurse-Midwives
ACOG: American Congress of Obstetricians and Gynecologists (or American College of Obstetricians and Gynecologists)
AHRQ: Agency for Healthcare Research and Quality
AFE: amniotic fluid embolism
AFI: amniotic fluid index
AMoL: active management of labor
AMOR-IPAT: Active Management of Risk in Pregnancy at Term
AMTSL: active management of third-stage labor
AROM: artificial rupture of membranes
AWHONN: Association of Women's Health, Obstetric, and Neonatal Nurses
BMI: body mass index
CDMR: cesarean delivery at maternal request
CI: confidence interval
CIMS: Coalition for Improving Maternity Services
CL: confidence limit
CNM: certified nurse midwife
COP: colloid osmotic pressure
CPD: cephalopelvic disproportion
CPM: certified professional midwife
CSA: childhood sexual abuse
CSE: combined spinal epidural
d: day(s)
DIC: disseminated intravascular coagulation
dL: deciliter
ECV: external cephalic version
EFM: external fetal monitoring
ERC: elective repeat cesarean
FHR: fetal heart rate
FTP: failure to progress
GBS: group B streptococcus
Hb: hemoglobin
Hct: hematocrit
HIE: hypoxic ischemic encephalopathy
ICEA: International Childbirth Education Association
ICU: intensive care unit
IOM: Institute of Medicine
IRB: Institutional Review Board
IUPC: intrauterine pressure catheter

LBW: low birth weight
IV: intravenous
MAS: meconium aspiration syndrome
MFMU: Maternal-Fetal Medicine Units
min: minute(s)
mL: milliliter
MSAF: meconium-stained amniotic fluid
mU: milliunit
N2O: nitrous oxide
NACS: Neurologic and Adaptive Capacity Score
NBCS: National Birth Center Study
NHS: National Health Service
NICU: neonatal intensive care unit
NIH: National Institutes of Health
NMR: neonatal mortality rate
NPO: *non per os* (nothing by mouth)
OA: occiput anterior
OP: occiput posterior
OT: occiput transverse
OR: odds ratio
PGE2: prostaglandin E2
PMR: perinatal mortality rate
PROM: prelabor rupture of membranes
PTSD: posttraumatic stress disorder
RCT: randomized controlled trial
RDS: respiratory distress syndrome
RR: relative risk or risk ratio
SGA: small for gestational age
SOGC: Society of Obstetricians and Gynaecologists of Canada
TOL: trial of labor
UK: United Kingdom
US: United States
VBAC: vaginal birth after cesarean
w: week(s)
WHO: World Health Organization
y: year(s)

Why This Book? The Failure of Obstetric Management

It has been a long journey since the early 1990s when I began writing *Obstetric Myths Versus Research Realities*, my first attempt to illuminate the gap between conventional obstetric management and the care model supported by the research.[11] At the time, I was teaching Lamaze classes and attending births as a doula. I essentially wrote the book I wanted to have on my bookshelf but which did not exist. It turned out I was not the only one who wanted a book that provided an evidence basis for a different model of care: *Obstetric Myths* became a modest hit in the birth community. Subsequently, I gave up teaching Lamaze and attending births as a doula to concentrate on writing and speaking about what the research establishes as safe, effective, satisfying care. I learned much about this, helped greatly by the burgeoning power of information technology and by becoming part of a community of like-minded people interested in the evidence underpinning maternity care. This book will take advantage of all I have learned in the 17 years since the publication of *Obstetric Myths*.

I hadn't gotten very far along with this book before I realized that it would benefit greatly from a co-author, and I knew just the person: Amy Romano, an academically inclined nurse-midwife experienced with birth in and outside of the hospital, whose knowledge and expertise worked synergistically with my own. We shared an affinity for physiologic care and the application of logic to maternity care research, but while I brought historical perspective and the insights of a system outsider, Amy brought her clinical knowledge and a public health systems perspective. She also had just given birth to her second child when we started this project, so she brought the maternity care user perspective as well. The collaboration has been a rich one, resulting in a much better book than I could have written alone.

Optimal Care may be new, but my viewpoint has not changed. What I said in the introduction to *Obstetric Myths* holds true, this time for both of us:

> Because I have biases (although I hope I am not prejudiced), I think you should know more specifically what those biases are. I believe we have a maternity care system whose unconscious principles and resultant conscious practices fail those who should be its primary beneficiaries.

> I am . . . opposed to the routine use of intervention. I have attended labors in which the judicious use of technology probably saved the baby and, even in a case or two, possibly the mother, but the key word is judicious. I believe the injudicious use of technology is doing considerable physical and psychological harm to mothers and babies....
>
> Here is what I think defines good care. Good doctors (and midwives):
>
> - believe childbearing to be a fundamentally healthy and normal part of a woman's psychosexual life;
> - treat women holistically, taking into consideration their thoughts, feelings, concerns, and priorities;
> - respect the right of women to make informed decisions for themselves and their babies;
> - respect labor as an experience with its own lessons and rewards;
> - offer supportive rather than interventive care;
> - evaluate individually and do not treat by rule;
> - start small when intervention becomes necessary;
> - keep abreast of the medical literature. (p. 3-4)

This book uses the obstetric research to show that care based on these principles will produce optimal mental and physical health and wellbeing in mothers and babies. It also offers an explanation for the gap—we may even say the chasm—between optimal care and current practice despite most practitioners'—although, unfortunately, not all—having the best interests of the women and babies under their care at heart. We hope that this knowledge will assist those of you working to reform our maternity care system, because in the end it does not matter what is in the care provider's heart; the harm done to mothers and babies is the same.

TWO CONTRASTING MODELS: BY THEIR FRUITS YE SHALL KNOW THEM

Two oppositional philosophies underlie the competing concepts of good maternity care. Medical management practitioners start from the premise that pregnancy and birth are intrinsically difficult and potentially dangerous processes that, when left to occur naturally, frequently result in poor outcomes. It follows that childbearing women require intensive monitoring for complications and aggressive intervention to prevent and treat them in order to achieve the best outcomes. Proponents of physiologic care hold that pregnancy and childbirth are healthy, normal experiences for the vast majority of women and their babies. The best outcomes will be achieved when caregivers promote and facilitate the natural process and reserve medical intervention for times when these measures prove inadequate.

Important consequences flow from the differences between these philosophies. The first is the definition of "good outcomes," a difference that drives much of how the two models organize maternity care. The medical management model

defines success as a live mother and a live baby in reasonably good physical condition at the time the patient is discharged from the provider's care. Care is therefore structured to prevent and, when prevention fails, manage serious problems that may result in death or serious short-term morbidity.

In contrast, the physiologic care model strives for optimal wellbeing of the mother and baby within the context of the family and broader society. This encompasses the absence of morbidity and mortality but also takes into account that the childbirth experience can potentially affect—for good or ill—long-term physical and psychological health, breastfeeding, mother-infant attachment, and parenting.

The Provenance of "Optimal Care"

Our use of *optimal care* derives from the American College of Nurse-Midwives' concept of optimality in maternity care. Midwifery researchers developed an instrument, the Optimality Index-US, that focuses on measuring positive outcomes, factoring the care process into that evaluation. Optimality is defined as the "maximal perinatal outcome with minimal intervention placed against the dynamic context of the woman's social, medical, and obstetric history" (p. 766)[14]—in other words, the least use of medical intervention that will produce the best outcomes given the individual woman's case. As this describes the goals for care that we espouse, we adopted it.

Physiologic care is the use of supportive care practices and low-technology techniques that facilitate the normal biological process of childbirth. It comprises optimal care for healthy women experiencing uncomplicated labor. Optimal care for women with complicated pregnancies or complex medical needs may involve more intensive monitoring and significant medical or surgical intervention; however, the *physiologic care model* dictates using physiologic approaches and engaging the woman as an active participant to the extent safely possible.

The second consequence is the difference in strategies used to achieve good outcomes. To manage complications and prevent disasters, medical management practitioners have adopted the maximin approach from game theory and military strategy.[4] Maximin (also known as minimax) strategies are designed to *min*imize the *max*imum potential losses. Accordingly, tests and procedures that were intended to prevent, diagnose, or treat uncommon complications are used frequently or routinely, although only a small minority stands to benefit from their use. For example, hospital policies prohibit eating and drinking during labor in hopes of

preventing the 1 in 3 million chance of dying of aspiration pneumonia (see chapter 11); care providers routinely induce labor at 41 weeks or even sooner to avert the less than 1 in 1000 chance that a healthy woman will experience a stillbirth late in pregnancy (see chapter 7); and women who have had previous cesarean surgery are forced to have repeat cesareans to avert a 1 in 3300 chance of a perinatal death resulting from uterine scar rupture (see chapter 6).

The physiologic care model, in contrast, is organized to maximize positive effects and minimize negative effects on the broader set of outcomes. Physiologic care focuses on preventing problems from arising in the first place by maintaining health and wellbeing and promoting optimal physical and psychological adaptation to pregnancy, labor, birth, and breastfeeding. Optimal outcomes are achieved by reserving machines and medicines for the times when normal physiology and preventive approaches are not sufficient.

These two fundamentally different approaches give rise to distinct perceptions of iatrogenic harm (injury or illness resulting from medical treatments and procedures). To continue the military metaphor, iatrogenic harms are the "collateral damage" of maximin obstetrics, unfortunate but supposedly unavoidable side effects of the tactics used to safeguard the mother and infant. In obstetrics, iatrogenic harms may come in the form of increased pain and suffering, more complicated labor, or fetal or newborn compromise, for example. In the long term, iatrogenic harms may manifest as chronic health problems (pelvic pain, gastrointestinal complaints), poor psychological outcomes (posttraumatic distress symptoms, depression, anxiety, or attachment disorders), or adverse effects on future reproduction (infertility, complications in future pregnancies).

To make matters worse, the medical management model tends to rely on more intervention to correct these problems. For instance, when high-dose oxytocin infusion leads to nonreassuring fetal heart rate, the medical management model calls for IV fluid boluses, internal fetal monitoring, and, ultimately, cesarean surgery. In contrast, clinicians working within the physiologic care model would minimize use of oxytocin because of the potential for fetal adverse effects, opting instead to use patience and supportive techniques to promote labor progress. Should oxytocin become necessary, they would administer physiologic doses and avoid co-interventions that might contribute to fetal intolerance of labor such as supine positioning or amniotomy. Physiologic care proponents argue, and this book will demonstrate, that collateral damage can be prevented with a wellness-oriented, low-technology approach to care without compromising outcomes.

The two models also diverge in whose needs and concerns take precedence. The medical model centers around the doctor and institutional staff. Their comfort and convenience are paramount and care is structured to meet their needs. The woman, cast in the role of "patient," is expected to comply with policies, routines, and preferences, however disruptive or uncongenial she finds them, without complaint. Taking

an authoritarian approach, the doctor makes all decisions, speaking as well for the baby's interests, which may be perceived as antithetical to those of its mother. The woman is expected to submit to her provider's authority, forfeiting her autonomy, bodily integrity, and physical and mental health when her care providers consider it necessary. The doctor makes decisions according to what he or she deems acceptable risks, a determination often based on self-interested motivations such as protection from malpractice suits or time management. For example, the clinician who advises induction at 41 weeks to avert the 1 in 1000 chance of stillbirth often has no problem with the liberal use of cesarean surgery, which increases the risk of neonatal death by the same amount and confers excess risk of pregnancy loss and perinatal death in future pregnancies. (See chapter 5.)

In marked contrast, the physiologic care model puts the woman at the center. Mother and baby form a single, inextricable unit; what is good for the mother becomes, by definition, good for the baby. The care provider's role is to provide the environment, resources, advice, unobtrusive monitoring, and encouragement that will promote the woman's ability to cope with and overcome the challenges intrinsic to labor and birth, thereby facilitating the natural process. Decision-making is collaborative. The woman articulates her needs and concerns and freely exercises her right to informed consent *and* refusal for both herself and her baby after consultation with her care providers and others. In labor and after birth, the care and setting are arranged to accommodate the needs of the woman and her baby. For example, in addition to pharmacologic means of dealing with labor pain, the woman has access to a full range of comfort measures. According to her inner dictates, she may move about, choose various positions, vocalize, drink to thirst, eat to hunger, and decide when and how to push. When the rare complication occurs, the woman actively participates in resolving it. Most importantly, when she or her baby requires medical intervention, they continue to receive sensitive, respectful, high-touch care.

The two models of care differ as well in their consequences for the organization of the maternity care system. The medical management model maintains that safe care requires proximity to specialized technology and those trained to use it. It follows that the gold standard for safety is universal hospitalization of birthing women under the supervision of obstetricians and preferably in a tertiary care center (a hospital with a neonatal intensive care unit and maternal-fetal medicine and neonatology specialists). Proponents of physiologic care, on the other hand, point to evidence that the mere presence of such technology leads to its overuse and therefore to preventable iatrogenic harm without improving outcomes. (See chapters 20 and 21.) Healthy laboring women, it follows, will be better off in settings that lack the accoutrements of high-tech surgical obstetrics. On these grounds, the World Health Organization recommends that healthy women at low risk of complications in labor should be attended by someone with midwifery

(note: not surgical) skills and that care should be provided at the "most peripheral level where birth is feasible and safe and where the woman feels safe and confident" (p. 37).[22] A maternity care system structured on these principles would provide midwives and birth settings stocked with basic equipment and medicines in every community, with efficient linkages to more sophisticated levels of care when it becomes necessary.

Finally, the two models of care diverge in the meaning assigned to birth within the larger family and societal context. By organizing care to prevent and treat pathology, the medical management model disregards the fact that, ultimately, birth is a transition to parenthood. The medical approach devalues both the importance of supportive care in assisting women to make this transition and the price paid by mothers, babies, families, and society at large when that transition is problematic. It also disregards how a model instilling the impression that women's bodies are incompetent to birth their children without expert help erodes a woman's confidence in her ability to care for her child. Attachment and breastfeeding are seen as niceties to be attended to after the mother and baby are "out of harm's way," with no recognition that physiologic care achieves all three goals. For example, uninterrupted skin-to-skin contact in the hours after birth promotes the optimal physical transition for both mother and baby while also enhancing breastfeeding and parenting outcomes, beneficial effects that persist well into infancy. (See chapter 17.)

The choice of model is critical because its assumptions and principles dictate care. Models should live or die depending on how well their application achieves their own goals. How has near universal implementation of the medical management model fared in this respect?

OBSTETRIC MANAGEMENT: BROKEN PROMISES

Since the publication of *Obstetric Myths*, with one exception, medical intervention rates have soared, and even that one exception, an episiotomy rate that has fallen from one in two women giving birth vaginally to one in four, could be one-tenth of what it is.[8, 16] The cesarean surgery rate, which approached one in four women before falling back to one in five, now has reached one in three, and *is rising in every subgroup of childbearing women*.[13] Far too few in the mainstream obstetric community have a problem with that. Elective primary cesarean surgery, which I treated as an example of a fringe extreme in obstetric thinking in *Obstetric Myths*, is now termed "maternal request cesarean" and presented as a reasonable alternative to vaginal birth. Vaginal birth after cesarean (VBAC), which slowly gained ground as the 1990s progressed, has nearly disappeared. Fewer than 1 in 10 women with a prior cesarean will ever give birth vaginally again, although 3 out of 4 or more could have a vaginal birth if they were allowed to try.[12] According to U.S. government statistics, the induction rate in 2008 was 23%, a 138% change since 1990, but this is among all women, including women having planned cesareans.[18]

An analysis of deliveries at 19 U.S. hospitals between 2002 and 2008 reported that nearly 1 in 2 women (44%) planning vaginal birth were induced.[24] According to Listening to Mothers II, a U.S. national survey of women giving birth in 2005, only 2% of women experienced all of the care practices that, according to Lamaze International and based on World Health Organization recommendations, promote normal birth.[8]

Increased use of tests, procedures, drugs, and restrictions has not paid off in healthier mothers and babies. We have seen minimal improvements recently in the preterm birth rate, but it is still higher than it was throughout the 1980s and 90s.[13] The maternal mortality rate is rising, and experts believe that for every maternal death there are at least 50 "near misses" not counted in the statistics.[2] While the physical casualties mount, what is not even on the radar screen is the psychological damage inflicted by a system that systematically undermines women's self-confidence and traumatizes many. In the first year after birth, two out of three women participating in Listening to Mothers II reported depressive symptoms at the time of the survey.[8] In a follow-up survey a full 9% appeared to meet all of the diagnostic criteria for childbirth-related posttraumatic stress disorder.[9] Nearly one in five (18%) had consulted a healthcare or mental health professional about their emotional wellbeing and nearly one in three (30%) reported that their emotional wellbeing interfered with their ability to care for their babies. Five percent of mothers had considered suicide. It sometimes seems that we could hardly do better at sabotaging maternal-child health and wellbeing if that were the goal. By all measurements, the medical model has failed dismally. In an ideal world, replacing it with a model that works would be easy, but in the real world this is far from the case.

OBSTACLES TO CHANGE: THE USUAL AND NOT-SO-USUAL SUSPECTS

Although the medical management model prevails in the United States and many other industrialized nations, every group that has ever set out to design a healthy maternity care system or to define quality maternity care has articulated the principles and practices of the physiologic care model.[5, 7, 10, 17, 20, 22] The wheel has been reinvented repeatedly, yet somehow we cannot get it rolling. The obvious question then becomes, Why not? A closer look at the forces that maintain the status quo should prove useful to anyone trying to implement reforms.

Chief among disincentives for change are core medical management model beliefs, starting with the belief that intensive use of tests, procedures, and medication protects doctors and hospitals from liability by showing that everything possible has been done to prevent a poor outcome. In reality, a 2009 survey of ACOG's members found that 91% of respondents had been sued,[15] which means that this approach *does not work*, but medical management model beliefs have blinded many to this fact, as well as the fact that obstetricians helped create the liability problem in the first place by implying that intervention-intensive management

would avert bad outcomes. As Marsden Wagner (2006) has written, "If you play God, you will be blamed for natural disasters" (p. 162).[21]

The medical management model also reduces anxiety by conferring an illusory sense of greater control over outcomes. Unlike the natural process, where, in medical model thinking, "anything can happen," medical management makes labor and delivery predictable, including its complications, and when complications occur, everybody knows what to do, up to and including the aces in the hole, cesarean surgery and hysterectomy, literally the ultimate rescue operations for baby and mother. With this mindset, a high-tech setting becomes essential.

Other barriers arise from perverse economic incentives. The ability to start and speed up labor artificially and to terminate it surgically enables obstetric care providers and facilities to control the timing and duration of labor.[3] This makes staffing and resource needs predictable, which reduces cost and allows practitioners more efficient time-management and convenient work hours. High epidural rates permit the extremely high costs of maintaining an anesthesia service to be amortized over the greatest number of patients, while nonpharmacologic measures and supportive care are not reimbursed. High-tech management increases hospital billing opportunities by increasing the use of equipment, drugs, lab tests, etc. Neonatal intensive care units (NICUs) can be profit centers, but they must be staffed at all times and overhead is large,[1] which means they require high occupancy rates. NICUs also eliminate the need to transfer high-risk patients out of the institution, thus losing the revenues they generate. Cesarean surgery increases postpartum stay and readmission rates, and each additional day of hospitalization enhances revenues. Indeed, from the perspective of all interested parties—other than the mother and the baby—the ideal birth is a scheduled c-section.

A final obstacle to change is one we would not have predicted when *Obstetric Myths Versus Research Realities* was published: the era of evidence-based practice. We, along with other advocates for maternity care reform, expected that evidence-based medicine would be the antidote to opinion-based practice. Science, not what a Lancet editorial scathingly called "GOBSAT"—Good Old Boys Sat at Table—would dictate care practices.[19] In the early 1990s it looked as if that dream might come true. The American College of Obstetricians and Gynecologists (ACOG) began issuing practice guidelines that were aligned with the research, and the mounting cesarean rate reversed course while the VBAC rate rose, but the revolution was short-lived. Despite growing evidence against the routine or frequent use of virtually all obstetric procedures, restrictions, tests, and medications, their use continued unchecked or even grew. Some harmful and ineffective practices have persisted because many clinicians do not keep abreast of the research or simply do not follow it, but as pressure mounted to practice obstetrics according to the evidence, studies began appearing that seemed to support intervention-intensive birth. A closer look, though, reveals that they are no more than what Phil Hall, a

Canadian obstetrician, as witty as he was wise, called "decision-based evidence making." As our next chapter will show, the precepts of evidence-based medicine render it vulnerable to subversion, both unintentional and intentional. In fact, as we will see, in many instances ersatz evidence has been used to give credibility to the medical management model. The body of research is now riddled with these faux studies, and because of the misplaced belief in the inerrancy of the process that produces them, they have been accepted into the obstetric canon, included in systematic reviews, and used to justify practice.

By now you may be thinking that the situation is hopeless; resistance is futile. It is not, but those wanting to reform maternity care need a solid foundation in what the obstetric evidence does, does not, or only seems to support, as well as an understanding of the impediments to change and how they are influencing the system. We propose to provide you with that. Along the way, we will help hone your skills at recognizing internal inconsistencies in the medical management model, identifying its unconscious assumptions, and exposing its faulty logic. You should emerge much better equipped to defend a model of care that is safe, effective, and satisfying and to avoid being misled or co-opted.

Despite the deck being stacked against physiologic care, we must not give up. The stakes are too high. The financial costs of medical management to society are enormous—just reducing the cesarean surgery rate to the World Health Organization recommended 15% would save $3.4 billion dollars annually.[6, 13, 23] (See chapter 3 for analysis.) The human cost is also enormous. As a result of overzealous use of technology in labor and birth, millions of women and babies have suffered, and all too many have died. Without a doubt, being a change-maker is likely to be frustrating and difficult, but when the health and wellbeing of childbearing women, babies, and society is at stake, no effort is too great, no accomplishment that forwards that goal too small.

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Why This Book? The Failure of Obstetric Research

When we planned *Optimal Care in Childbirth*, we intended to include a chapter on how to understand and evaluate a research paper, but we discovered that it was not necessary: someone had already done it. Those interested in acquiring these skills should read Trisha Greenhalgh's (2010) superb book *How to Read a Paper: The Basics of Evidence-Based Medicine.*[3]

Greenhalgh's book, however, is not the end of the story. Two sets of problems specific to the obstetric research fall largely outside of its scope: the first set relates to the precepts, practices, and philosophy of evidence-based medicine, the second to the mismatch between the usual conduct of medical research, a process founded on a disease-based model, and the requirements of studying what best promotes the optimal unfolding of a complex physiologic process involving body, mind, and spirit. This chapter will discuss these problems and the distortions they introduce systematically into maternity care research.

EVIDENCE-BASED MEDICINE: THE NEW DOGMA

The principles of evidence-based medicine were developed to redress problems with the traditional foundation of medical practice, which was an "understanding of the basic mechanisms of disease coupled with clinical experience. The latter is epitomized by the individual authority ('expert'), or, better still, collective medical authority, such as a panel of experts" (p. 2 of 7).[7] Grimes (1986) trenchantly points out the problems with this model: "The trouble with conventional wisdom of medical practice is that it tends to be more conventional than wise" (p. 88), as do Isaacs and Fitzgerald (1999): "Clinical experience . . . has been defined as making the same mistakes with increasing confidence over an impressive number of years" (p. 1618).[5, 10] In contrast to the traditional model, one of evidence-based medicine's prominent proponents defines it as: "The conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research" (p. 71).[17]

Since clinicians do not have the time, even if they have the expertise—which most do not—to search out the "best available" evidence to answer the myriad

clinical questions that arise in their practices, information on the best evidence is supplied by experts trained in research methods.[7] These experts sift through the research synthesizing it into predigested summaries to guide practice, the oldest and best known of these being the Cochrane Database of Systematic Reviews. Basing medical practice on scientific evidence is clearly a superior strategy to basing it on individual or even collective opinion or experience—as has been said, "The plural of anecdote is not data"—but, unfortunately, enshrining it as the new dogma has introduced its own set of problems.

One problem resulted from the study design hierarchy devised by early proponents of evidence-based medicine. They placed case studies at the bottom, put observational studies above them, ranked experimental studies higher still, with randomized controlled trials (RCTs) (participants are allotted to groups by chance) at the pinnacle of experimental trial designs, and crowned the whole with systematic reviews (a structured methodology for studying the evidence on a specific clinical issue), generally, although not always, of RCTs.[4] Nowadays, experts reject this hierarchy. Jadad and Enkin (2007) write, "We believe that the . . . tendency to place RCTs at the top of the evidence hierarchy is fundamentally wrong. Indeed, we consider the very concept of a hierarchy of evidence to be misguided and superficial. There is no 'best evidence,' except in reference to particular types of problem, in particular contexts" (p. 106).[11] Case reports, for example, can serve as a warning of serious problems too rare to be detected by RCTs, and observational studies are often the only way to gather information on long-term outcomes.[16] In addition, grading the validity of the evidence according to this hierarchy can be misleading. The conclusion of a systematic review of several small, poor-quality RCTs will outrank the results of a single, large, high-quality RCT, and valuable data from well-conducted observational studies are often excluded altogether.[2]

Studies themselves also have inherent weaknesses. One is that they aggregate populations and include and exclude participants based on predetermined criteria. This means that, however valid the results may be for the study population, they cannot be generalized with certainty to populations with different characteristics under different circumstances, or even to individuals within the study population.[12] Another weakness is that many studies rely on surrogate outcomes such as laboratory results, imaging studies, or clinical observations thought to be in the pathway to a clinical event of interest. Surrogate outcomes are often easier to measure and occur more frequently than adverse outcomes of clinical significance, so fewer participants are needed. In most cases, though, surrogate measures relate weakly or not at all to clinically important outcomes.[6] Yet a third weakness is that many studies have too short a follow-up period. As a result, they may fail to detect late-developing adverse effects or the narrowing of differences between groups over time. Finally, observational studies depend on available data, whether reviewed (retrospective studies) or gathered (prospective studies). Collected data

may fail to capture crucial factors, especially, as we shall see in the next section, when medical model biases determine what is thought worthy of collection.

Moreover, the structure of RCTs limits them to posing the question, "Is intervention X better than standard management (control group) or, in some trials, intervention Y?" which shuts out the possibility that physiologic care or intervention Z might be better than either. RCTs are also predicated on the assumption that context can be eliminated, but factors such as environment and care provider philosophy and judgment powerfully affect outcomes.

The belief that the human factor can be eliminated has other consequences as well. RCTs do not consider that a woman's willingness to participate in a random assignment trial already distinguishes her in potentially important ways from those who refuse participation.[8] Her indifference to the form of care she receives or from whom she receives it means results may not apply to those who have a preference. And agreeing to participate does not mean that either clinicians or participants will follow instructions. Clinicians have been known to subvert random assignment because they were convinced of the value or non-value of treatment. (Modern trials use sabotage-proof allocation methods, but this may be a problem with older trials.) Care providers or participants may also fail to comply with trial protocol. This can happen because participants prefer the other treatment, which, for example, substantial percentages of women allocated to the no-epidural group did in most of the epidural vs. no-epidural trials. It can also happen because clinicians believe deviation from protocol to be clinically indicated, as many of them did in trials of labor induction, amniotomy, and episiotomy.

Protocol violation and crossover cause a serious difficulty: RCTs keep participants with their assigned group ("intent to treat") when analyzing results. To do otherwise would negate the point of random assignment, which is to avoid bias; however, when sizeable percentages of participants receive the treatment of the other group (crossover), it diminishes the differences between them, potentially making it falsely appear that there is no difference.

Another drawback of RCTs is that the expense and logistics of conducting them prohibit trials from being large enough to detect differences in rare outcomes. When dealing with the indiscriminate use of intervention in a healthy population, the occurrence of rare catastrophic outcomes is a crucial consideration. Likewise, expense and logistics preclude thorough evaluation of long-term outcomes in RCTs, but the harms of some obstetric interventions—most notably cesarean surgery—may not manifest until months or even years later or in a future pregnancy.

Systematic reviews pose problems as well. You can generally find the flaws in individual studies, but systematic reviews are "black boxes." You cannot evaluate the quality of their component studies beyond what the reviewers describe, which brings us to the next problem: "garbage in, garbage out." Many poor quality studies have been published in highly respected journals and incorporated into systematic

reviews despite their flaws. Even if the component studies are well conducted, systematic reviews can do no more than synthesize studies that likely suffer from the systemic weaknesses of medical model research (see next section), and even when aggregating trials, the combined population still will be too small in almost all cases to show a difference in rare catastrophic outcomes.[16]

Systematic reviews also have weaknesses that relate to the beliefs underlying them. Advocates for evidence-based medicine claim that systematic reviews will produce objective evidence, but it is naïve to think that the biases of the reviewers will not affect the selection of studies, their interpretation, and reporting in the review. In witness to this, some years ago, the Maternity Center Association (now Childbirth Connection) commissioned two systematic reviews of the literature on epidurals, one from an anesthesiologist and the other from a pediatric epidemiologist.[13, 14] Even though the studies the reviewers included mostly overlapped, the systematic review headed by the epidemiologist found far more areas of concern and noted far more outcomes for which there were insufficient data to relieve concern than the one led by the anesthesiologist. Systematic review methodologies assume that strict adherence to a well-designed set of rules will produce a sound review by eliminating the bias that may be introduced by the use of individual judgment.[12] Following the rules, however, leaves reviewers open to missing problems not incorporated into those rules. These problems may be generic, such as a failure to account for the confounding effects of protocol violation, or they may be problems specific to individual studies not captured by quality evaluation checklists.

Last on the list, because they combine data from multiple studies, systematic reviews can create a false impression of definitive scientific authority. Reviewers often report the total number of included studies and participants in their abstracts, numbers that can be impressively large, but individual results may actually be based on much smaller numbers and on as few as a single trial. (Cochrane reviews report number of trials and participants for each result in the abstract.) Meta-analyses have a drawback as well: pooling data demands that all studies use comparable interventions, look at comparable outcomes, and take place in comparable contexts, caveats that are often ignored.[12] As Greenhalgh (2006) writes in *How to Read a Paper*, "Four apples and five oranges makes four apples and five oranges, not nine appleoranges" (p. 130).[4] Greenhalgh quotes another critic of systematic reviews describing them as "subjectively selected, arbitrarily summarized, laundered, and biased conclusions of indeterminate validity or completeness . . . carried out by people of unknown ability, experience, and skills using methods whose opacity prevents assessment of the original data" (p. 4).[4] Despite their weaknesses, however, systematic reviews have now become the inerrant and unquestioned word on care. Evidence-based medicine demands that we trust the experts who are custodians of the evidence to provide accurate, objective information on which to base care, but as Kemm (2006) writes, "[A]ll too often the phrase

'evidence-based' introduces . . . an attempt, by those who have no knowledge of evidence or understanding of rigour, to pretend that highly contestable propositions are beyond dispute" (p. 323).[12] It invites the question: *Quis custodiet ipsos custodes*? (Who will guard the guards?)

One axiom of evidence-based medicine is that well-conducted research permits the attainment of scientifically objective truth. Does it? Holmes and colleagues (2006) write, "Those who are wedded to the idea of 'evidence' in the health sciences maintain . . . a Newtonian, mechanistic world view [that] reality is objective, which is to say that it exists, 'out there,' absolutely independent of the human observer, and of the observer's intentions and observations" (p. 182), but, they go on to argue, this is a false premise.[9] Rarely does objective truth in medical research exist independently of the observer or the system within which the observer works. Indeed, the authors of "The social and cultural shaping of medical evidence" write:

> Our evidence suggests that mainstream obstetric *science* follows mainstream obstetric *practice*. A patient and expectant approach to birth . . . where all is considered normal until proved otherwise, produces a science that proves intervention to be unnecessary. Alternatively, an aggressive approach to birth . . . where birth is regarded as normal only in retrospect, generates a science that demonstrates the need for monitoring and intervention (p. 2704).[1]

Nonetheless, the powerful claim that it replaces subjective opinion with objective fact has enabled evidence-based medicine to become the "organizing structure for knowledge and a mechanism of ideological reinforcement for the dominant scientific paradigm" (p.184).[9] Scientific discourse in medicine is now determined and controlled by evidence-based medicine's language and structure. As a result, what falls within its purview becomes difficult to challenge or test because the institutionally based academicians who are its custodians dictate the terms by which the test will proceed. One consequence is that any study that conforms to evidence-based medicine's rules and terminology will be perceived as credible and valid whatever its flaws, and critiques on grounds other than that of violating evidence-based medicine's precepts will be dismissed. Worse yet, "The ideology [of evidence-based medicine] lends [its] disciples a profound sense of entitlement. . . . By a so-called scientific consensus, this 'regime of truth' ostracises those with 'deviant' forms of knowledge, . . . rejecting their work as scientifically unsound" (p. 185).[9] In other words, we have replaced the fallible expert opinion of clinicians with the fallible expert opinion of medical academicians, many of whom are convinced that their conclusions represent objective science. Unlike with clinicians' expert opinions, where science, which claims its authority on a different basis, may contradict them, evidence-based medicine experts have set up a court from which there is no appeal except according to the experts' set of rules, and

often, if the critic is perceived as being outside of the evidence-based medicine culture, not even then. In a self-reinforcing system, anyone crying "The emperor has no clothes!" cannot be heard.

Despite its faults, though, evidence-based medicine remains superior to the alternatives for determining medical care: expert opinion, anecdote, or GOBSAT (good old boys sat around table) because it is based on science. While science has its limitations, it has one enormous advantage: it incorporates objective, neutral standards to which those who disagree can resort, which means it has a built-in self-correction mechanism, even though boulders may be strewn in the path. Indeed, evidence of that self-corrective process can be seen. As we noted, Cochrane reviews now report the number of studies and participants included in each meta-analysis, newer reviews in the Cochrane collection as well as others may evaluate the effects of crossover (sensitivity analysis), and systematic reviews of observational studies are becoming more common. Moreover, the vast majority of studies may be flawed, but most still provide us with valuable information if read with a critical eye, and some researchers see the same problems we do and have designed and implemented high-quality studies to avoid them. Our task is to reject the dogmatic approach and maintain a healthy skepticism. Not every practice or policy that claims to be evidence-based actually is.

THE LIMITATIONS OF MEDICAL MODEL-BASED RESEARCH

That medical-model management and its precepts form the backdrop of every study has consequences for the obstetric research beyond those discussed in the previous section. First and foremost, this renders the effects of the medical management model invisible in the same way that fish do not notice the water in which they swim. Under this model, what procedures, drugs, tests, and restrictions the woman undergoes depend little on her condition and almost entirely on her care provider's philosophy and practices. However, despite numerous studies demonstrating this, medical research invariably attributes differences in outcomes to variables relating to the patient or the intervention under study, not the clinician's biases or idiosyncrasies.

Another consequence is that, as so many elements of the medical management model have been shown to be harmful, ineffective, or both, studies occurring in medical management model environments or with "standard management" as the control group compare "frying pans" with "fires." The best that can be said for whatever comes out ahead is that it is less or equally hazardous than management already established as harmful, which is a long way from being found harmless or beneficial.

Moreover, clinical studies compare new treatments with current treatments, which are assumed a priori to be the "gold standard" against which new treatments are measured. In order to justify instituting physiologic care practices and policies, such as eating and drinking in labor or keeping mothers and babies together after

birth, they must be shown to produce not just equivalent but superior outcomes to their opposites. These outcomes, moreover, must be so-called "hard" outcomes as defined in medical-model canons, not "soft" outcomes such as women preferring it or babies crying less.

In fact, the ubiquity of the medical management model has instituted a set of iatrogenic norms, a range of normal values for biological processes that come from measuring the effects of medical intervention but are believed to be inherent parameters of the physiologic process. For example, immediate cord clamping, the usual practice for many decades, deprives newborns of a substantial proportion of their blood volume. As a result, the bilirubin distribution curve is established based on infants who have fewer red blood cells in the early days of life than they should. Definitions of hyperbilirubinemia are derived from the degree of deviation from the mean of this artifactual curve. As a consequence, a study that evaluates delaying cord clamping—now deemed an "intervention"—will find it wanting because more newborns will have bilirubin levels higher than the iatrogenically established norm. Iatrogenic norms affect everything from duration of pregnancy to length of labor to blood loss after birth. They make it almost impossible to dislodge the practices that produced them because care that research shows produces deviant results is, by definition, care that produces abnormal results, and care that produces abnormal results is, by definition, substandard care.

Furthermore, although all biological processes have wide normal ranges, the medical management model has imposed ever narrower definitions of normal on the physiology of pregnancy and labor without regard for whether certain deviations from the norm represent real problems. Studies then hold women and babies to these restricted parameters, classifying deviation as abnormal, which, as with iatrogenic norms, further reinforces this model. In one case, even the average is now defined as abnormal: 41 weeks is the median length of pregnancy in healthy nulliparous women,[15] yet it is now regarded as the cut point of abnormal.

The medical management model also acts as a cultural blinder, limiting what research questions get asked, what comparisons are made, what outcomes are considered important, how results are interpreted, and what implications are seen. It creates a bias toward measuring outcomes that are physical and quantifiable (p. 9).[11] Susan Hodges (2000) sums up the mismatch:

> [T]he scientific method requires clear definitions, rigid boundaries, limited variables, precise measurements, and overall objectivity. However these requirements are in conflict with the complex and variable nature of childbirth, for which subjective and imprecise elements such as attitudes, beliefs, and feelings (of safety, empowerment, comfort, freedom) are important; rigidity, control, limitations, and precision are the antithesis of normal, natural childbirth (p. 281).[8]

Or, as Jadad and Enkin (2007) succinctly put it: "Many things that really count cannot be counted" (p. 9).[11] Another mismatch is that medical-model ideology can lead to emphasizing statistical significance, meaning differences between groups are unlikely to be due to chance, as opposed to clinical significance, meaning differences are ones that women are likely to think important in their lives. For example, authors of studies of incontinence may label women who occasionally lose a few drops of urine as "incontinent" and then use statistically significant differences between vaginal birth and cesarean delivery to argue in favor of the latter. (See chapter 5.) Ideology likewise governs how medical-model practitioners view rare events that are of clinical significance but require enormous numbers to demonstrate their statistical significance. In healthy women and fetuses, the miniscule risk of perinatal death from uterine scar rupture—3 per 10,000 planned vaginal births after cesarean (VBAC)—becomes a rationale for denying VBAC (see chapter 6), and the risk of an emergent complication in home birth potentially resulting in a poor outcome overwhelms all other considerations (see chapter 21), but the equally small excess risks of severe maternal or perinatal morbidity or mortality intrinsic to cesarean surgery may not deter elective use. (See chapter 5.)

This all may sound discouraging, but these are not intractable problems. Physiologic-care thinkers have adapted conventional research designs and strategies to the requirements of studying physiologic care, producing a growing body of research specifically evaluating its safety and effectiveness. Combining this research with a thoughtful analysis of more conventional studies will enable us not only to build the case that physiologic care should be the norm but to build it based on the analytic principles of determining evidence-based treatment. In this way, we will separate the wheat from the chaff, presenting the "wheat" to our readers in a useful format. The next chapter will describe how we plan to accomplish that goal.

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CHAPTER 3

About This Book: The Nuts and Bolts

This chapter provides a roadmap for the rest of the book and describes our systematic approach to evaluating and presenting evidence, an approach that reflects our twin priorities of rigor and transparency.

The book begins with a section on "The Cesarean Epidemic," encompassing both primary and repeat cesarean surgery. Cesarean surgery is the quintessential issue that distinguishes the medical and physiologic models of care. Here they diverge both in terms of beliefs about and consequent attitudes toward cesarean surgery and in the panoply of care practices that, in the medical management model, tend to lead down the track to surgery and, in the physiologic care model, promote vaginal birth. In addition, cesareans have the most salient consequences for women and babies.

Sections III through VII, forming the bulk of the book, examine what practices promote optimal outcomes—the highest probability of spontaneous birth of a healthy baby to a healthy mother who feels pleased with herself and her caregivers, ready for the challenges of motherhood, attached to her baby, and who goes on to breastfeed successfully. The final section steps up to the systems level to evaluate the impact of care providers and place of birth.

The book also contains two appendices. One summarizes best practice for some clinical situations that we call "not-so-optimal," situations that are deviations from normal but not true pathology. The other looks at preventing maternal psychological morbidity, a crucial but neglected issue.

We structured the chapters with the intent to be useful to a wide range of users with varying purposes. They can be read independently, allowing readers to look up what interests them. Each chapter begins with an *essay* that examines the cultural and historical underpinnings of conventional obstetric practice, delineates the gap between evidence and practice, and explores the factors that explain why that gap persists in defiance not just of evidence, but of biological principles and even common sense. We believe this knowledge is vital if we hope to bring about change. As we also wanted to provide practical information, the chapter essays in the meat of the book end with evidence-based and best practice "Strategies for Optimal Care." Chapters conclude with a set of *mini-reviews of the literature* summarizing the body of research relevant to the points being argued in the essay. The primary difference between a systematic review and a mini-review as defined

by Griffiths (2002) is that systematic reviews typically address multiple outcomes simultaneously while mini-reviews are more focused and consider just one or two outcomes.[3] (Our methods are described below.) These mini-reviews enable readers to determine for themselves the strength of the support for our position. In many chapters, we begin the mini-reviews section with a discussion of the global limitations and weaknesses of the research underpinning that chapter, which can alert readers not only to issues with studies we include but studies that may be published in the future.

While we have focused on care in the United States, the book has international applicability, as clinicians use obstetric interventions injudiciously almost everywhere in the world, and as we have drawn on the worldwide medical literature for our sources, much of which is published in English-language journals. To further enhance the book's value in countries other than our own, we have included research on some practices that differ between the U.S. and other parts of the world, notably mediolateral episiotomy and the prophylactic use of ergot derivatives in third-stage labor, and on systems of maternity care service delivery that differ substantially from the physician-led obstetric management that prevails in the United States. We believe we have produced a book that will be useful to anyone hoping to improve maternity care. We hope you will agree.

Limitations of Scope

While we mention the impact of certain medical interventions on maternal psychological wellbeing and breastfeeding success, have an appendix on optimal practice for protecting maternal mental health, discuss how economic motivations drive practice, and touch on factors affecting maternal satisfaction with the birth experience, we do not perform an in-depth analysis of any of these topics. There are several reasons for this. First, with a few exceptions, the quality of evidence for an association between intrapartum care practices and these outcomes is relatively poor, with many studies subject to considerable bias or relying on surrogate endpoints or survey measures that have not been validated in childbearing women. Second, study results often cannot be generalized to other populations, institutions, systems, or eras. Third, satisfaction ratings depend on many factors, including who is asking (caregiver or neutral party), where the survey is completed (hospital or clinic or woman's home), and time elapsed since the birth, and the validity of ratings depends on whether the woman had access to a comprehensive set of options and chose freely among them based on accurate and complete knowledge of their benefits and harms. None of these nuances or caveats will be captured in simplistic Likert scale ratings. Finally, space constraints forced

us to sacrifice some topics in order to provide detailed critical analysis of the clinical outcomes for which a larger body of research was available.

Although we do not cover these outcomes in-depth in this book, we think a strong argument can be made that physiologic care will optimize mental and emotional health and satisfaction and promote breastfeeding. And to cite but one example of how cost *in*effective our maternity system is, studies have shown that the cesarean surgery rate could safely be less than 15% in a mixed-parity, mixed-risk population. (See chapter 4.) The 2009 U.S. rate was 33%, or 1,359,000 women of the 4,131,000 women who gave birth that year.[4] If the rate had been 15%, only 620,000 women would have had a cesarean. This means that 739,000 women or more had cesarean surgeries that could have been avoided. The average maternity services payment for a cesarean delivery in 2010 was $13,000 vs. $8400 for a vaginal birth,[2] a difference of $4600. Multiply $4600 by 739,000, the excess number of cesareans, and we see that avoidable cesarean surgeries cost the health care system an extra $3.4 billion dollars in 2010 alone. In addition, it costs an extra $6450 for a vaginal birth in a hospital compared with a freestanding birth center, not counting the cost of anesthesia services, newborn care, and birth practitioner.[1] The cost of a home birth would be lower still. Imagine the savings if every low-risk woman planned to give birth in a low-technology environment attended by a midwife.

For more information on these issues, we recommend the following resources:

Declercq ER, Sakala C, Corry MP and Applebaum S. New Mothers Speak Out: National Survey Results Highlight Women's Postpartum Experiences. New York: Childbirth Connection, 2008.

Sakala C, Corry MP. Evidence-Based Maternity Care: What It Is and What It Can Achieve. New York: Milbank Memorial Fund, 2008.

Smith LB. Impact of birthing practices on breastfeeding. Sudbury, MA: Jones & Bartlett; 2009.

OUR MINI-REVIEW METHODS

Mini-reviews are more rigorous than narrative reviews, in which reviewers tend to cherry pick evidence to support their own theories and omit what does not.[3] But, as we saw in chapter 2, any review process, including rigorous systematic reviews, is vulnerable to bias. Our solution is transparency. Bias cannot be eliminated completely, but we can make our point of view explicit, describe our methods, and explain our reasons for deviating from conventional review methodologies.

Transparency also allows us to retain the rigor of systematic reviews to determine prospectively search strategies and inclusion/exclusion criteria while at the same time allowing for individual judgment. Chapter 1 gives you our point of view, our biases, if you will, and our grounds for thinking the way we do, while here we describe our review methods and, where relevant, the reasoning behind them. In this way, we place all cards face up on the table, so that our readers can decide for themselves whether our arguments have merit.

One problem, however, could not be resolved because it is inherent to the obstetric research: we rarely know what the outcomes would have been had women received optimal care. For example, VBAC studies in hospitals report rates ranging from 61-72% in women with no prior vaginal births, but a study in freestanding birth centers reported an 81% rate, 9 to 20 more VBACs per 100 women. (See chapter 6.) Keep this caveat in mind as you read the mini-reviews.

Data Sources

We searched Pubmed and the Cochrane Database of Systematic Reviews using relevant keywords and MESH terms. We used the PubMed "related articles" function, the bibliographies of relevant studies, including narrative reviews, and hand-searched our personal files. When a potentially pertinent study was not readily available, we made reasonable attempts to obtain it by using interlibrary loans and querying colleagues.

Inclusion/Exclusion Criteria

We included relevant studies applicable to contemporary care in maternity care systems with adequate resources and where we had sufficient information to judge the quality of the research. Our exclusion criteria fell into two categories: absolute and relative. Absolute exclusions included the following:

- Studies published in languages other than English. The English-language abstracts that accompany some non-English-language studies do not provide sufficient information to judge study quality.
- Abstracts. Studies published only as abstracts or brief reports also do not provide sufficient information to judge study quality.
- Narrative reviews, commentaries, clinical guidelines. These are all opinion pieces and as such provide unacceptably weak evidence.
- Systematic reviews that include other systematic reviews. We felt that this removes us too far from the original sources and therefore the ability to evaluate them.
- Unpublished studies or those not published in peer-reviewed journals. While we may quarrel with the quality of many studies published in peer-reviewed journals, the peer review and editing process sets a minimum standard. Unfortunately, this meant excluding reports published by organizations or

agencies such as Childbirth Connection's excellent Listening to Mothers surveys (although we did cite data from these in chapter essays).

We also had relative exclusions—exclusions that do not necessarily apply under all circumstances. When we include studies with the following characteristics, we provide our rationale for inclusion, either in the text or in footnotes:

- Studies published before 1990. We chose a cutoff date, albeit an arbitrary one, to ensure that care in the study was reflective of current care. However, if a systematic review included studies published prior to 1990, we did not exclude it on that basis.
- Studies in low-resource maternity care systems. We excluded such studies except in rare cases where we lacked data from high resource maternity care systems and when the study's methods section established that care in that setting provided access to appropriately trained and knowledgeable clinicians and modern technology, or, alternatively, when lack of resources would not affect the outcome of interest.
- Studies reporting only surrogate outcomes. We excluded studies reporting only laboratory values or imaging results believed to be in the pathway to outcomes of clinical importance but not in themselves of clinical importance (Apgar scores, for example) or problems that may be part of normal recovery after birth (urinary incontinence limited to the first few months, for example).
- Studies included in included systematic reviews. Including these studies would duplicate results, thereby giving a misimpression of the strength of the data. Sometimes, however, a systematic review did not report on an outcome of interest. In those cases, we included the study for that outcome alone, but excluded it for remaining outcomes included in the review.

Studies qualifying for inclusion could also be excluded based on our appraisal of individual quality. Following our principle of transparency, we will list the reasons why a particular study was excluded, although, in the interest of length, that information will be posted on the book's website (www.optimalcareinchildbirth.com). Studies could be excluded from one mini-review but included in another, as it is possible for study weaknesses to affect reliability of some findings but not others, or because no well-conducted study of stronger design could be found for some particular outcome.

Finally, if well-designed randomized controlled trials (RCTs) or systematic reviews offered reliable evidence pertaining to an outcome or association of interest, we often excluded observational studies for that outcome. Sometimes, however, observational studies were included anyway because they added pertinent data that expanded or deepened our understanding of the issue at hand.

How We Present Statistics

Wherever possible, we present absolute differences (the arithmetical difference in occurrence rates) instead of or in addition to relative differences, such as relative risk (RR) and odds ratios (OR), because relative differences provide an incomplete and sometimes inflated picture of the effects of interventions. For example, tripling the odds or risk can mean going from 10% to 30% or from 1% to 3% or from 1 per 10,000 to 3 per 10,000. For this reason, the absolute likelihood of a particular outcome or the absolute difference in risk if the woman adopts a specific behavior or accepts a specific intervention is more useful for making clinical decisions. In some studies, the investigators reported absolute differences or the number needed to treat or harm, which are calculated from absolute differences, but where they did not, absolute differences could usually be calculated from study data, with one caveat: unlike odds or risk ratios, raw occurrence rates in observational studies* have not been adjusted for confounding or correlating factors. Still, adjustment usually has little effect on the ratio, so we felt that our calculation was a reasonable proxy, if not a strictly by-the-book statistic. In all cases, readers may assume that differences are statistically significant unless stated otherwise.

No review strategy is perfect, but we think we have developed one that serves the purpose of evaluating physiologic care better than medical-model strategies designed to evaluate treatment and prevention of disease. We hope that we have provided a model that can be further refined by those interested in what the research establishes as optimal care for the essentially healthy woman and baby.

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* Data from RCTs does not need to be adjusted for possible confounders because participants have been allocated by chance.

CHAPTER 4

The Cesarean Epidemic: The Chase to the Cut

"Cesareans have become so safe and relatively easy for women. No rushing around, the baby doesn't have to come out right away. . . . [Women are] happy and pain-free and walking around the first day."

Douglas Richards, professor of obstetrics-gynecology, University of Florida quoted in Dorschner (2009)[28]

"The cesarean epidemic. . . . serves as a stunning indication of the level at which the biomedical models of birth now dominant in most countries do not work in terms of either morbidity or *mortality."*

Davis-Floyd et al. (2009)[23]

The first subsection in this book covers cesarean surgery because the cesarean epidemic is the inevitable result of the medical model practices and policies with which we will deal in the rest of the book. It made sense to separate the facts of cesarean from their associated sociocultural issues. We begin, therefore, with an overview that explores the cesarean epidemic's origins, explains what really fuels it, and dismantles the rationales used to defend it.

A HISTORY OF THE CESAREAN EPIDEMIC

The "chase to the cut" began in the early 1970s. Up to then, the U.S. cesarean rate had been stable for decades at around 5%.[103, 104] This low rate did not represent confidence in women's ability to birth normally, but rather a belief among obstetricians that the perils of vaginal birth were outweighed by those of surgery. With improvements in anesthesia and surgical techniques, that perception changed. The primary cesarean rate climbed steeply during the 1970s, and because "once a cesarean, always a cesarean" held sway, women who had primary cesareans went on having cesareans with subsequent children.[100] This sent the cesarean rate soaring to the unprecedented height of 17% by the end of the decade.[104] In response, in 1979 the National Institutes of Health (NIH) convened a task force of health care professionals and stake-holders from other disciplines such as ethics, psychology, and economics to determine the "'state of the art' of management of childbirth by cesarean delivery" (p. iii).[103] After reviewing the research, they concluded: "The rising cesarean birth rate is a matter of concern. The consensus statement reflects

the judgment that this trend of rising cesarean birth rates may be stopped and perhaps reversed, while continuing to make improvements in maternal and fetal outcomes, the goal of clinical obstetrics today (p. 4)." Their recommendations addressed the four most common cesarean indications: labor dystocia, repeat cesarean, breech presentation, and fetal distress. These recommendations had no effect on the primary cesarean rate, which continued to climb, but repeat cesarean rates fell, and VBAC rates emerged from the single digits in 1988.[104] Consumer pressure played a role, but the real reason VBAC became a viable option was that it was the low-hanging fruit: changing how obstetricians manage labor dystocia, breech, and fetal distress is difficult, but get them to say "yes" to VBAC, and most women will birth vaginally—not that most women had that chance. Even during the mid 1990s, the peak years for VBAC, the VBAC rate never got above 28%.[105]

Definitions of Rates

- Cesarean rate: percentage of live births by cesarean delivery.
- Primary cesarean rate: percentage of cesarean deliveries in women who have not had a previous cesarean delivery, including all nulliparous women and parous women with only prior vaginal births.
- Primiparous cesarean rate: percentage of cesarean deliveries in first-time mothers.
- VBAC rate: percentage of vaginal births in women with a previous cesarean delivery.

WARNING: Some agencies have begun reporting these rates in low-risk women (excluding abnormal presentation, preterm, fetal death, multiple gestation, and breech), not in women overall, without making this distinction, which gives the misimpression that cesarean rates are lower and VBAC rates higher than they really are.[77, 79]

With the continuing rise in the primary cesarean rate and the paucity of VBACs, the cesarean rate continued to climb to a peak of 25% in 1988, i.e., one in four women giving birth via major abdominal surgery.[104] In 1990, a consortium of U.S. public health departments launched Healthy People 2000, among whose goals was reducing the cesarean rate to 15% by the year 2000[1]—ironically, roughly the same rate viewed with alarm ten years earlier.

The rising cesarean rate was not solely a U.S. phenomenon. Rates were inexorably going up all over the world and were soaring in some countries.[92] Concern over the appropriate use of obstetric technology led the World Health Organization

(WHO) to sponsor a series of international consensus conferences. Participants agreed that "countries with some of the lowest perinatal mortality rates in the world have caesarean section rates under 10%," but a minority dissented from the proposed second part of the statement: "Clearly there is no justification in any specific geographic region to have a caesarean section rate higher than this 10%" (p. 193).[108] This minority had no quarrel with the accuracy of this statement but felt it had become an impractical goal for many hospitals. To achieve consensus, the final statement was amended to "no more than 10-15% caesarean section births." The WHO conference recommendations were equally ineffectual at stemming the global rising tide.

Meanwhile, in the U.S. it looked for a time as if public health concerns and the burgeoning body of evidence that high cesarean rates did no good and much harm were finally having some impact. After 1988, the primary rate fell back a bit, stabilizing at 15%, a little below its peak of 17%. This and the increasing percentage of women having VBACs resulted in a falling cesarean rate, reaching a low of 21% in the mid-1990s.[105] It looked as if the Healthy People goal might be met, but starting in 1996 the "VBAC-lash" set in, with papers on VBAC's supposed risks and commentaries on its malpractice liability, and the VBAC rate crashed. The primary rate began to rise, as well, and thanks to the multiplier effect of the return to "once a cesarean, always a cesarean," the overall cesarean rate surged upward.

Healthy People 2010, which set public health goals to be achieved by that year, launched in 2000. Pressured by the obstetric community not to set a goal cesarean rate at all,[81, 89] the consortium watered down its new goals to 15% in low-risk (full-term, singleton, vertex) first-time mothers and a 37% VBAC rate in all women with prior cesarean.[47] Even these more modest goals were no match for the cesarean juggernaut. In 2002 the cesarean rate surpassed the previous high of 25%,[68] and every year since it has set a new record. By 2007, one in three first-time mothers was delivering via cesarean surgery, and the VBAC rate was once more in single digits.[62] In 2009, the cesarean rate in women overall was one in three (33%),[40] having grown 50% over its 1996 low and 600% since the start of the rise in 1970.[71]

In 2005, 25 years after its landmark conference documenting the dangers of an unchecked cesarean rate and proposing measures to bring it under control, the NIH convened another task force. In marked contrast to its predecessor, the new conference report concluded that "indirect evidence suggests relatively similar degrees of risk from both pathways in women intending to limit their childbearing to one or two children" (p. 12) and that "cesarean delivery on maternal request may be a reasonable alternative to planned vaginal delivery" (p. 11).[74]

That is not true, of course. Cesarean sections are at least partly to blame for the rise in the U.S. maternal mortality rate. A review of California maternal deaths from 1999 to 2008 found that the rate rose from 9.4 per 100,000 in 1999-2001 to 14.0 per 100,000 in 2006-2008, a statistically significant trend.[17] Neither changes in

population risk factors nor changes in reporting explained the rise, even though the latter was used to justify the dismissal of the report, sight unseen, by the spokesperson for the American Congress of Obstetricians and Gynecologists (ACOG).[51] It was no coincidence that cesareans rose by 50% over the same time period: 15 of the 95 deaths involved causes directly related to the present or prior cesarean surgery.[17] Nor do deaths tell the whole story. Wrote Catherine Camacho, director of California's Center for Family Health, "For every maternal death, there are 10 near misses; for every near miss, there are 10 severe morbidity cases (such as hysterectomy, hemorrhage, or infection), and for every severe morbidity case, there are another 10 morbidity cases related to childbirth."[51]

In light of everything we know about the inherent hazards of surgery, how could the second conference reach such a different conclusion? Let us now turn to arguments cesarean proponents use to defend high cesarean rates, what really drives rates, and how obstetric community leaders promote excessive use.

RATIONALES FOR THE CESAREAN EPIDEMIC: "ROUND UP THE USUAL SUSPECTS"

The majority of U.S. obstetricians have no problem with the cesarean rate. A survey of 500 ACOG fellows in 2003 found that 60% of them did not think the cesarean rate, 28% in that year, was too high.[22] All along, obstetricians have offered a lengthening list of justifications and benefits for having an ever higher cesarean rate, but none hold water.

Rationale: Liberal use of cesarean surgery improves perinatal outcomes. Obstetric management has always been shaped by the fundamental belief that labor and birth pose great risk to the child, a belief exemplified in a Canadian survey in which 59% of obstetricians at a teaching hospital agreed that "Childbirth is only normal in retrospect"[84] and more vividly in individual opinions: "Labour is one of the shortest yet most hazardous journeys humans take during their lifetime" (p. 150).[18] With this mindset, frequent use of cesarean surgery becomes the logical means of rescuing the fetus from those dangers. For example, an obstetrician quoted in a Seattle Post-Intelligencer article says, "How many cases of children with hypoxia, cerebral palsy, are we willing to tolerate in return for simply reducing our C-section rate?"[79] The development of ultrasonography in the 1970s contributed to the increasingly low threshold for cesareans because the newfound ability to see the fetus and evaluate its status furthered conceptualizing the fetus as a separate patient with needs and rights potentially antithetical to—and superseding—its mother's.

The proposal that *all* births should be cesareans for the fetus' sake first appeared in a 1985 commentary, "Prophylactic cesarean at term?" published in the New England Journal of Medicine.[29] Almost laughably extreme at the time, the

authors argued that elective surgery would decrease perinatal mortality and that women should be informed of this. They concluded: "If a patient considers the procedure and decides against it, must she then be required to sign a consent form for the attempt at vaginal delivery?" (p. 1267). The same argument for universal prophylactic surgery was made two decades later by Gary Hankins, chairperson of ACOG's Committee on Obstetric Practices, only now it is no longer extreme and no one is laughing.[42, 43] Denial of VBAC, too, is predicated on grounds of fetal risk.

Rebuttal: Beyond a certain point, more cesareans do not improve perinatal outcomes. Multinational statistical analyses show that neonatal mortality increases when cesarean rates exceed the 10-15% rate recommended by the WHO.[14, 106] Why should this be? Cesarean surgery is not risk free. An analysis of U.S. statistics found that ultra-low-risk women having primary cesareans will experience a small excess in neonatal deaths compared with similar women planning vaginal births (some of whom will have intrapartum cesareans).[63] When cesareans are reserved for situations where the danger of perinatal (or maternal) death is substantial, benefits outweigh the risk, but a rising cesarean rate necessarily means surgical delivery of healthier babies and women. At some point—around 10% to 15%, according to statistical analyses—the balance tips the other way. Indeed, the rise in cesarean surgery has contributed not only to the prevalence of preterm birth,[64] a potent threat to newborns in and of itself, but also, after controlling for confounding factors, increased morbidity and mortality in babies born preterm.[67] Furthermore, primary and repeat cesarean surgery increase the risk of fetal and neonatal death in subsequent pregnancies, and as primary cesarean rates rise, more babies are exposed to this potential. (See chapters 5 and 6.)

Rationale: Liberal use of cesarean section averts malpractice suits. Apologists claim that doctors' hands are tied because "eighty percent of OB lawsuits involve a claim that C/S was not done or was done too late" (p. 6).*[81] ACOG, whose 1995 VBAC guidelines read "Women [with low transverse incision] should be counseled and encouraged to undertake a trial of labor" (p. 92),[13] explained its 180-degree turn on VBAC on liability grounds in its 1999 guidelines: "Increasingly, these adverse events during trial of labor have led to malpractice suits. These developments . . . illustrate the need to reevaluate VBAC recommendations" (p. 2).[12]

Obstetricians operate based on this rationale. In a 2003 survey of 502 ACOG obstetricians, nearly two-thirds of them (64%) said that fear of liability was moderately or most important when recommending VBAC.[22] A 2009 ACOG survey of 5644 of its members reported that 29% had increased the number of cesarean deliveries and 26% had stopped offering VBAC for the same reason.[54]

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* The author of that statement has also opined that eliminating vaginal birth altogether would prevent fetal brain damage.[50]

Rebuttal: Obstetricians have blamed women for suing over bad outcomes since the beginning of the epidemic, but the steep rise in malpractice suits and malpractice insurance premiums did not occur until the early 1980s, by which time the cesarean rate had already tripled.[102] Moreover, most malpractice lawsuits between 1976 and 1979 were associated with cesarean surgery rather than failure to perform surgery—since with surgery comes a higher probability of something going wrong[76]—and obstetricians won 97% of lawsuits closed by 1987.[80] The "malpractice crisis" continues to be largely a myth: tort filings and judgment awards are down in recent years, most lawsuits have merit, most never go to court, and of those that did in recent years, doctors won the vast majority.[15, 54] Then, too, as pointed out in chapter 1, defensive medicine does not work: the 2009 survey of members of ACOG found that 91% of respondents had been sued.[54] (The ethical aspects of defensive medicine will be addressed later.)

Rationale: It's the women's fault, i.e. cesarean rates have risen because the childbearing population is now fatter, older, or at higher medical risk. Citing obstetric "experts" as its source, a 2002 Washington Post article asserts that "part of the reason is that more women are having babies at older ages, when they tend to have more complications. . . . At the same time, the nation's obesity epidemic means that more overweight mothers are carrying more big babies, which are more difficult to deliver."[99] Some even claim that women are an evolutionary failure: a 1985 San Jose Mercury News article quotes a local hospital's director of obstetrical services as saying, "These kids today are growing so damned big. . . . In the evolution of the human race, somehow babies are growing faster than mothers' pelvises."†[97]

Rebuttal: Cesarean rates do rise in correlation with factors such as maternal age and birth weight,[78] which means that a proportional increase in the population would affect the cesarean rate, but this is not the end of the story. U.S. cesarean rates have increased sharply at every maternal age, in every ethnic group, and for every demographic or medical risk factor.[65] The relationship between maternal weight and cesarean rate cannot be ascertained directly, but the proportion of high-weight women increased from 1991 to 1996 while cesarean rates were falling and held steady from 1999 to 2004 when cesarean rates were once again on the rise.[65] An increase in macrosomic babies also fails to explain the rise in cesarean rates. Cesarean rates have increased in all weight categories,[85] the incidence of macrosomia declined from 1990 to 2000,[85] and cesarean rates with macrosomia have soared: U.K. physicians delivered only 3% of babies weighing 4000 g or more via cesarean in 1958,[30] while U.S. obstetricians today may perform cesareans on as many as half the women with babies of this size.[58, 110]

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† This absurdity is still in play. A.R. heard it in a 2009 grand rounds lecture. The lecturer then used evolution as a reason for the increase in preterm births: women's bodies somehow know they will not be able to birth the baby if the pregnancy goes to term.

Rationale: Cesarean surgery prevents pelvic floor dysfunction. Write two members of ACOG's leadership, "The evidence is now overwhelming that vaginal delivery is the major risk factor for development of urinary or anal incontinence in women" (p. 16).[39]

Rebuttal: The major risk factor associated with postpartum urinary incontinence is prepartum urinary incontinence, not mode of delivery.[20] As chapter 5 will document, beyond the healing period and without taking into account the deleterious effects of conventional second-stage management, cesarean surgery does not protect against anal incontinence, urinary urge incontinence, severe urinary stress incontinence (it offers some protection against mild urinary incontinence in which symptoms had little effect on quality of life), or sexual dysfunction. It makes no sense to undergo prophylactic surgery when few women will experience severe problems beyond the early postpartum weeks and months, and urinary incontinence can often be alleviated or relieved by nonsurgical means such as a program of pelvic floor exercises or losing weight.[20] Furthermore, no long-term study we know of has found a protective effect past age 50.

Rationale: Substantial numbers of women are requesting elective primary cesareans, and respect for their autonomy demands honoring that request. The supposed groundswell in "maternal request" cesarean was the motivation for evaluating cesareans' comparative benefits and risks in the 2006 NIH conference: "Internationally and domestically, estimates of cesarean delivery on maternal request range from 4 to 18% of all cesarean deliveries . . . [no sources given for this data]" (p. 1).[74]

Rebuttal: Leaving the issue of respecting autonomy aside for now, U.S. estimates of maternal request cesarean come from birth certificate data where there is no apparent indication for cesarean surgery,[46, 70] but it cannot be assumed that "no indication" cesarean equates to "maternal request" cesarean. Listening to Mothers II, a survey of U.S. women giving birth in 2005, which asked women themselves, reported that 0.4% of respondents had an elective primary cesarean at the woman's request.[25] The task force commissioned for the NIH conference could not determine to what degree cesarean at maternal request contributed to the cesarean rate in developed countries.[107] It reported that only one study, in Scotland, specifically distinguished "cesarean delivery at maternal request (CDMR)," which the task force defined as "a cesarean delivery for a singleton pregnancy, on maternal request, at term, and in the absence of any maternal or fetal indication for cesarean delivery" (p. 24). The task force claimed this study reported a 7.7% rate of CDMR, but only 31 of the 623 women supposedly having CDMR had a vertex fetus and no prior cesarean, the rest having either breech babies or a previous cesarean.[113] Recalculating the CDMR with "31" as the numerator yields a 0.4% CDMR rate, exactly the rate reported in Listening to Mothers II. The task force's failure, however, did

not stop it from bandying about numbers or from continuing to call the conference "Cesarean Delivery on Maternal Request."

We are now well into the second generation of excessively high cesarean rates. Over time, high rates have come to seem normal for women and clinicians alike and have taken on the force of "what is must be right," as evidenced by the most bizarre rationale for elective surgery so far:

> More than one in four women who do not have a cesarean section by choice will end up having one anyway, and their morbidity and mortality will exceed that sustained by women whose surgeries are scheduled. It is against this backdrop that physicians must consider the role of patient choice in determining the proper mode of delivery in the circumstance of an uncomplicated pregnancy (p. 113).[73]

In other words, because obstetricians mismanage labor so badly, women, like Brutus in *Julius Caesar,* should leap into the pit themselves rather than tarry till they are pushed. But as Childbirth Connection (2006) so eloquently put it, "All mothers should have access to safest vaginal birth practices. We should not expect them to choose between vaginal birth with avoidable harms and cesarean section."[21]

"IF YOU DON'T WANT TO GET CUT, DON'T GO TO A SURGEON"

Several bodies of evidence tie today's high cesarean rates to obstetricians' beliefs and their resultant practices. Beginning with studies of practice variation, cesarean rates vary wildly in homogeneous populations. One study reported that rates for low-risk nulliparous women among 15 obstetricians ranged from 6% to 20%;[72] another that rates among 11 obstetricians serving very-low-risk women ranged from 19% to 42%;[35] and a third that, after adjustment for maternal age, cesarean rates in full-term nulliparous women with singleton, vertex fetuses at 20 hospitals ranged from 11% to 30%, with only 6 of the 20 achieving the Healthy People 2010 goal of 15%.[66] A study compared outcomes among women planning home birth with home-birth-eligible women planning hospital birth with the same midwives or with physicians.[49] The cesarean rate in women planning home birth was 6%, versus 12% for the planned midwife-attended hospital births, versus 18% for the planned physician-attended births. Cesarean rates also vary widely in mixed-risk populations. A rural maternity hospital without cesarean capability serving Native Americans reported a 7% cesarean rate versus a 21% U.S. national rate while achieving a similar perinatal mortality rate compared with the national average, despite serving a population at greater-than-average risk.[57] Finally, a study of 171,000 New Jersey births grouped obstetricians according to whether their cesarean rates were low (< 18%), medium (18-27%), or high (> 28%).[59] Obstetricians maintained their cesarean rankings in all subgroups: nulliparous women;

women with prior cesarean; women at term, pre-term (33-36 w), and postterm; and women with diagnoses of dystocia, fetal distress, preeclampsia/eclampsia, placenta previa, and placental abruption. Higher cesarean rates did not improve outcomes: low cesarean-rate obstetricians had similar perinatal mortality rates to medium- and high-rate obstetricians despite serving a socioeconomically higher-risk population and performing fewer cesareans in women with complications.

A second body of evidence highlights the impact of obstetrician judgment. Obstetricians are much more likely to perform a cesarean when they wrongly believe the baby weighs 4000 g or more based on sonographic estimates than when the baby actually weighs this much but the obstetrician did not suspect it.[58, 62, 90, 110] Impatience, too, heavily influences cesarean rates. ACOG advises that labor dystocia cannot be diagnosed until active phase labor,[4] but data collected at 19 U.S. hospitals on 229,000 women from 2002 to 2008 revealed that, among nulliparous women having cesareans for failure to progress, one-quarter of those beginning labor spontaneously had their cesarean before 6 cm dilation, jumping to half of induced nulliparous women.[115] Among VBAC women having cesareans for this reason, one-third had c-sections before 5 cm dilation. Small surprise, then, that the cesarean rate overall in nulliparous women was 31% and the VBAC rate was a dismal 57%.‡ Similarly, a study of a protocol mandating at least four hours of adequate contractions on oxytocin in women with arrested labor progress and more if contractions could not be brought up to par achieved an 8% cesarean rate.[87] The authors report that if (as is not uncommon) cesareans had been done after two hours on oxytocin with inadequate progress, the cesarean rate would have been 23%.

A third body of evidence documents obstetricians' pro-cesarean bias. Surveys reveal that substantial percentages of obstetricians prefer elective cesareans for themselves or their spouses. One done at a regional ACOG meeting found that 57% of the male and 33% of the female obstetricians, 46% overall, would choose elective cesarean surgery.[31] Another, of Maine obstetricians, reported that 21% preferred elective cesarean for themselves or their partner.[109] The reasons for their preference were not evidence based (see chapter 5): 12% believed that elective surgery would avoid urinary or anal incontinence, and 9% believed it would avoid sexual dysfunction and pelvic prolapse. Erroneous beliefs will color both obstetricians' judgment and what they tell patients. Proof of bias can also be found in the reasons obstetricians find acceptable for surgical delivery. The same Maine survey reported that 5% would agree to perform cesarean surgery on a healthy woman for "convenience," 6% for having "certainty of delivering practitioner," and 7% for "[labor] pain".[109] Among male obstetricians in Portland, Oregon, 29% would agree to elective surgery for a "librarian in early labor who is fearful of urinary incontinence," 24% for a "cashier not in labor, history of previous stillbirth," 13% for a

‡ VBAC rates in the mid-70 percents or more are readily achievable in an unselected population.[37]

"physician not in labor who is tired of being pregnant," and 3% for a "secretary in early labor requesting cesarean because of painful contractions."[33] The authors of the 2006 NIH conference report state that "a provider's view of CDMR may be influenced by his or her training, practice environment and experience, personal philosophy regarding birth, and medicolegal experiences" (p. 11), without seeing this as a problem affecting provision of appropriate care and deem the following factors ethically acceptable justifications for cesarean surgery:[74]

- "woman's ability to take time off from work" (p. 114);[73]
- "her need to have a distant relative in the home around the time of the birth" (p. 114);[73]
- "the control of the process afforded by cesarean delivery" (p. 10);[74]
- "hospital resources such as operating rooms and staff" (p. 11);[74]
- "economic considerations, such as insurance coverage, payment, and scheduling conflicts" (p. 11);[74]

and last, but far from least:

- "Unpredictability of the timing and length of labor for a provider's lifestyle and fatigue level . . ." (p. 11).[74]

These "indications" would provoke outrage were they proposed for any other major operation—let alone one on a healthy person—yet they passed muster without a murmur at a prestigious national conference.

Obstetric beliefs and obstetric practices reinforce each other. Obstetric beliefs ensure that obstetricians attribute the resultant harms of medical model management to the dangers of the natural process instead of to their actual cause, an illusion that leads to imposing yet more tests, procedures, drugs, restrictions, and surgeries, thereby continuing the vicious circle. At the same time, the perceived need for medical model management legitimizes the hegemony of obstetricians. (More on this below.) Unfortunately, this renders obstetric beliefs highly resistant to change in the face of logic, science, and the research evidence.

WHAT IS REALLY DRIVING THE CESAREAN RATE?

As we have seen, none of the rationales for a high cesarean rate proposed by obstetricians holds water. What, then, are the real drivers? We have already discussed malpractice and the effects of medical management as well as the role of obstetric beliefs about vaginal birth and cesarean surgery. Let us now turn to money and power.

Beginning with money, on the obstetrician's side, the average payment for cesarean delivery in 2010 was $3505 versus $2997 for vaginal birth, a $508 difference.[19] This is not, perhaps, a huge sum, but cesarean sections also increase patient throughput. Jennifer Block quotes a doctor as saying, "OB is a business. It's a volume business . . . If you get paid $2400 to deliver a baby and you pay out

$90,000 in malpractice insurance, you have to do a lot of deliveries to pay that fee" (p. 60),[15] while a San Jose Mercury News article on the reasons behind the high cesarean rate explains, "In some cases, doctors say it simply is impractical to attend a protracted labor when there's a room full of patients waiting at the office."[97] Moreover, if women can be convinced that their care provider must be able to perform a cesarean, or better still, that cesarean surgery is the optimal mode of delivery, obstetricians eliminate their main competitors: midwives. On the hospital side, cesarean surgery ensures the use of anesthesia services; increases billable services, procedures, and drugs; and lengthens postpartum stay. In 2010, the total average payment (facility and provider) for cesarean surgery was $13,016, versus $8435 for vaginal birth, a $4581 difference, most of it accruing to the hospital.[19] A Los Angeles Times article quotes Elliot Main, the chief of obstetrics at a Northern California hospital chain, who sums up the problem: "Cesarean birth ends up being a profit center in hospitals, so there's not a lot of incentive to reduce them."[34] And, we would add, plenty of incentive not to: Between 1985 and 1987, a hospital instituted a successful program to reduce its cesarean rate.[56] The rate fell from 18% to 12%, losing the hospital $1 million in revenues—no small sum in those days.

Planned cesareans offer an even bigger benefit: they reduce overhead by reducing staffing unpredictability. A California survey found that women were 17% more likely to have a cesarean at a for-profit hospital than a non-profit one; "California Watch" quotes Gene Declercq, a Boston University professor of community health science, who explains "It's a lot easier if you can do all your births between seven and 10 in the morning and know exactly how many operating rooms and beds you need."[50]

Then there is power. The fiction that birth is inherently pathologic enabled obstetricians to attain high status in the medical hierarchy historically and has maintained them there, with the accompanying financial rewards, prestige, and control. It justifies the need for having them involved in—or at least in charge of—delivering babies. As Barbara Perkins (2004) writes:

> Ob-gyns continued to use their mastery of female reproductive pathology to promote their profession over their competitors. Recognizing that the vast majority of births were normal in the sense of resulting in healthy mothers and babies, obstetric leaders honed in on a pathologic potential of birth, commonly asserting that a diagnosis of normal was possible only in retrospect. This implied that only obstetricians—qualified to deal with pathology—were qualified to deliver babies (p. 113).[80]

Currently, the system provides no incentives for reform, no rewards for safely achieving a difficult vaginal birth—not monetary, not time management, and not personal satisfaction when professional identity is bound up with being a surgeon.

It imposes no penalties for engaging in harmful, ineffective practices and unnecessary surgeries; for giving inadequate, no, or wrong information; for using coercion; or for violating women's rights to give consent or refusal. Obstetricians have no accountability to any agency outside of themselves, least of all to their professional organization, for as we shall see in the next two sections, ACOG protects its own.

ELECTIVE CESAREAN SURGERY: WHO GETS TO VOTE IN THIS ELECTION?

As we saw above, few women elect surgical deliveries without indication. In confirmation of this, two reviews of studies of women's request for cesarean, comprising 17 studies published between 2000 and 2005, reported that studies included women with clinical indications for cesarean and that the women themselves perceived medical or psychological indications for their decision.[32, 69] A truly elective cesarean would require a decision based on accurate information, after rejecting alternatives, free from influence or pressure—let alone insistence—by care providers. This, however, rarely happens.

To begin with, women are not being given accurate, unbiased information. Listening to Mothers II reported that, when asked to agree or disagree with four statements on the adverse effects of cesarean section, three-quarters of respondents were either not sure how to respond or responded incorrectly.[25] Women who had had cesareans were no more likely to know the correct answers than women who had not. In addition, as we have seen, obstetricians themselves are likely to have erroneous beliefs about the comparative benefits and harms of cesarean surgery versus vaginal birth, which they surely pass on to their patients. The same holds true for repeat cesarean. In 1996, the obstetrician-editor of *OBG Management* proposed a VBAC consent form, subsequently widely adopted, that included in boldface, "I understand that if my uterus ruptures during my VBAC, there may not be sufficient time to operate and to prevent the death or permanent brain injury to my baby"(p. 65), but nowhere were the potential harms of elective repeat cesarean surgery specified.[82] Writes an ACOG vice-president in response to a plea to reconsider its VBAC policies: "[I]n two percent of cases the result can be rupture of the old scar. If [scar rupture] happens, then death of the baby is almost certain and death of the mother is probable. Even if the mother does not die, virtually 100% will lose their child bearing ability."[38] The truth is that the scar rupture rate can be 0.5% or less, 94% of scar ruptures do not result in perinatal death—2400 to 6100 repeat cesareans would be needed to prevent one scar-rupture related perinatal death according to a systematic review—and the woman is at greater risk of losing her uterus or her life with elective repeat cesarean.[37]

Other than recommending that women have access to "effective" (p. 14) pain management in labor,[74] nowhere do advocates for elective cesarean surgery acknowledge responsibility for exploring why a woman is so frightened of labor that she prefers surgery, much less for trying to address her concerns. Yet studies in

Scandinavia show that counseling can reduce anxiety sufficiently that roughly half or more of the women who requested elective primary or repeat surgery (VBAC is the norm in these countries) change their minds.[75, 91, 96] Doula care, too, could help. Even where fear of labor pain is the issue, there is no admonition to discuss the pain of recovering from major surgery, which, as we shall see in the next chapter, is likely to be a much bigger problem than pain after vaginal birth. No woman can make a truly informed choice burdened by severe anxiety and offered no alternatives.

The real electorate here is not women but obstetricians. While 0.4% of primiparous women without medical indication in the Listening to Mothers II survey elected cesarean surgery,[25] 9% said they felt pressured by their obstetricians to agree to a cesarean, and that pressure worked: 25% of the group who had a cesarean felt pressured to agree versus 2% of women having vaginal births. Obstetricians also freely exercise veto power. Vaginal breech birth and vaginal twin birth are almost impossible to obtain despite evidence of similar outcomes in eligible, properly cared-for women. Despite finding VBAC to be a "reasonable and safe choice for the majority of women with prior cesarean" (p. 143), authors of the massive review underpinning the 2010 NIH consensus conference on VBAC conclude without demur: "Some women will not have a choice due to provider, hospital, insurance, or medical-legal factors that mandate [repeat cesarean delivery]" (p. 145).[37] Listening to Mothers II found that over half the women (56%) who wanted VBAC were denied that option, and that was back in 2005. Doubtless, too, many more agreed to elective repeat cesareans based on inaccurate information on its safety and the dangers of labor. We have, in addition, evidence of elective cesarean surgery at *obstetrician* request. A 2004 survey of obstetricians at one hospital reported that 13% of intrapartum cesareans were self-reported as done without medical indication at the obstetrician's behest.[52] An additional 3% were reported as decided between the obstetrician and the woman, but, given the power inequity of the obstetrician-patient relationship, especially in labor, these could reasonably be included as "obstetrician request" cesareans as well. That is one in six intrapartum cesareans at this hospital.

Power imbalance in the obstetric encounter is a more complex concept than we generally think. Shapiro and colleagues (1983) described three escalating levels, the lowest being the conventional concept that the more powerful person's decisions prevail.[95] With greater power inequity, "some persons may be so powerful that they prevent others' concerns from reaching the decision making agenda" (p. 140). However, at the highest level, "[C]onflict, even covert, does not arise. Power . . . is achieved by influencing, shaping or determining others' very wants. One may know if power has been exercised by observing that a person or group have acted against their own interests, even though they may express satisfaction and contentment with the outcome" (p. 140). We can see all three levels at work around cesarean surgery. As we have seen, the majority of women who want VBACs are not allowed that choice, much less women with breech babies or twins (Level 1). Most women, though, go

under the knife never realizing that vaginal birth was an option (Level 2), and many think elective repeat surgery was the better choice either based on misinformation or for such trivial reasons as "knowing what to expect" or "convenience in scheduling" (Level 3).[53] This highest level can also be seen in elective primary cesareans:

> [K]nowing she came "from a long line of women who have had excruciating, dangerous vaginal births," she was terrified of what might happen to her or her baby during delivery. . . . So after long talks with her doctor and husband, . . . Neumeyer scheduled a Caesarean. "I had waited a long time to get pregnant and wanted some sense of control," she said.[99]

This woman and others like her are presumably happy with their choice, but as one obstetrician protests:

> Offering cesarean delivery or consenting to perform it electively at term is irresponsible, dangerous, and ultimately unfair to many women. . . .[T]he advice of physicians is seriously heeded by many under our care. . . . The less informed woman is merely agreeing to our recommendation without true knowledge of the [potentially life-threatening] consequences. This is . . . a blatant misuse of power (p. 264).[26]

THE DISINFORMATION CAMPAIGN

The Language of Disinformation

The discourse around mode of delivery is rife with loaded language that subliminally biases the discussion.

- *"Cesarean birth."* A case of unintended consequences, the intent was to humanize cesarean surgery by reminding medical staff that a baby was being born, but it is now used to suggest that little distinguishes surgical delivery from vaginal birth.
- *Increased "safety" of cesarean surgery.* Improved ability to rescue people from burning buildings does not make it OK to start the fire.
- *VBAC as a "procedure."* Obstetricians have argued that the right to refuse to perform procedures includes VBAC, but VBAC is not a procedure in the sense of a taking a positive action. Labor will occur *unless* a procedure, in this case, cesarean surgery, is undertaken to *prevent* it.
- *"Elective VBAC."*[88] This too inverts the real situation. A woman cannot elect labor; she can only elect not to labor.

- *"Autonomy."* Respect for women's autonomy is used only in the context of freedom to elect cesarean surgery, never to choose vaginal birth when their doctors oppose it.
- *"Maternal-fetal" conflict.* This is actually "maternal-doctor" conflict in that the obstetrician defines the conflict, speaks for the fetus, and advocates for cesarean surgery. The woman's resistance will be framed as a selfish desire for the experience over the baby's wellbeing, as in this obstetrician's assertion in a 1984 Boston Globe Magazine article: "When women look to vaginal delivery as the goal of their pregnancy—and there are those out there who tell them they should . . . you have a lot of dead and damaged babies along the way."[55] Writes Martin Richards (1982):

> Characteristic of many conversations between doctor and mother is the use of that peculiar royal "we" by the doctor. "We would not want to do anything that might jeopardize the baby." . . . There is . . . an implicit message that it is only the doctor who has the true interests of the mother or, more especially the child, at heart. It is a patronizing and paternalistic "we". . . . There is the hint that the mother is not only an incompetent vessel for her baby . . . but that she may be selfishly uncaring and not doing what is best for her baby (p. 255).[86]

- *Vaginal birth as a "preference."*[60] Used by members of ACOG's ethics committee, this term reduces the fundamental right to refuse surgery to a menu option. Rights must be honored; preferences, as the commentary goes on to argue, may or may not, depending on the obstetrician's preference and other nonmedical factors. The "preference" framing also opens the door to proactively discussing primary elective surgery with patients.
- *"Cesarean delivery on maternal request."*[74] This term equates elective primary cesarean with maternal request cesarean. It also conveys that only a "request" is needed, not an informed choice based on accurate, unbiased information and after considering and rejecting nonsurgical alternatives.
- *"Attempted vaginal delivery."*[74] The implication here is that vaginal delivery is an "iffy" proposition even for a healthy woman, making planned cesarean appear reasonable and attractive.
- *"Cosmetic surgery" analogy.* "I think if somebody can decide to . . . have her breasts enhanced . . . she can have an elective C-section"

says a woman in a 2006 Los Angeles Times article.[16] Women undergoing cosmetic surgery get what they paid for but women having elective cesarean surgery to preserve their pelvic floor do not because elective cesarean has little effect on pelvic floor dysfunction before menopause and none at all afterwards.

- *"Prophylactic" cesarean surgery.*[39] In an editorial, Ralph Hale and W. Benson Harer Jr., both prior ACOG officer holders, define "prophylactic" as being for the "preservation of health or the prevention of injury either to mother or child" (p. 1), which tacitly assumes that vaginal birth threatens health and safety and that cesarean surgery does not. This proposition is made more explicitly in the "premium baby" argument: "'Today every baby is precious,' obstetrician Kadonaga said. 'When we do a Caesarean section, we're sure we're going to get a good result.'"[97]
- *Calls for a randomized controlled trial.* This sounds like a scientific way to determine the comparative benefits and harms of cesarean delivery versus vaginal birth, but trials should be reserved for situations when the "effects are not absolutely clear from observational studies" (p. 6),[48] which they are in this case. (See chapters 5 and 6.) It also presumes that the harms of vaginal birth do not depend on care practices, which they do.

The disinformation campaign takes forms other than spreading misinformation about the safety of cesarean surgery and the supposedly inherent harms of physiologic birth. It uses biased language to convey covert meaning (see text box) and maligns attempts to set target cesarean rates by public health agencies such as Healthy People, as, for example, in this quotation from the NIH (2006) cesarean conference statement: "Some authors have proposed an 'ideal rate' of all cesarean deliveries (such as 15%) for a population. There is no consistency in this ideal rate, and artificial declarations of an ideal rate should be discouraged" (p. 4),[74] and this one in the editorial by two ACOG officers: "The WHO has clung steadfastly to the 15% maximum despite its own data indicating benefits to both mother and child from a much higher rate [no source given]" (p. 15).[39] On the contrary, the WHO maintains that the "[15%] upper limit is not a target to be achieved but rather a threshold not to be exceeded" because of "a growing body of research [citing three studies] that shows a negative effect of high rates" (p. 25).[114] Even the Joint Commission, the body that accredits U.S. hospitals, now begs to differ. Its 2010 *Specifications Manual for Joint Commission National Quality Core Measures* includes reducing cesarean rates.[101] Why?

> The removal of any pressure to not perform a cesarean birth has led to a skyrocketing of . . . cesarean section (CS) rates. Some hospitals have CS rates over 50%. Hospitals with CS rates at 15-20% have infant outcomes that are just as good and better maternal outcomes. There are no data that higher rates improve any outcomes, yet the CS rates continue to rise. . . . Many authors have shown that physician factors, rather than patient characteristics or obstetric diagnoses are the major driver for the difference in rates within a hospital (p. 22).

Another smear tactic is portraying pressure to lower cesarean rates as a cost-cutting measure at the expense of maternal-child health and women's autonomy, as in this editorial by the editor-in-chief of an obstetric trade journal: "[Public Citizen's Health Research Group and the International Cesarean Awareness Network's] diatribes are grist for the mill of third-party payers who are dangerously intent on driving the cesarean rate lower . . ." (p. 6),[81] while two prestigious Boston academics assert, "Economic forces are driving the cesarean-delivery rate toward the Healthy People 2000 goal of 15 percent. Before we permit this trend to continue, we need to ensure the safety and health of mothers and babies" (p. 56-57).[89] The commentary argues that by "mandat[ing]" (p. 56) VBACs and forcing obstetricians into doing potentially dangerous vacuum extractions instead of indicated cesareans, reducing the cesarean rate will increase complications. VBAC, too, has been maligned as unduly risky: "After a thorough discussion of the risks and benefits of attempting a vaginal delivery after cesarean section, a patient might ask, 'But doctor, what is the safest thing for my baby?' Given the findings of Lydon-Rochelle et al., my unequivocal answer is: elective repeated cesarean section" (p. 55).[36] Greene, an editor of the *New England Journal of Medicine*, was commenting on a study that did not directly report the newborn death rate associated with scar rupture, although the rate could be calculated: 3 per 10,000 planned VBACs with spontaneous labor onset, 4 per 10,000 induced with oxytocin, and 13 per 10,000 when prostaglandins were involved.[61]

Even more harmful is the subversion of the research evidence because the lie persists even when disproven. One example is the Term Breech trial.[44] It sounded the death knell for vaginal breech in the U.S. even in the face of commentaries exposing its discrediting flaws and even though—flaws notwithstanding—follow-up studies showed that prophylactic cesarean failed to improve outcomes for breech babies.[44, 45, 112] The review underpinning the 2006 NIH so-called "state-of-the-science" conference, is, however, bar none, the supreme example of hijacking the research along with the prestige and credibility of respected institutions (Agency for Healthcare Research Quality and the National Institutes of Health) to advance an agenda, namely establishing elective cesarean surgery as a "reasonable alternative" (p. 11) to planned vaginal birth.[74] The problems with this review are so egregious that it is hard to believe that they were not intentional. (See chapter 5's mini-reviews introduction.) That there was an agenda was openly, if unwittingly, acknowledged. During

the conference, the review team, led by a urogynecologist, repeatedly rebuffed criticism by saying the team could not go beyond their tasking, but the "tasking" should have been to produce a sound, comprehensive review reporting all relevant results. Epitomizing the team's position, Dr. Gary Hankins, chairperson of ACOG's Committee on Obstetric Practice, had this response when challenged from the floor to admit having an agenda after giving a presentation on the perinatal advantages if all women scheduled cesareans: "I had a tasking . . . . Now, I'm a good soldier. When I'm given an assignment, I carry out the assignment."[41] This was the same excuse given at the Nuremberg trials and again at Abu Ghraib. The precedent is not hyperbole. Women and babies will die as a result of this man's misrepresentation of the research in the service of condoning elective cesarean surgery.

The NIH conference achieved its goal. It and its underpinning review are now being cited in the U.S. and abroad in support of elective primary surgery.[2, 60, 98] Thanks in no small part to the repercussions of this conference, we now face a growing danger that the disinformation campaign will convert the imaginary groundswell of maternal request cesareans into a real one.

ACOG ETHICS: AN EXERCISE IN SOPHISTRY

ACOG's "Code of Professional Ethics" (2003) enjoins its members to practice *beneficence:*[3] "The welfare of the patient is central to all considerations in the patient-physician relationship" (p. 1); *autonomy:* "The respect for the right of individual patients to make their own choices about their health care is fundamental" (p. 1); *veracity:* "The obstetrician-gynecologist must deal honestly with patients . . . not misrepresenting himself or herself through any form of communication in an untruthful, misleading, or deceptive manner" (p. 1); and *nonmaleficence:* "maintenance of medical competence through study, application, and enhancement of medical knowledge and skills is an obligation of practicing physicians" (p. 1). ACOG's Ethics Code also mandates that "Conflicts of interest should be resolved in accordance with the best interest of the patient, respecting a woman's autonomy to make health care decisions" (p. 2). Unfortunately, ACOG's leadership and prominent members fail to adhere to these principles.

ACOG systematically puts the welfare of obstetricians ahead of that of their patients. One of us (H.G.) heard an outgoing president of ACOG candidly state during a presentation that ACOG's role is to protect the Fellows against liability and that it enlists its guidelines to that purpose.[27] Surely, not wanting to be sued constitutes a conflict of interest. Yet concern about malpractice is openly admitted to be a driving factor in the cesarean rate in general and VBAC denial in particular. Far from pointing out where obstetricians' ethical duties lie, ACOG ethicists accept without question any number of nonmedical reasons to override a woman's right to refuse surgery, including hospital prohibition, strictures of liability insurance, and even obstetrician "reluctance" (p. 914),[60] and ACOG's VBAC guidelines, are,

indeed, crafted to protect the Fellows. The standard—"VBAC should be attempted in institutions equipped to respond to emergencies with physicians immediately available to provide emergency care" (p. 5)[11]—instituted in 1998 and still extant in its 2010 guidelines,[10] is largely responsible for the decline in VBACs. Doctors and hospitals point to the difficulty or impossibility of meeting it as a reason for forbidding VBAC, although, in fact, hospitals that meet the criteria perform few VBACs. Among the eight Level 3 hospitals in Massachusetts, VBAC rates ranged from 8% to 15% in 2008.[24] Malpractice insurance companies have also adopted it as a criterion, which provides an even better excuse.[93] It is, however, based on "expert opinion" (p. 5)—in other words, the opinion of the self-interested parties, not evidence.

ACOG's Committee Opinions "Informed Consent" (2004) and "Maternal Decision Making, Ethics, and the Law" (2005) reiterate that women have the right to bodily integrity and to give consent, a right that has no meaning where there is no right to refusal.[5,6] States ACOG in "Informed Consent": "Consenting freely is incompatible with being coerced or unwillingly pressured by forces beyond herself. It involves the ability to choose among options and to choose other than what may be recommended" (p. 11). However, ACOG offers a loophole: "Patient Choice in the Maternal-Fetal Relationship" allows that obstetricians not disposed to respect patient autonomy can "offer the patient the option of obtaining medical care from another individual [notice it is not "find her someone else"] before an emergency arises that might put the pregnant woman and the caregiver in unresolvable conflict" (p. 34),[9] thus providing an ethical veneer for firing a patient who balks at a cesarean, which, in effect, compels her to agree or forgo medical care. Obstetricians decry the dangers of women denied hospital VBAC who choose home birth—"It's only a matter of time before [a home VBAC] goes wrong and a baby dies because a C-section could not be performed quickly enough," says one in a USA Today article—but they are silent on calling to account those who forced women into it.[88]

Obstetricians also flout their obligation to acquire the appropriate skills, and here, too, ACOG lets them off the hook. Forced to acknowledge that vaginal breech birth was "reasonable" (p. 339) after the term breech trial was invalidated, its Committee Opinion on breech states: "The decision regarding the mode of delivery should depend on the experience of the health care provider. Cesarean delivery will be the preferred mode of delivery for most physicians because of the diminishing expertise in vaginal breech delivery" (p. 340).[7] What is lacking is the will, not the way. Practitioners still exist in the U.S. and abroad who retain skills for assisting at breech births and who could transmit them using training videos if not in person. Simulation models could be used to learn them before practicing them on living women and babies. Nonetheless, ACOG ethicists go along with the "don't know how" excuse in direct contravention of their Code.[60]

As can be seen throughout this overview, obstetricians are derelict in their duty to maintain medical competence in knowledge, not just skills, and to deal honestly

with patients. As we have documented, ACOG leaders and prominent academics not only fail to correct misinformation, they are often its source. Rather than working to implement practice reforms or restrain members who have excessive cesarean rates, ACOG gives obstetricians carte blanche. In fact, an ACOG news release on elective cesarean has even gone so far as to assert that "belief" alone—never mind the facts—is sufficient to legitimize performing major surgery on a healthy woman: "[I]f the physician believes that [elective] cesarean delivery promotes the overall health and welfare of the woman and her fetus more than does vaginal birth, then he or she is ethically justified in performing a cesarean delivery."[8]

Cognitive Dissonance in ACOG Positions

- *Women can elect cesarean surgery, but they cannot refuse it.* Women do not have autonomy when they can only say "yes" to a cesarean but not "no."
- *Women are entitled to cesarean on demand because the overriding factor is their rights, but they are not entitled to vaginal birth on demand because the overriding factor is the baby's rights.*
- *VBAC is too risky for the baby, but amniocentesis is not.* The odds of rupture related perinatal death in a VBAC labor are 3 per 10,000;[37] the odds of losing the pregnancy as a result of an amniocentesis are 60 per 10,000.[94]
- *VBAC requires an on-site obstetrician and around-the-clock ability to perform an urgent cesarean, but labor inductions and epidurals, both of which can precipitate emergent situations, do not.* If a hospital isn't safe for a VBAC labor, it isn't safe for any woman to labor there.
- *Obstetricians should not be forced to perform VBACs (although, in fact, VBAC was never mandatory), but women can be compelled to have repeat cesareans.*

To be sure, the "chase to the cut" has not gone unprotested by obstetricians both prominent and otherwise. (They, by the way, are unsung heroes, because they are likely to be ostracized by their colleagues and even punished for going against the dominant culture by having a low cesarean rate or providing VBACs.[83, 88, 111]) Nonetheless, they will be like King Canutes trying to hold back the tide so long as the academic and professional leadership defends and promotes ethically bankrupt practices and policies. Nor does it matter whether supporters are cynically protecting what best serves their self-interest or are true believers. The damage is done regardless. As we shall see in the next two chapters, over the decades, as a

result of the ongoing cesarean epidemic, millions of women and babies have suffered permanent harm unnecessarily and, tragically, thousands have died.

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The Case Against Liberal Use of Cesarean Surgery

"Our comprehensive assessment, across many outcomes, suggests no major differences between primary [elective] cesarean delivery and planned vaginal delivery."
Visco et al. 2006, p. 1517[144]

"Cesarean section is a major operation, with great potential benefit, but also with substantial risks for both mother and baby. . . . Consensus by clinicians and consumers by means of evidence-based clinical guidelines and public education may result in more uniform and appropriate use of this major intervention."
Enkin et al. 2000, p. 407[41]

We have seen that the research supports a maximum cesarean rate of 15% in the general population, that none of the rationales for the frequent—let alone elective—use of cesarean surgery holds water, and that the skyrocketing cesarean rate is fueled by motivations having nothing to do with the wellbeing of mothers and babies. This chapter summarizes and documents the harms of cesarean surgery and refutes claims for its benefits compared with vaginal birth. It aims to put a stake through the heart of the myth that choosing between cesarean surgery and vaginal birth is like choosing between vanilla and chocolate, or that, outside of rare situations where the life or health of the mother or baby is at risk or for the few women truly unable to birth their baby vaginally, cesarean surgery has any meaningful benefits for women, babies, or society.

LIBERAL USE OF CESAREAN: BAD FOR MOTHERS

Cesarean surgery increases the likelihood of severe maternal harm in both the short and long term. Excess rates of severe harms may be small, but where surgery could have been avoided, even one woman suffering serious morbidity or death is one too many.

- Nine to 25 more women per 100,000 die of causes directly attributable to cesarean surgery compared with women having vaginal birth. The true number is greater because of study exclusions and inherent limitations on maternal mortality data collection. (See mini-review 1. See also results of the *California Maternal Mortality Review* in chapter 4.)
- Four more healthy women per 10,000 having elective primary cesarean surgery have peripartum hysterectomies compared with healthy women

planning vaginal birth.* Eleven more women per 10,000 with no predisposing factors having primary cesarean surgery have peripartum hysterectomies compared with women *having* vaginal birth. (See mini-review 3.)

- One woman per 1000 having primary cesarean experiences bladder puncture or bowel injury during surgery; 4 per 10,000 experience ureteral injury. (See mini-review 2.)
- Five women per 1000 having cesarean require re-operation postpartum. (See mini-review 2.)
- Healthy women having elective cesarean are more likely to experience major morbidity than healthy women *having* vaginal birth. Excesses per 1000 cesareans include 27 surgical wound complications, 20 major puerperal infections, 3 anesthetic complications, and 1 thromboembolic event. They are also more likely to experience major morbidity than healthy women *planning* vaginal birth.* Excesses per 1000 cesareans include 10 obstetric wound hematomas, 4 major puerperal infections, and 3 anesthetic complications, as well as an excess per 10,000 cesareans of 15 cardiac arrests, 3 venous thromboembolisms, and 4 wound disruptions. (See mini-review 2.)
- Within the first two months postpartum, 17 more primiparous (first birth) women per 100 reported cesarean incision pain than perineal pain after vaginal birth to be a major problem. Among multiparous women, 36 more multiparous (> 1 prior birth) women per 100 with primary cesarean and 14 more per 100 with repeat cesarean reported incision pain to be a major problem over perineal pain. At six months or more postpartum, 1% to 3% of women (depending on parity) were still experiencing perineal pain compared with 12% to 22% of women (depending on parity and whether the cesarean was primary or repeat) experiencing pain from their cesarean incision. (See mini-review 5.)
- Some women having cesarean surgery experience life-threatening complications such as amniotic fluid embolism (AFE),† uterine artery pseudoaneurysm, or pseudo-obstruction of the colon (Ogilvie's syndrome). (See mini-review 4.)
- One more woman per 100 requires hospital readmission after cesarean surgery than after vaginal birth. Women are also more likely to be readmitted sooner and stay longer, which suggests more severe problems occurring after cesarean surgery. Excess readmission rates continue through the first year. Later readmission rates include excesses for gallstones, appendicitis, and stroke. (See mini-review 6.)

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* In this study, 8% had an unplanned cesarean. See introductory notes to this chapter's mini-reviews for a discussion of planned vaginal birth versus actual vaginal birth.

† The study compared postpartum AFE cases only to control for AFE leading to cesarean.

- Three to 15 women per 1000 develop endometriosis in the cesarean wound caused by iatrogenic seeding of uterine lining cells during surgery. Women with cesarean scar endometriosis experience cyclic pain and in rare cases develop intractable hemorrhage requiring hysterectomy or have endometriosis devolve into cancer. The only curative treatment is wide excision of the affected tissue, sometimes requiring grafting. Reported incidence rates are almost certainly an undercount because women may not seek treatment and are often misdiagnosed. Four to 9 women per 100 having surgery for cesarean scar endometriosis have it recur. (See mini-review 6.)
- Dense adhesion rates from cesarean surgery range from 12% to 50%. (See mini-review 7.) Dense adhesions make all future pelvic surgery,[17, 28] not just future cesareans, more difficult and more likely to result in intra- and post-operative complications. Adhesions are also implicated in chronic pain[79] and bowel obstruction.

Cesarean surgery also takes a psychological toll. Data from a U.S. national survey reveals that compared with women having vaginal birth, women having cesarean deliveries were significantly more likely to feel overwhelmed (49% vs. 42%), frightened (52% vs. 30%), and helpless (34% vs. 19%) and less likely to feel capable (24% vs. 52%), confident (33% vs. 47%), and powerful (7% vs. 24%) during the delivery.[34] Unplanned cesarean puts women at risk for posttraumatic stress disorder (PTSD), a syndrome that can occur, according to Jukelevics (2008), when a person experiences "an actual or *perceived* serious injury or actual or *perceived* threat to the physical integrity of oneself or others" (p. 63).[63] Symptoms of PTSD include intrusive memories, nightmares, hyperarousal (which may manifest as difficulty sleeping or concentrating or in irritability), and avoidance of the places and people who remind them of the traumatic event. Because this may include the baby, women may have difficulties establishing an emotional attachment. Left untreated, PTSD often transitions to depression, which has adverse consequences for the maternal-child relationship as well. Depressed women are also at risk for suicide, a common cause of postpartum mortality.[26] (See appendix "If Mama Ain't Happy.")

Some argue that planned primary cesarean surgery greatly reduces or eliminates maternal risks. True, compared with unplanned surgery, infection rates will be lower, operative injury and hemorrhage less likely, and women less likely to suffer depression or psychological trauma. Nonetheless, elective cesarean still increases the risk of morbidity, women still have the difficulties of recovering from major surgery while caring for a child, and they and any future children still are subject to the long-term and reproductive risks resulting from uterine and abdominal scars.

LIBERAL USE OF CESAREAN: BAD FOR BABIES

Cesarean surgery increases fetal and neonatal risks, adversely affects children's health, and compromises subsequent pregnancies and deliveries. Even minor neonatal morbidity can interfere with maternal attachment and establishing breastfeeding, and anxiety over the infant's wellbeing can adversely impact parenting long after recovery.

- One more neonatal death per 1000 occurs in healthy women having elective primary cesarean surgery compared with equally healthy women planning vaginal birth.‡ (See mini-review 9.)
- Serious respiratory morbidity is more common, including transient tachypnea, respiratory distress syndrome (RDS), persistent pulmonary hypertension, and pneumothorax, in term infants delivered by elective cesarean compared with women having vaginal birth and women planning vaginal birth (some of whom would have intrapartum cesareans). This holds true after adjustment for gestational age and is not entirely averted by scheduling cesareans after 39 completed weeks. (See mini-review 11.)
- Cesarean delivery adversely affects breastfeeding. The best data are from a survey of 1600 U.S. women who gave birth in 2005.[35] No statistical analysis was done, but while similar percentages of women having primary cesarean (65%) and women having vaginal birth (63%) planned to breastfeed exclusively, only 42% of women who had primary cesareans were exclusively breastfeeding at one week versus 56% of women who had vaginal birth.
- Cesarean delivery is associated with development of autoimmune diseases in childhood (asthma, allergies, type 1 diabetes, celiac disease). (See mini-review 12.) Investigators theorize that differences in gut flora, which mediate immune intolerance, explain the excess.[5, 19, 31, 62] Babies delivered by cesarean are not exposed to vaginal bacteria, and their mothers are usually given prophylactic peripartum antibiotics to reduce risk of infection. Antibiotics cross the placenta and are found in breastmilk, thereby also affecting gut flora colonization. In addition, cesarean-born infants are more prone to transient tachypnea and RDS, both of which are associated with increased risk of asthma.[5]

LIBERAL USE OF CESAREAN: THE GIFT THAT KEEPS ON GIVING

Prior cesarean results in more maternal and neonatal morbidity and mortality in subsequent pregnancies, and elective repeat cesarean does not negate that risk.

- Three studies reported that 6 to 9 fewer women per 100 with a primary cesarean have a second child compared with women with a vaginal first birth, although a fourth study found no difference. Even if cesarean

‡ In this study, 8% had an unplanned cesarean.

surgery has no direct effect, more women decide not to have more children after cesarean surgery than after vaginal birth (voluntary infertility). (See mini-review 8.)

- Implantation can occur in the uterine scar (cesarean scar ectopic pregnancy), which is invariably fatal to the embryo and life-threatening to the woman. Ten percent of cesarean scar ectopic pregnancies end with hysterectomies. (See mini-reviews 3 and 9.)
- Seven of eight studies reported 1 more stillbirth per 1000 in women with prior cesarean compared with women with no prior cesarean, and the dissenting study has methodology and reporting problems. The stillbirth excess is probably an underestimate because some studies excluded women with complications that are more common with prior cesarean. Perinatal death rates (stillbirth plus deaths in the first seven days) may also be increased by 1 to 2 per 1000, according to three studies, although a fourth found no difference. (See mini-review 9.)
- Four studies report 1 to 2 more deliveries before 37 weeks per 100 second births in women with prior cesarean, although a fifth study reported no difference. The gap may grow with multiple prior cesareans compared with multiple vaginal births. Excess spontaneous preterm labor is responsible for some of the difference, which suggests that prior cesarean, not just timing of elective delivery, is responsible for the excess. (See mini-review 10.)
- Primiparous cesarean may be responsible for 1 more baby per 100 at the next delivery weighing less than 2500 g. The excess may grow with multiple cesareans. (See mini-review 10.)
- Primiparous cesarean may cause as many as 1 more small-for-gestational-age (SGA) baby per 100 at second delivery. SGA is even more troubling than low birth weight (LBW) because it suggests that prior cesarean may compromise uterine and placental perfusion. (See mini-review 10.)
- At the next delivery (see mini-review 13):
  - 1 more woman per 100 will require blood transfusion,
  - 1 more woman per 100 will be admitted to intensive care,
  - 4 more women per 1000 will be readmitted to hospital,
  - 1 more newborn per 100 will require ventilation,
  - 1 more newborn per 100 will have a hospital stay longer than 7 days.
- One to 9 more women per 1000 with one or more prior cesareans will have hysterectomies compared with women with only prior vaginal births. (See mini-review 3.)

The primary source of increased morbidity and mortality in subsequent pregnancy is the increase in abnormal placental attachment and placental abruption.

With primiparous cesarean surgery compared with primiparous vaginal birth (see mini-review 14):

- 2 to 4 more women per 1000 will experience placental abruption,
- 1 to 2 more women per 1000 will experience placenta previa,
- 3 more women per 10,000 will experience placenta accreta,
- 8 to 10 more women per 100 who have placenta previa and prior cesarean delivery will also have accreta compared with women who have placenta previa and no prior cesarean deliveries. (See chapter 6 for data on increasing rates of abnormal placental attachment with increasing numbers of prior cesarean surgeries.)

One reason for increased morbidity and mortality is that abnormal placental attachment increases likelihood of hysterectomy. Women with placental abruption are more likely to have hysterectomy, and women with prior cesarean are more likely to have abruptions. Two-thirds of women with prior cesarean who have hysterectomies have them because of placenta accreta, previa, or both. (See mini-review 15.) An analytic model projects that if the U.S. cesarean rate continues its upward trajectory, by 2020 the increasing number of cesareans and the consequent increase in placenta previa and accreta will result in nearly 4000 more hysterectomies and 130 maternal deaths annually.[129]

Compared with women with no placental abruption:

- 24 more babies per 100 are born before 37 weeks,[89]
- 26 more babies per 100 weigh less than 2500 g,[89]
- 55 more babies per 1000 die in the perinatal period.[89]

Compared with women with no previa:

- 13 more women per 100 experience severe morbidity (severe postpartum hemorrhage, renal failure, intensive care admission, ventilation, shock, disseminated intravascular coagulation, hysterectomy or other procedure to control hemorrhage),[109]
- 21 to 35 more babies per 100 are born before 37 weeks,[89, 109]
- 14 more babies per 100 weigh less than 2500 g,[89]
- 12 more babies per 100 are admitted to intensive care,[109]
- 2 to 13 more babies per 1000 die in the perinatal period.[89, 109]

Probably because placenta accreta in combination with placenta previa is more common, prior cesarean worsens prognosis with placenta previa. Compared with women with placenta previa and no prior cesarean, 8 more women per 100 with one prior cesarean and placenta previa experience severe morbidity (transfusion, hysterectomy, operative injury, coagulopathy, thromboembolism, or pulmonary

edema) or die. In women with prior cesarean and placenta previa, 35% of babies were delivered before 35 weeks and 15% before 32 weeks, 49% were admitted to intensive care, 26% developed RDS, 2% developed necrotizing enterocolitis, 1% had seizures, 0.4% had intraventricular hemorrhage grade III or IV, and 2% died. Outcomes were equally poor with placenta previa regardless of whether women had one or several prior cesareans. (See mini-review 15.)

Placenta accreta is especially dangerous. Five percent of women with accreta in one study experienced severe morbidity (hysterectomy, transfusion > 4 units, disseminated intravascular coagulopathy, intensive care admission, or placenta percreta) or death.[48] In another, 21% were transfused with more than 5 units, 8% developed disseminated intravascular coagulopathy, and 3% experienced hypotensive shock.[100] A third study reported that 5 of 7 women with accreta had hysterectomies.[67] In women with accreta, 855 per 100,000 died.[21, 48, 67, 96, 100, 107, 136, 142] (The U.S. national maternal mortality rate in 2005 was 15 per 100,000.[76]) In addition, a study of placenta accreta histologically confirmed at cesarean hysterectomy reported that 59% of babies were delivered before 37 weeks and 5% before 30 weeks, and 35% weighed 2500 g or less;[100] however, these incidences may be taken as the worst case, as not all accretas result in hysterectomies.

LIBERAL USE OF CESAREAN: ANYTHING GOOD ABOUT IT?

Cesarean advocates claim that cesareans improve perinatal outcomes and prevent pelvic floor dysfunction. Is this true? To a degree, yes, but the benefits are minimal, and the studies supporting those benefits have caveats that reduce their validity and clinical significance, namely, outcomes with planned vaginal birth largely depend on modifiable factors such as use of oxytocin, instrumental vaginal delivery, conventional second-stage management, and episiotomy, but cesarean morbidity is mostly intrinsic to having surgery. Furthermore, almost all mothers and babies recover completely from traumatic injury or hypoxic insult, and risk-free alternatives such as pelvic floor exercises or losing weight can improve or relieve pelvic floor dysfunction.[14, 23] Nor does it make sense to plan cesarean surgery to avoid being among the few women who might want repair surgery later. With these caveats in mind, here is what cesareans can and cannot do for mothers and babies.

With respect to perinatal morbidity:

- Fetal laceration rates during surgical delivery range from 7 to 32 per 1000 with some newborns requiring suturing or wound closure with staples, although laceration is less likely with planned cesarean. (See mini-review 16.)
- Rates of facial nerve palsy and brachial plexus injury do not differ between spontaneous vaginal birth and planned cesarean. (See mini-review 16.)
- A study reported a small excess (2 more newborns per 1000) in major trauma (fracture, various nerve palsies, spinal cord trauma, traumatic

intracranial hemorrhage, or grade III or IV intraventricular hemorrhage) with spontaneous vaginal birth compared with intrapartum cesarean, but we do not know what proportion were fractures, which have no long-term consequences, or what percentage eventually recovered from brain or nerve injury. (See mini-review 16.)

- Intracranial hemorrhage rates do not differ in newborns of women planning vaginal birth (including intrapartum cesarean) versus women having planned cesarean. (See mini-review 16.)
- Liberal use of cesarean surgery does not reduce cerebral palsy prevalence. (See mini-review 16.)

With respect to pelvic floor dysfunction:

- Eight studies failed to find that cesarean surgery prevented sexual dysfunction. A ninth study reported considerably more dyspareunia (painful intercourse) with spontaneous vaginal birth when interviewed at 10 months postpartum, but it is unclear whether women were reporting current experience or dyspareunia at any time since delivery. (See mini-review 17.)
- Cesarean surgery does not protect against anal incontinence (spontaneous leakage of gas or liquid or solid fecal material) or urinary urge incontinence (sudden need to void followed by involuntary loss). (See mini-review 18.)
- By six months or more postpartum, 0 to 21 more women per 100 having vaginal birth will experience urinary stress incontinence (incontinence with exercise, laughing, sneezing, or coughing) of some degree. The excess varied little with planned or intrapartum cesarean or with primiparity versus multiparity. Symptoms, though, were mild enough to have little effect on quality of life. Three out of four studies reported low and similar rates of severe stress urinary incontinence with cesarean delivery (1-2%) versus vaginal birth (2-3%). The fourth study, the same that reported excess rates of dyspareunia with spontaneous vaginal birth in contrast to eight other studies, reported 7% severe stress incontinence rates with cesarean versus 17% with vaginal birth; however, as before, it is unclear whether women were reporting current symptoms or symptoms at any time since delivery. Interestingly, a study reported an *increase* in stress incontinence from 3 to 12 months postpartum that was especially marked in women with cesareans (8% at 3 months vs. 22% at 12 months). (See mini-review 19.)
- One more women per 100 having vaginal birth will experience symptomatic pelvic floor prolapse. Prevalence increases with the number of vaginal births (5% with 1, 7% with 2, 9% with ≥ 3) compared with 3% with cesarean delivery only. Nonetheless, a long list of nonobstetric factors can cause pelvic floor prolapse. (See mini-review 20.)

STRATEGIES FOR OPTIMAL CARE

Vaginal birth in general and spontaneous vaginal birth in particular is the optimal mode of delivery. Neither cesarean surgery nor vaginal birth, however, occurs in a vacuum. They are the culmination of a series of practitioner decisions. As midwife Mayri Sagady Leslie argues, we should not speak about "avoiding unnecessary cesareans," but of "preventing the preventable cesarean" because in many cases, by the time the cesarean is called, it has become necessary. To maximize chances of spontaneous vaginal birth,

- await spontaneous labor (see chapter 7),
- refrain from rupturing membranes (see chapter 9),
- encourage continuous labor support by trained or experienced women who are not hospital staff members (see chapter 18),
- use intermittent auscultation (see chapter 10),
- offer comfort measures and pain management strategies other than epidural analgesia (see chapter 12),
- discourage early epidural (see chapter 12),
- encourage mobility and position changes in labor (see chapters 8 and 13),
- have patience with slow labors in the absence of other indicators for delivery (see chapter 9),
- allow sufficient time when inducing or augmenting labor (see chapter 9),
- absent a new indication for cesarean, encourage and support vaginal birth after cesarean (see chapter 6).

Causing the Preventable Cesarean

Studies in U.S. teaching institutions provide a glimpse into the degree to which non-evidence-based management is practiced and therefore taught. Two studies of planned cesarean versus planned vaginal birth in low-risk primiparous women reported (suspected) macrosomia as a reason for surgery (8% and 15%).[46, 112] In one of them, in women free of any complication that might predispose to cesarean delivery, the cesarean rate in women planning vaginal birth was an astounding 36%.[46] A third study examined cesarean delivery between 2002 and 2008 in 19 hospitals, 17 of them teaching institutions.[152] It, too, noted planned cesareans for macrosomia as well as for such reasons as "elderly gravida," "postdates," "Group B streptococcus positive," and "social/religion concerns." Nearly half the women planning vaginal birth (44%) were induced, which doubled the primary cesarean rate (20% vs. 9%). Among nulliparous women, more than one-quarter (28%) with spontaneous labor onset who had cesareans for "failure to progress/cephalopelvic disproportion" had their cesarean at 5 cm dilation or less. With induction, the percentage rose to more than half (53%).

When a cesarean is not preventable, practices should preserve physiologic care insofar as it is possible and minimize the potential for psychological trauma. To this end, caregivers should

- obtain informed consent,
- include companions of the woman's choice during the prep, surgery, and recovery periods,
- ensure adequate anesthesia (see chapter 12),
- remember that the woman is awake and aware and that the surgery is also a birth,
- provide explanations and emotional support,
- keep healthy newborns with their mothers after delivery and during recovery,
- assist women with breastfeeding and refrain from giving bottles.

To minimize the likelihood of cesarean-related complications, caregivers should

- await labor onset whenever possible with planned cesarean,
- minimize vaginal exams, especially with ruptured membranes,
- refrain from bolus administration of IV fluids (see chapter 11),
- use double-layer uterine closure (see chapter 6),
- close the peritoneum.[22, 53, 105]

MINI-REVIEWS

Notes:

- Where possible, we include only studies that took into account that some complications, placenta previa or pre-eclampsia, for example, are more likely to require a cesarean, more likely to cause serious adverse effects intra- or postpartum, and may repeat in subsequent pregnancies.
- Most studies we include reported outcomes according to actual mode of birth. Some will argue that this approach is not valid because substantial percentages of low-risk nulliparous women have unplanned cesareans, a riskier proposition than planned surgery. We disagree. Identifying and quantifying the effects of cesarean surgery on maternal-child outcomes is a necessary precursor to determining under what circumstances benefits outweigh risks.
- In some cases, studies of healthy women planning vaginal birth were available, but while cesarean surgery still conferred excess morbidity and mortality, intrapartum cesarean rates were low. Adverse outcome rates in studies of low-risk planned vaginal birth depend largely on the intrapartum cesarean rate, and as we saw in the text box "Causing the Preventable Cesarean," intrapartum cesarean rates can be extremely high in low-risk women, which would diminish differences between

groups. This, however, argues not for equivalence of planned cesarean but against suboptimal vaginal birth management.
- Keep in mind that cesarean delivery introduces harms intrinsic to having surgery, whereas harms associated with vaginal birth depend largely on modifiable factors and clinician judgment.
- Mini-reviews have been confined to mortality and serious or long-term morbidity, and where morbidity could occur with either cesarean or vaginal birth, we excluded studies with no vaginal birth comparison group.
- Assume differences are statistically significant unless otherwise noted.

What About the Review of "Cesarean Delivery on Maternal Request"?

The systematic review undertaken for the National Institutes of Health conference on elective cesarean and the derivative article that was published in *Obstetrics and Gynecology* have been excluded for reasons we have excerpted with permission from Childbirth Connection's analysis:[24]

- "literature searches for the evidence report failed to specify most outcomes of interest (including breastfeeding, mother-infant behaviors and attachment, asthma in babies, placental abruption, ectopic pregnancy, infertility, and numerous fetal/newborn outcomes in future pregnancies); therefore many reported studies that met authors' criteria were undoubtedly overlooked
- "no data were provided about many important outcomes, including ectopic pregnancy, placental abruption, placenta accreta, chronic pelvic pain, and uterine rupture in future pregnancies
- "adhesions are a common, widely recognized consequence of surgery and are associated with a broad range of future reproductive and non-reproductive problems, yet the word is mentioned just once in the report, with reference to needed research
- "a notable proportion of included studies had no vaginal birth comparison group, did not meet established criteria and should not have been included
- "a notable proportion of included studies involved only mothers with breech presentation, which in planned vaginal birth groups involves higher rates of injurious interventions, e.g., episiotomy, 'assisted' delivery with vacuum extraction or forceps, and unplanned cesarean; for this reason, it was inappropriate to include these studies
- "many included studies had too few participants to draw any conclusion about less common outcomes of interest (with great vulnerability for 'type II' errors: reporting 'no difference' when outcomes are in fact more likely with one mode of birth than another); they should not have been included in analysis about less common outcomes."

1. Cesarean surgery increases the likelihood of maternal death.

Three studies with adequate power ascertained the risk of maternal death directly or indirectly due to cesarean surgery. The oldest study, of 154 pregnancy-related deaths among 1,872,586 Dutch women between 1983 and 1992, has the strongest design, as investigators cross-linked data between two databases to maximize the capture of cases, included deaths beyond 42 days (the usual cut-off) and categorized complications from a prior cesarean (two uterine scar ruptures) as direct cesarean deaths.[120] The death rate directly attributable to cesarean surgery (women healthy before delivery and an incident during surgery or anesthesia administration causing death), was 13 per 100,000 (14/108,587) compared with 4 per 100,000 (65/1,763,999) for deaths for any cause associated with vaginal birth or in undelivered women (absolute difference 9 per 100,000 attributable to cesarean surgery). In an additional 16 cases, the surgery was considered a contributing factor. If these deaths are included, the cesarean-related death rate rises to 28 per 100,000 (absolute difference 24 per 100,000). Two studies used case-control methodologies. One looked at deaths in North Carolina from 1992 to 1998.[56] Using linked databases to maximize capture, investigators found 118 pregnancy-related deaths occurring in conjunction with live birth and up to one year postpartum among 731,217 women, which they compared with 3697 randomly selected controls. The death rate associated with cesarean delivery was 36 per 100,000 compared with 9 per 100,000 with vaginal birth (absolute difference 25 per 100,000). After controlling for medical complications, maternal age, and preterm delivery, women were four times (OR 3.9) more likely to die with cesarean surgery than with vaginal birth. The other case-control study looked at maternal deaths in France between 1996 and 2000.[36] Using death certificate data, and excluding deaths that did not result in a birth (e.g., ectopic pregnancy) and all pregnancy conditions that would both increase the risk of death and the likelihood of cesarean surgery, which excluded women with abnormal placentation or placental abruption, investigators identified 65 cases of maternal death occurring within 42 days after delivery. Cases were compared with 10,244 controls meeting the same criteria. After adjusting for age, nationality, parity, and preterm delivery, women were 3.6 times more likely to die in conjunction with cesarean surgery than vaginal birth.

The case-control studies will underestimate the true cesarean-related mortality rate because they do not take into account that prior cesareans increase the risk of death by increasing cesarean scar ectopic pregnancies, abnormal placentation, and placental abruption, and the French study omits late deaths. The risk attributable to complications related to prior cesarean can be gauged from a U.S. study (N = 30,132) of repeat cesarean surgeries.[125] Among women with one or more prior cesareans the mortality rate was 63 per 100,000. This study, too, though, will have undercounted the true rate because investigators only included women having cesarean deliveries, which would omit deaths related to prior cesareans that occurred early in pregnancy, and they only abstracted data through six weeks postpartum, which would omit late deaths.

2. Women who have cesarean surgery are more likely to experience serious morbidity than women having vaginal birth.

Three studies accounted for complications that can lead to both cesarean surgery and severe adverse outcomes. One compared morbid outcomes within 60 days after birth in 31,034 cesarean deliveries and 137,702 vaginal births.[74] After adjustment for maternal race, age, and a

long list of medical and labor complications, women having cesarean surgery ran excess risk of major puerperal infection (RR 4.1), thromboembolic events (RR 4.1), anesthetic complications (RR 3.6), transfusion (RR 1.9), and obstetrical wound complication (RR 12.1). (Cesarean was protective for genital and pelvic trauma [RR 0.1].) We can further isolate the direct effect of cesarean surgery by comparing the subgroups having elective cesareans (term, singleton, birth weight 2500-4000 g, no medical risk factors or labor or delivery events) (n = 5393) and spontaneous vaginal births (n = 120,107). Elective cesarean resulted in more major puerperal infection (28.7 per 1000 vs. 9.0 per 1000), thromboembolic events (1.9 per 1000 vs. 0.7 per 1000), anesthetic complications (3.9 per 1000 vs. 0.9 per 1000), and surgical wound complications (30 per 1000 vs. 2.5 per 1000). Transfusion rates were similar (0.7 per 1000 vs. 1.1 per 1000), and elective cesarean reduced obstetrical trauma (10.9 per 1000 vs. 73.5 per 1000). The second study compared outcomes in singleton, term, vertex, healthy women beginning labor spontaneously, of whom 6.6% of the 3241 nulliparous women and 1.8% of the 5426 parous women had unplanned cesareans, vs. 8 nulliparous and 150 parous women who had elective cesarean.[38] Parous women in the elective cesarean group were more likely (30% vs. 9%) to have postpartum complications (one or more: hematoma, wound dehiscence, anemia, endometritis, urinary tract infection, wound infection, septicemia) as were nulliparous women (18% vs. 13%), although the latter failed to reach statistical significance, probably because it was underpowered to do so. The third study compared 46,766 healthy women having planned primary cesarean for breech with 2,292,420 similar women with a vertex fetus planning vaginal birth of whom 8% had cesareans.[87] Women planning cesarean were more likely to experience severe morbidity (one or more: hysterectomy, transfusion, uterine rupture, anesthetic complications, obstetric shock, cardiac arrest, acute renal failure, assisted ventilation or intubation, venous thromboembolism, major puerperal infection, wound disruption, or hematoma) (27.3 per 1000 vs. 9.0 per 1000), hysterectomy (0.6 per 1000 vs. 0.2 per 1000), anesthetic complications (5.3 per 1000 vs. 2.1 per 1000), cardiac arrest (1.9 per 1000 vs. 0.4 per 1000), venous thromboembolism (0.6 per 1000 vs. 0.3 per 1000), major puerperal infection (6.0 per 1000 vs. 2.1 per 1000), wound disruption (0.9 per 1000 vs. 0.5 per 1000), and obstetric wound hematoma (13.0 per 1000 vs. 2.7 per 1000). Transfusion rates favored cesarean delivery (0.2 per 1000 vs. 0.7 per 1000). Two additional studies of primiparous women reported similar transfusion rates among all groups. One compared 513 planned cesareans with 261 intrapartum cesareans and 251 vaginal births,[112] and the other compared 180 planned cesareans with 3868 planned vaginal births.[46]

Taking a different tack, a study investigated the causes of the rising prevalence of severe obstetric morbidity in the United States between 1998 and 2005.[75] Adjustment for the increasing cesarean rate explained almost all of the increase in risk of renal failure, adult respiratory syndrome, and ventilation; half the increase in risk of shock; one-third of the increase in risk of pulmonary embolism; and one-fifth of the increase in risk of transfusion, whereas adjustment for age, payer, multiple births, diabetes, and hypertension had little effect on results.

Some serious peripartum morbidities only occur with surgical delivery. Three database analyses report on operative injury during primary cesarean.[96, 107, 125] Cumulative incidence rates are 1 per 1000 (8/7310) for bladder puncture, 1 per 1000 (7/7310) for bowel injury, and 0.4 per 1000 (3/7083) for ureteral injury. Another study reported that 5 per 1000 (18/3380) women having cesarean delivery required re-operation for hemorrhage, protrusion of the intestines through the abdominal wound, or intra-abdominal abscess.[88]

3. Cesarean surgery increases the likelihood of hysterectomy in both primary cesarean and subsequent deliveries.

> **Note:** Confining analysis to the delivery admission will undercount hysterectomies associated with repeat cesarean. A case-control study of 896 peripartum hysterectomies within 30 days after delivery found that 13% were performed at hospital readmission and that women with repeat cesarean were at increased risk of hysterectomy at readmission while women with vaginal birth, primary cesarean, or VBAC were not.[15]

Three studies that compared the likelihood of peripartum hysterectomy with cesarean vs. vaginal birth accounted for the fact that abnormal placental attachment and antepartum bleeding can lead to both cesarean surgery and hysterectomy. All concluded that cesarean surgery was independently associated with increased risk of hysterectomy. One study compared outcomes between 46,766 healthy women having planned primary cesarean for breech with 2,292,420 healthy women with a vertex fetus planning vaginal birth, of whom 8% had a cesarean.[87] Women having planned cesarean were more likely to have hysterectomies (0.6 per 1000 vs. 0.2 per 1000). After adjustment for such factors as maternal age and having ≥ 5 prior births, planned cesarean more than tripled the risk (OR 3.2, absolute difference 0.4 per 1000). A case-control study of 50 cases of emergent peripartum hysterectomy excluded women with indications for planned cesarean such as placenta previa and women who were not offered vaginal birth and compared characteristics with 100 similar control women who did not have a hysterectomy.[64] More cases had cesareans (80% vs. 21%), odds ratio 12.9 after controlling for prior cesarean, prior D&C or abortion, use of prostaglandin, and use of oxytocin. The third study analyzed peripartum hysterectomy rates (n = 131) during the delivery admission in 151,494 women among whom 69% had vaginal births, 21% had primary cesareans, and 10% had repeat cesareans.[131] Excluding women with placenta previa, accreta, or abruption, and after adjustment for age, malpresentation, and uterine tumors, women having primary cesarean were more likely to have hysterectomies than women having vaginal birth (1.4 per 1000 vs. 0.3 per 1000; OR 4.8). Authors of all three studies speculate that one reason for more hysterectomies with hemorrhage during cesarean surgery is the ready access to the uterus.

Turning to pregnancies after cesarean, among 302 cases of cesarean scar ectopic pregnancy (implantation within the uterine scar) accumulated from a review and nine case reports and series published subsequently, the hysterectomy rate was 10%.[13, 29, 30, 68, 85, 95, 99, 114, 117, 140] In addition, seven studies agree that prior cesarean greatly increases the risk of urgent peripartum hysterectomy. (See also chapter 6 for the effect of increasing numbers of prior cesareans.) Three studies reported rates in cohorts of 94,689, 151,494, and 23,800,000 women.[130, 131, 146] Rates with only prior vaginal birth were remarkably similar (0.3 to 0.5 per 1000) while rates varied from 1.6 to 9.0 per 1000 with one or more prior cesareans.[130, 131, 146] Absolute differences ranged from 1.3 to 8.5 per 1000. Two cohort analyses reported prevalence of prior cesarean among women having hysterectomies: 55 hysterectomies in 70,449 births at one hospital of which 64% were in women with prior cesareans,[44] and 39 hysterectomies in 14,220 deliveries

at another hospital, of which 79% were in women with prior cesareans (unadjusted RR 15.2).[8] Two studies used a case-control design. One compared mode of delivery for 15 cases with the births immediately preceding and succeeding cases (n = 30 controls).[122] More cases had prior cesareans (66% vs. 30%). The adjusted (adjustment factors not specified) odds ratio was 13.5. The other, of 315 cases, used the same strategy to select controls (n = 608). Again, more cases had a prior cesarean (52% vs. 15%).[71] More than one in four hysterectomies (28%) were attributable to prior cesarean.

4. Certain rare, life-threatening maternal complications are associated with cesarean surgery.

A case-control study of 60 cases of amniotic fluid embolism (AFE) vs. 1227 control women reported an association between the 26 postpartum cases and cesarean delivery (OR 8.8).[72] Confining analysis to postpartum cases accounted for AFE leading to cesarean. Maternal mortality among all cases was 20% (n = 12). A systematic review of cases of uterine artery pseudoaneurysm, a complication that can result in life-threatening hemorrhage, reported that among the 36 cases associated with childbirth, 27 (75%) occurred after cesarean surgery.[61] Ogilvie's syndrome, also called acute pseudo-obstruction of the colon, is another rare complication of cesarean surgery that has caused maternal deaths.[97]

5. Women who have cesarean surgery are more likely to experience pain after hospital discharge compared with women having spontaneous vaginal birth. (See chapter 14 for the effect of instrumental vaginal delivery.)

> **Note:** Prevalence and severity of incision pain do not differ between planned and intrapartum surgery.[33, 135]

A U.S. study of 1573 women who gave birth in 2005 provides the most nuanced data because it reports outcomes according to mode of delivery, parity, and whether multiparous women had a primary or repeat cesarean.[33] In the first two months after delivery, more primiparous women who had cesareans reported incision pain (86%) than women who had spontaneous vaginal births reported perineal pain (73%), and more women having cesareans reported pain to be a major problem (45% vs. 28%). Similarly, more multiparous women reported incision pain with primary (97%) or repeat (68%) cesarean than reported perineal pain (37%) after spontaneous vaginal birth, and again, more women having cesareans reported pain to be a major problem: 44% with primary and 22% with repeat cesarean, vs. 8% perineal pain after vaginal birth. Differences between cesarean and spontaneous vaginal birth groups would have been greater had women not had episiotomy. Women who had episiotomy (presumably median since this is a U.S. study) were more likely to report perineal pain to be a major problem whether they were primiparous (34% vs. 24%) or multiparous (18% vs. 5%) than women who did not. (Instrumental vaginal delivery would also increase the likelihood of perineal pain as well as its severity and longevity.) At six months or more after delivery, 2% of primiparous women and 1% of multiparous women said that the perineal pain they had experienced at two months "was still a problem now," while the

same was true of cesarean incision pain for 17% of primiparous women, 22% of multiparous women having primary cesarean, and 17% of those having repeat cesarean.[33]

Cesarean pain is not limited to incisional pain. A survey of primiparous women 5-7 weeks postpartum found that women who had cesarean delivery (n = 220) had lower mean scores (66 vs. 78) for "bodily pain" (unspecified) on a 100-point scale (where 100 indicated optimal functioning) than women who had spontaneous vaginal birth (n = 486).[91] In addition, a systematic review examined factors correlated with chronic pelvic pain.[79] Two studies included in the review (1116 cases vs. 1083 controls) evaluated the association with cesarean surgery, and a meta-analysis combining them found a positive association (OR 3.2).

6. Women who have cesarean surgery are more likely to experience serious health problems in the weeks and months following delivery than women having vaginal birth.

Two studies of similar design reported that women were more likely to be readmitted to the hospital after cesarean surgery. Both Liu et al. (2005),[86] a study of 900,108 women, and Lydon-Rochelle et al. (2000),[90] a study of 256,795 women, included singleton deliveries to a live infant, excluded women with serious medical conditions such as chronic hypertension or diabetes, reported hospital readmission rates within 60 days after discharge, and made statistical comparisons with spontaneous vaginal birth. Lydon-Rochelle, however, looked only at first delivery whereas Liu's population was of mixed parity, therefore including VBACs and repeat cesareans. Hospital readmission rates with spontaneous vaginal birth were 1.0 and 1.5% vs. 1.7 and 2.7% with cesarean surgery (absolute differences 0.7 and 1.2%). Liu further stratified readmission rates according to planned vs. intrapartum cesareans and reported similar rates (2.6% vs. 2.3%). Lydon-Rochelle analyzed a subgroup of 213,895 women with no obstetric or intrapartum complications and found the same excess with cesarean delivery as in the group overall, which suggests factors inherent to surgery are the cause of excess readmissions. Liu and Lydon-Rochelle reported similar excess rates of readmission with cesarean delivery for major puerperal or uterine infection (absolute difference 1.8 per 1000 and 2.3 per 1000), thromboembolism (absolute difference 0.4 per 1000 and 0.6 per 1000), cardiopulmonary complications (absolute difference 1.0 per 1000 and 0.7 per 1000) and gall bladder problems (absolute difference 0.8 per 1000 and 0.6 per 1000). Excess rates differed for readmission for genitourinary complications (absolute difference 1.7 per 1000 and 0.4 per 1000). Liu reported on gastrointestinal complications (absolute difference 1.9 per 1000) whereas Lydon-Rochelle reported specifically on appendicitis (absolute difference 0.2 per 1000). Liu reported an excess in readmission for pelvic injury/wounds with cesarean (absolute difference 8.0 per 1000) while Lydon-Rochelle reported an increased rate with spontaneous vaginal birth (absolute difference 0.2 per 1000) for pelvic injury, but, unlike Liu, their definition of pelvic injury did not include the uterine wound. Differences may be due to variations in definition, population, or both. In addition, Liu reported that women with cesarean delivery were more likely to be readmitted sooner after discharge (15 d vs. 20 d) and to stay longer (4 d vs. 3 d) compared with women having spontaneous vaginal birth, which suggests more severe problems occurring after cesarean surgery.

A third study compared hospital readmission rates in 244,088 women with no prior cesarean and no reported risk factors having planned primary cesarean vs. planned vaginal

birth.[32] The intrapartum cesarean rate was 8.7%. More women with planned cesarean were readmitted in the first 30 days after discharge (1.2% vs. 0.8%), with most admissions in the planned vaginal birth group coming from women having intrapartum cesareans. The most common reason for readmission in the planned cesarean group was wound infection (6.6 per 1000 vs. 0.5 per 1000) followed by major puerperal infection (3.3 per 1000 vs. 1.8 per 1000) and delayed postpartum hemorrhage (1.2 per 1000 vs. 0.6 per 1000). Readmission rates with primary cesarean delivery continued to exceed those with planned vaginal birth 31-180 days after discharge (0.1% vs. 1.4%) and 181-365 days after discharge (0.9% vs. 1.5%). The reasons for readmission after 30 days were less directly associated with delivery, but as with Liu et al. (2005) and Lydon-Rochelle et al. (2000) they included an excess of admissions for gallstones and appendicitis. Liu speculates that the association with gallstones may be because high-BMI women are more likely to have cesarean deliveries and gall bladder problems and that appendicitis may result from manipulation during surgery.

In addition, a study of 987,010 women evaluated the incidence of hospital readmission for stroke in the year following birth.[82] Investigators reported a widening gap between women delivered by cesarean and women having vaginal birth. Cumulative rates were 0.2 per 1000 with vaginal birth vs. 0.3 per 1000 with cesarean delivery at 3 months postpartum, 0.3 per 1000 vs. 0.5 per 1000 by 6 months, and 0.5 per 1000 vs. 0.8 per 1000 by one year. The authors observe that their database source did not permit adjustment for confounding factors such as BMI and also that women who had preeclampsia and had cesareans had an elevated risk compared with women having cesareans who did not, but they also postulate mechanisms by which cesarean surgery could predispose to late stroke.

Finally, the worldwide literature is peppered with case studies and series of women experiencing cesarean scar endometriosis, a complication investigators concur is caused by iatrogenic seeding of endometrial cells into the abdominal wall or uterine wound during surgery. A 2008 systematic review of case series of five or more cases included 248 cases of cesarean scar endometrioma (a circumscribed mass of endometriotic tissue).[60] Since its close date, eight case series of five or more cases have been published comprising 297 additional women.[11, 20, 80, 83, 101, 108, 147, 153] Presenting symptoms are pain, often cyclical in nature, and sometimes bleeding from superficial lesions. Incidence rates ranged from 0.3% to 1.5% of women with prior cesarean,[60, 80, 101, 108, 147] but cesarean scar endometriosis is almost certainly under-ascertained. Women are often misdiagnosed, which means some probably never receive a correct diagnosis; and only women agreeing to surgical excision make up study cases, which would be those women with more severe symptoms. Also, time to onset of symptoms averaged 2-4 years and ranged higher, which would reduce the index of suspicion.[11, 20, 60, 80, 83, 101, 108, 147, 153] Clinicians agree that the only curative treatment is wide excision of the affected tissue, which may include the abdominal fascia and require a mesh repair. Recurrence rates ranged from 4% to 9%[11, 60, 80, 101, 153] with an outlier at 20%,[20] but this, too, is likely under-ascertained: follow-up periods varied and may have been too short to detect recurrence, and some women may have chosen to endure the symptoms rather than undergo repeat excisional surgery. Sequelae can be severe. Uterine scar involvement has caused profuse hemorrhage requiring hysterectomy,[65, 123] and endometriosis has devolved into cancer.[10, 60, 81, 101, 153]

7. Cesarean surgery can cause dense adhesions.

Six studies report on dense adhesions at second cesarean.[53, 92, 96, 103, 105, 107] Rates ranged from 12% to 50%. The strongest data come from a prospective study scoring adhesions in 173 women having a second cesarean and comparing outcomes according to whether the parietal peritoneum was sutured closed at the primary cesarean or, as is more usual practice, left open.[92] Overall, 39% of the women had dense adhesions. Women were less likely to have adhesions if the parietal peritoneum was sutured (n = 67),§ but even so, 30% had dense adhesions vs. 45% left open (n = 106). The other five studies were retrospective analyses of medical records and thus more subject to inaccuracy and observer bias. (See also chapter 6 mini-reviews for the escalating risk of adhesions with multiple cesareans.) In addition, a cohort analysis of hospital admission and surgery for adhesions and bowel obstruction in women free of factors that increased risk of these complications (N = 1,019,607 births) found that exclusive cesarean delivery increased the risk of adhesions (3.1 per 1000 vs. 1.6 per 1000, OR 2.1) and bowel obstruction (2.2 per 1000 vs. 1.2 per 1000, OR 2.0) over women with vaginal births only.[2]

8. Cesarean surgery is associated with decreased fertility, probably mostly by choice.

Most studies report decreased fertility with first delivery by cesarean. Three studies compared rates of having no second child when first delivery was by cesarean vs. vaginal birth.[102, 127, 137] Rates with prior cesarean ranged from 28.6 to 33.1% vs. 19.4 to 26.8% with prior vaginal birth, and absolute differences varied from 5.9 to 9.2%. Some studies, though, have found reduced fertility rates in women having first instrumental vaginal delivery. Four studies compared rates with first delivery cesarean with first spontaneous vaginal birth, which eliminates this confounding factor.[39, 102, 127, 138] In three studies, infertility rates subsequent to first delivery by cesarean ranged from 32-41% vs. 25-38% with first spontaneous vaginal birth,[102, 127, 138] and absolute differences varied from 3% to 6%, although in one study, a relatively small case-control study (576 cases vs. 576 controls), the difference (3%) did not achieve statistical significance.[138] The fourth, another small case-control study, compared 271 Dutch women who were planning home birth but who had breech babies and subsequently gave birth in hospital to term, normally formed breech babies (165 cesarean, 114 vaginal) with 268 similar women with vertex presentation who gave birth at home as planned.[39] This population was chosen to eliminate reasons for cesarean that might also influence having a second child. Contrary to the other studies, rates of no further pregnancy were similar (21% vs. 22%) to women with first vaginal delivery. In addition, a systematic review reported results of five studies comparing rates of at least one subsequent birth according to mode of first delivery.[57] Four studies reported a 5-10% decrease (OR range 0.90-0.95) with prior cesarean, and one study reported no difference.

Infertility and delayed fertility subsequent to cesarean delivery can be involuntary (can't have another baby) or voluntary ("I'm never going through that again"). Supporting involuntary infertility, one study of 3994 women (3572 no prior cesarean, 422 prior cesarean) desiring pregnancy reported that conception was more likely to take more than one year

§ Hamel (2007) and Myers and Bennett (2005) also report decreased risk of dense adhesions with peritoneal closure.[53, 105]

with prior cesarean than with prior vaginal birth (absolute difference 3.6%).[104] The same held true for conception taking more than three years, although the difference did not reach significance, probably because numbers were small. A confounder is that women who have difficulty conceiving are more likely to have cesareans, which was the case in this study; however, odds ratios were adjusted for factors related to fertility. The study's authors note that the association may be stronger than it appears because the study reported only on delayed conception, not failure of conception. In contrast, the Dutch study discussed in the previous paragraph reported similar median conception times to next pregnancy in all groups.[39]

Three studies provide evidence for voluntary infertility. A survey of 150 women three years after cesarean delivery reported that 21 women (14%) had not had further children because they "could not go through childbirth again."[6] A second study investigated why women had no second child.[12] More women having first cesarean (n = 705) "found aspects of the birth particularly distressing" than women with first spontaneous vaginal delivery (n = 476) (42% vs. 36%), but distress was related to whether the cesarean was planned (n = 129) or intrapartum (n = 546) (31% planned cesarean vs. 45 % intrapartum cesarean). Compared with women having first spontaneous vaginal birth (n = 370), women with first cesarean (n = 504) were more likely to give the following as reasons for voluntary infertility: that they were "unwilling to experience pregnancy/childbirth again" (38% vs. 16%), "relationship with child" (13% vs. 9%), "recovery period in hospital and at home" (67% vs. 37%), and "initial bonding with child" (33% vs. 21%). The cesarean category is not stratified into planned vs. intrapartum cesareans, which may have affected both answers related to mode of delivery and to overall rates of voluntary infertility. On the one hand, intrapartum cesareans were more distressing; on the other, women having planned cesareans were more likely to be older and to have more fertility and medical problems. The low response rate (60%) to the questionnaire may also have skewed answers. In the third study, investigators divided a population of 596,000 Norwegian women into two cohorts: women having a first child 1967-81 and followed until 1988 and women having a first child 1982-96 and followed until 2003.[137] Investigators looked at the effect of mode of delivery at first birth according to whether the baby was alive or was stillborn or died before one year. Looking at the later cohort (n = 301,373), if the first baby lived, fewer women had a second child (absolute difference 9.2%) if the first delivery was cesarean compared with women giving birth vaginally, but if the first baby died, the same number of women had a second child regardless of mode of first delivery. Moreover, looking at the entire group, if an initial cesarean was followed by a VBAC, a similar percentage (40%) of women went on to have a third child as those whose first two births were vaginal (32%), but if the first two deliveries were cesareans, only 19% of women had a third child.

9. Cesarean surgery is associated with an increased likelihood of pregnancy loss and fetal and neonatal death.

A U.S. study evaluated the effect of elective primary cesarean surgery on neonatal mortality (< 28 d after birth) in 8,026,415 women giving birth between 1999 and 2002 at "no indicated risk" for cesarean (singleton, term, vertex, no reported medical risk factors, no prior cesarean).[94] Investigators compared mortality rates between women planning vaginal birth (n = 7,755,236), of whom 8% had intrapartum cesareans (n = 617,168) and 271,179 women having planned cesareans. The neonatal mortality rate with planned cesarean was 1.7 per

1000 compared with 0.7 in women planning vaginal birth (0.6 per 1000 in women having vaginal birth and 1.7 per 1000 in women having unplanned cesarean), absolute difference 1 per 1000. After adjusting for birth weight, gestational age, maternal age, race or ethnicity, parity, education, and smoking, planned cesarean more than doubled the odds of death (OR 2.3). A second model further excluded all infants with congenital anomalies because this could affect both choice of birth route and mortality risk. The odds of death were still double (OR 1.9) those with planned vaginal birth. A third model additionally excluded all infants with Apgar scores < 4 as a proxy for fetal distress, which, as with anomalies, could affect both choice of birth route and mortality. This decreased the odds ratio to 1.7, still 70% greater than with planned vaginal birth. A Georgia study linking birth certificate data with hospital discharge data for births during the same time period found that 87% of 40,932 women having "no indicated risk" primary cesareans according to birth certificate data had antenatal or intrapartum risk factors.[66] However, most were intrapartum complications, which the U.S. study did not exclude, and it seems likely that antepartum risk factors would be equally likely to be under-recorded in women planning vaginal birth.

Cesarean surgery also increases mortality risk early in subsequent pregnancies. A systematic review found 268 cases of cesarean-scar ectopic pregnancy published in case reports and series between 1995 and 2008.[117] Reviewers cite an earlier review reporting an incidence of 1 in 1800-2216 pregnancies and note that the incidence will rise substantially as cesarean rates continue to increase. Nine additional case reports and series published in 2009 and 2010 have added 35 more cases.[13, 29, 30, 68, 85, 95, 99, 114, 140] Implantation in the cesarean scar, a complication unique to post-cesarean pregnancies, would invariably prove fatal to the developing embryo. The association between cesarean surgery and subsequent miscarriage (loss prior to 20 weeks) is less clear. A systematic review concluded that miscarriage is more likely with a prior cesarean, but the poor quality of one of the included studies compromises the reliability of the findings.[57] Published subsequently and contradicting the review are a British case-control study of 576 women with first cesarean delivery vs. 576 women with first vaginal birth, in which 6% of women with prior cesarean and 8% with prior vaginal birth had one or more subsequent miscarriages, and an analysis of a Scottish country-wide database reporting no significant difference.[127, 138]

Cesarean surgery probably increases the subsequent risk of stillbirth (fetal death > 20 w gestation). The first study to report this was from Scotland (N = 120,633 second births).[126] It has since been followed by two studies in different Australian states (N = 36,638 and 136,101 second births),[67, 132] one in England (N = 81,707),[50] one in Germany (N = 62,698 second births),[113] one in Canada (N = 157,929),[149] and two in the U.S.: one in Missouri (N = 396,441 second births) and one using national data (N = 11,061,599).[7, 118] Six of these eight studies found that, compared with women with no prior cesarean, those with prior cesarean have an excess risk of fetal death, significantly so in three of the studies,[50, 67, 113, 126, 132, 149] while a seventh, the study in Missouri, found an increase in black women but not white women.[118] Two of the three studies finding no statistically significant increase were underpowered to do so,[50, 149] and the third did not perform a power calculation.[132] In marked contrast, the eighth study reported a protective effect for prior cesarean and will be discussed last.[7]

The seven studies finding an increase varied in time span, whether they were confined to antenatal demise or included intrapartum death, whether they considered only unexplained stillbirths or all stillbirths, who was excluded, and what adjustments were made for

factors correlating with both increased risk of cesarean and stillbirth. Nevertheless, while mortality rates varied substantially from study to study, absolute excesses with prior cesarean were similar, ranging from 0.3 to 1.6 per 1000 (mean absolute excess 1.1 per 1000). Adjusted hazard ratios (the increased risk with which one group is likely to experience the outcome of interest) in the five studies reporting this statistic ranged from 1.4 to 1.6, mean 1.5.[50, 67, 113, 126, 149] The English study concluded that if the relationship between prior cesarean and stillbirth is causal, about 4% of all stillbirths in their population, in which the cesarean rate was only 7%, may be attributable to prior cesarean.[50] Additionally, four studies plotted the cumulative incidence of stillbirth according to prior mode of delivery as gestation advances.[67, 113, 126, 149] All found a growing divergence in stillbirth rates during the third trimester with prior cesarean.

Moreover, the 1-per-1000 excess in deaths may underestimate the excess risk of stillbirth in subsequent pregnancies because some studies restricted analysis to unexplained antenatal demise, which will undercount fetal and neonatal deaths from hemorrhage secondary to placenta previa, accreta, abruption, and uterine scar rupture, all of which may be attributable to prior cesarean. (See mini-review 14.) We can, however, get an idea of the magnitude of the contribution of these factors. The English study, which measured effects of any prior cesarean, reported stillbirth rates due to hemorrhage/abruption of 1.4 per 1000 with prior cesarean vs. 0.5 per 1000 with no prior cesarean (absolute difference 0.9 per 1000) and rates due to "mechanical" causes (a category including uterine rupture, according to the Scottish study) of 0.5 per 1000 with prior cesarean and 0.2 per 1000 with no prior cesarean (absolute difference 0.3 per 1000).[50] The Scottish study, which was confined to the next pregnancy after the first birth, found smaller differences: for hemorrhage, 0.6 per 1000 with first delivery cesarean vs. 0.4 with first birth vaginal (0.2 per 1000 absolute difference), and for "mechanical," 0.03 per 1000 vs. 0.01 per 1000 (absolute difference 0.07 per 1000).[126] Differences between these two studies may be explained by the former's including any history of cesarean vs. the latter's including only second deliveries. Risk of abnormal placental attachment increases with accumulating cesarean surgeries. (See chapter 6 mini-reviews.)

Studies may also report an excess of perinatal deaths with prior cesarean. The German and the two Australian studies reported more perinatal deaths (stillbirths and deaths in the first 7 d) in the second pregnancy with first delivery cesarean.[67, 113, 132] Rates ranged from 6.0 to 6.5 per 1000 with first delivery cesarean vs. 4.6 to 5.4 per 1000 with first birth vaginal, and absolute differences varied from 0.9 per 1000 to 1.8 per 1000. Perinatal death was more likely with prior cesarean delivery for both term and preterm pregnancies.[113] However, a Finnish study likewise reporting on perinatal mortality in the second pregnancy (N = 55,391) found no difference with first delivery cesarean (5.4 per 1000 vs. 5.5 per 1000).[58]

In contrast to the other seven studies, an analysis of stillbirth rates in U.S. women having singleton deliveries reported a *protective* effect for prior cesarean.[7] Investigators report a stillbirth rate of 1.3 per 1000 with prior cesarean vs. 1.5 per 1000 with no prior cesarean, the latter cohort comprising primiparous and multiparous women (RR 0.88, absolute difference 0.2 per 1000) (group I). Plotting the accumulation of stillbirths against gestational age, investigators found an excess in the *vaginal* birth cohort at all gestational ages. Investigators then excluded all labors that ended in primary cesarean in the no-prior-cesarean cohort and women with underlying medical conditions (not specified) and fetuses with structural or chromosomal abnormalities (group II). Prior cesarean surgery remained protective for

stillbirth (cesarean 0.4 per 1000 vs. 0.6 per 1000 no prior cesarean; RR 0.71; absolute difference 0.2 per 1000). Finally, investigators further narrowed the cohort to women with only one prior birth (group III). Rates were not significantly different (0.7 per 1000 first cesarean delivery vs. 0.8 per 1000 first birth vaginal).

What could explain so different a finding? Unlike all other stillbirth studies, group I includes nulliparous women in the no-prior-cesarean group. First pregnancies are at greater risk of adverse outcome. Beyond that, it is impossible to judge because, unlike the other seven studies, the authors fail to provide us with crucial information. They omit, for example, group population sizes and numbers of stillbirths according to prior delivery route. We do not even know the size of group I, the total population having term singleton births, because the only number they report is 11,061,599, the number of all singleton deliveries at ≥ 20 w gestation. Nor do they provide details on exclusion factors. The poor quality of this study despite its authors coming from Yale and Harvard raises the serious question of bias among investigators and peer reviewers.

10. Prior cesarean surgery is associated with increased likelihood of preterm birth, LBW, and possibly SGA babies.

Four of the stillbirth studies from the previous mini-review also report preterm birth (< 37 w) at second delivery.[67, 113, 126, 132] As noted above, all make some adjustment for factors correlating with perinatal morbidity and mortality and with greater likelihood of cesarean at first delivery. All found a significant difference between groups. Preterm birth rates ranged from 4.8% to 7.4% with first birth cesarean vs. 4.1% to 5.8% with first birth vaginal. Despite the range in preterm birth rates, absolute differences were remarkably consistent, ranging from 1.0% to 1.6%. A fifth study of perinatal morbidity at second birth according to birth route at first birth in Finnish women (N = 55,391) agreed when adjusting only for maternal age, smoking, and infant sex, but when analysis was limited to women with no health problems in first pregnancy, differences disappeared (2.4% cesarean first delivery vs. 2.3% spontaneous vaginal first birth).[58]

Excess preterm birth may be caused by timing of elective repeat cesareans, but a case-control study suggests prior cesarean may predispose to subsequent preterm labor. Investigators compared outcomes in the next pregnancy after three or more prior cesareans with two control groups: the next pregnancy after one or two prior cesareans and the next pregnancy after three or more spontaneous vaginal births.[121] Preterm birth rates were 16.2% with three or more prior cesareans vs. 11.5% with one or two prior cesareans vs. 2.3% with three or more prior spontaneous vaginal births. When stratified according to scheduled vs. unscheduled cesarean, most preterm deliveries in the study group were unscheduled (40% vs. 9%).

Prior cesarean may also be responsible for an excess of LBW babies. One of the stillbirth studies reported an increase in LBW (< 2500 g) (4.3% vs. 3.5%, absolute difference 0.8%) as did the study of multiple prior cesareans (16.1% ≥ 3 prior cesareans vs. 10.8% 1 or 2 prior cesareans vs. 5.3% ≥ 3 prior vaginal births).[67, 121] Excess LBW may relate to the excess in preterm deliveries. The study reporting no excess preterm deliveries with prior cesarean among women with healthy first pregnancies also reported similar LBW rates in that subgroup.[58]

Of even greater concern because it suggests suboptimal uterine and placental perfusion, subsequent SGA babies may be a problem as well. Three of the stillbirth studies

reported on SGA.[67, 126, 132] One reported similar rates between groups,[132] one a small but significant excess (7.6% vs. 7.3%),[67] and one a larger significant excess (4.1% vs. 3.2%).[126] Finally, investigators in a study of 637,497 women having first and second singleton births adjusted for confounding factors by reporting outcomes at second birth in the subgroup that did not have that particular complication at the first birth.[27] This study, too, reported a significant excess of SGA babies (7.6% vs. 6.5%) in women with first cesarean.

11. Cesarean surgery increases the likelihood of neonatal respiratory morbidity in term newborns, not all of which is averted by scheduling surgery at 39 completed weeks.

> **Note:** While iatrogenic prematurity is a potent factor affecting neonatal respiratory morbidity, another modifiable factor may be fluid overload resulting from infusing large volumes of IV fluid before and during surgery to prevent maternal hypotension. (See chapter 11 mini-reviews.)

A systematic review analyzed nine studies comparing neonatal respiratory morbidity with elective cesarean with vaginal or planned vaginal birth in term or near term neonates.[54] Included studies differentiated between elective and intrapartum cesarean, had a vaginal or planned vaginal birth comparison group, defined outcome measures, and had information on gestational age. Studies were too disparate to perform meta-analyses. Four studies evaluated RDS and rates ranged from 0.2% to 0.7% with elective cesarean vs. 0.1% to 0.2% with vaginal or planned vaginal birth. Relative risk was significantly increased in two of the studies (ORs 7.1 and 5.9) and increased but not significantly so in the third, while the fourth had too few cases for calculation. In one of the studies finding a significant increase, the increase peaked at 37-38 weeks and disappeared beyond 39 completed weeks of gestation. Six studies evaluated transient tachypnea and rates ranged from 0.9% to 12% with elective cesarean vs. 0.3% to 3% with vaginal birth. Three studies reported a significant increase (ORs 2.3, 2.6, 2.8), two of them adjusting for gestational age. The other three studies reported a nonsignificant increase. One study reported higher rates of persistent pulmonary hypertension with elective cesarean (0.37% vs. 0.08%, OR 4.6). Six studies reported on a combined measure of respiratory morbidity. All included RDS and transient tachypnea but varied in other respiratory complications. Incidence rates ranged from 3.2% to 12.4% with elective cesarean versus 0.14% to 1.6% with vaginal birth, and all differences were statistically significant. One study stratified risk by gestational age, finding that risk was higher at 37 completed weeks (OR 14) than at 39 completed weeks (OR 3.5). Reviewers note that the majority of studies failing to find a significant increase were small, suggesting that insufficient power explains the failure.

Three studies that evaluated respiratory morbidity as a composite outcome and met the review's inclusion criteria have been published after the review's close date. One was a case-control study of RDS or transient tachypnea in 277 women having term singleton elective cesareans vs. 311 control women having vaginal birth.[98] Respiratory morbidity rates in cases exceeded controls (1.8% vs. 0%). Mode of delivery remained independently

associated with respiratory morbidity after adjusting for gestational age, among other factors. A second study looked at RDS, transient tachypnea, and persistent pulmonary hypertension in 2687 women having term singleton elective cesarean and 31,771 women planning vaginal birth, of whom 2877 had unplanned c-sections.[55] Respiratory morbidity rates with elective cesarean exceeded rates with planned vaginal birth (4.2% vs. 1.5%). Rates of severe morbidity (treatment for ≥ 3 d with continuous oxygen supplementation, nasal continuous positive airway pressure, or any mechanical ventilation) with elective cesarean also exceeded those with planned vaginal birth (0.63% vs. 0.15%). Newborns born by elective cesarean experienced a significant excess at every gestational week through 39 completed weeks, although the odds ratio declined from 3.9 at 37 w to 1.9 at 39 w. The same pattern of excess with elective cesarean was seen in low-risk women (no growth restriction, diabetes, hypertension), in the subgroup with serious morbidity in both the population overall and low-risk women, and when the elective cesarean group was confined to patient choice cesareans, although differences were not always significant. Excluding meconium aspiration, sepsis, infection, and breech did not affect outcomes. Babies were still at excess risk of respiratory morbidity when delivered by elective cesarean in the fortieth week (absolute difference at 39 completed weeks 1.0%). The third study evaluated RDS or transient tachypnea in 814 women having term, singleton, planned, nonurgent cesarean and giving birth to a normally formed infant vs. 17,828 women planning vaginal birth.[73] Women with fetal indications for cesarean surgery (intrauterine growth restriction, maternal isoimmunization, fetal distress) were excluded. Respiratory morbidity rates with planned cesarean exceeded those with planned vaginal birth (1.6% vs. 0.8%) and were significantly different when adjusted for gestational age. Differences were no longer significant in infants ≥ 39 weeks.

Three additional studies reported on specific respiratory complications. Two were case-control studies using the database of a program assuring care for the sickest newborns (program admission depended on neonatal intensive care stay ≥ 3 d, hospital readmission within 96 h of birth, or neonatologist recommendation) to evaluate the effect of labor on RDS in one study and transient tachypnea in the other.[47, 124] Both studies excluded congenital malformation, placenta previa, breech, and multiple gestation. Investigators in the RDS study matched each of 4778 cases with five controls (n = 23,890) who were neither admitted to intensive care nor experienced RDS.[47] Cesarean delivery remained a factor after controlling for gestational age, birth weight, and variables associated with fetal distress. Compared with controls, cases having planned cesareans were at greater risk (OR 2.6) for RDS than cases having intrapartum cesarean (OR 1.9). Investigators in the transient tachypnea study matched 800 cases with 800 randomly selected controls free of transient tachypnea.[124] After controlling for factors such as gestational age, preeclampsia, placental abruption, and meconium, planned cesarean tripled the risk of transient tachypnea (OR 2.9) compared with vaginal birth. Babies delivered by planned cesarean incurred greater risk than those delivered by intrapartum cesarean (OR 1.2). This difference was nonsignificant, but the study was underpowered to detect significance. The third study compared incidence rates of pneumothorax at term with elective cesarean (n = 9988), intrapartum cesarean (n = 7795), and vaginal birth with spontaneous onset (n = 49,178).[151] Incidence rates were 2.9 per 1000 with elective cesarean, 1.5 per 1000 with intrapartum cesarean, and 0.4 per 1000 with vaginal birth. Odds ratios were 8.0 for elective cesarean vs. vaginal birth (absolute difference 2.5 per 1000), 4.2 for elective

cesarean vs. intrapartum cesarean (absolute difference 1.4 per 1000), and 1.3 for intrapartum cesarean vs. vaginal birth (absolute difference 1.1 per 1000). There was a significant reduction in incidence with advancing gestational age. Fourteen percent of infants delivered by elective cesarean who had pneumothorax also had pulmonary hypertension and required high frequency oscillatory ventilation and nitric oxide treatment.

Two other studies failed to define respiratory morbidities but are of special interest. The first is a best case scenario in that elective cesareans were usually done at ≥ 39 w, and in the hospital in which more than half the deliveries took place, fetal lung maturity was tested before performing cesareans at < 39 w.[84] Adjusting for gestational age, investigators compared rates of RDS, transient tachypnea, and aspiration pneumonitis in normally formed singleton term infants born after spontaneous vaginal birth (n = 99,679), intrapartum cesarean (n = 16,508), and planned cesarean (n = 10,755). Rates of RDS with intrapartum cesarean exceeded rates with spontaneous vaginal birth (0.2% vs. 0.1%; OR 2.1) as did rates with planned cesarean (0.6% vs. 0.1%, OR 5.4). Similarly, rates of transient tachypnea with intrapartum cesarean exceeded rates with spontaneous vaginal birth (1.2% vs. 0.6%, OR 2.0), as did rates with planned cesarean (1.6% vs. 0.6%, OR 2.4). Rates of any respiratory morbidity (RDS, transient tachypnea, or aspiration pneumonitis) could be calculated from the data. Rates were 2.1% for intrapartum cesarean and 2.4% with planned cesarean vs. 1.0% with spontaneous vaginal birth. The second study was confined to low-risk women, ensuring true elective cesarean.[42] Investigators compared respiratory morbidity (transient tachypnea, pneumothorax, RDS) in 121,460 women having elective cesarean or planned vaginal birth at term. Rates were higher with elective cesarean (3.0% vs. 2.0%, OR 1.5) with planned vaginal birth. Odds ratios decreased, but rates with elective cesarean continued to exceed rates with planned vaginal birth the succeeding week or later at every week, including elective cesarean at 39 w compared with planned vaginal birth at ≥ 40 w.

12. Cesarean delivery is associated with development of autoimmune diseases in the child.

Two systematic reviews published in 2008 evaluated development of asthma according to cesarean delivery vs. vaginal birth.[5, 134] Included studies largely overlap, but differences between the reviews make it worthwhile to summarize both. Pooling data from 23 studies, one review reported that delivery by cesarean surgery increased the odds of developing asthma (OR 1.2); however, studies were significantly heterogeneous.[134] Restricting analysis to studies ascertaining asthma onset before age 18 reduced heterogeneity without altering risk (OR 1.2). Sensitivity analyses tested for effect of study design (cohort vs. case-control), method of ascertaining asthma (medical record vs. questionnaire), geographic region (European, U.S., or other), and publication bias (studies with positive results may be more likely to be published). None of these affected results. Reviewers could not adjust for confounding factors but observed that studies that adjusted for breastfeeding (2 studies) and for maternal smoking (6 studies) did not find that this reduced the effect of cesarean delivery, nor did the "majority" of studies that adjusted for low birth weight (7 studies). The other review, which pooled data from 26 studies, reported similar increased odds of asthma with cesarean delivery (13 studies; OR 1.2), which is not surprising given the overlap.[5] Reviewers also reported an increased risk of hospitalization for asthma (7 studies; OR 1.2). In addition, reviewers reported increased risk of food allergy/food atopy (immediate allergic reaction) (6 studies;

OR 1.3) and allergic rhinitis (7 studies; OR 1.2). Four percent of food allergy/food atopy cases, 1.5% of allergic rhinitis cases, 1.5% of asthma cases, and 1.1% of asthma hospitalizations were attributable to cesarean delivery. Another study has been published since the close date of the two reviews.[115] Investigators prospectively followed 2917 Dutch children for eight years. Overall, 20.2% of children delivered by cesarean developed asthma by age 8 compared with 11.7% of children born vaginally (absolute difference 8.5%, OR 1.79). When one parent was allergic, rates were 23.5% vs. 14.1% (absolute difference 9.4%, OR 9.4%), and if both were allergic, rates were 44.0% vs. 19.9% (absolute difference 24.1%, OR 2.91). When neither parent was allergic, rates were 12.9% vs. 8.4%, still an excess, but not statistically significant. Odds ratios were adjusted for sex, birth weight, breastfeeding, maternal education, maternal BMI, and, in the total population analysis, parental allergy status.

Cesarean delivery also appears to be associated with the development of type 1 diabetes and possibly celiac disease. A systematic review of 20 studies found that cesarean delivery increased the likelihood of developing type 1 diabetes (OR 1.2).[19] Statistical analyses showed that these studies were not heterogeneous, nor was there evidence of publication bias. Adjustment for potential confounders (gestational age, birth weight, maternal age, birth order, breastfeeding, maternal diabetes) did not affect the relationship (OR 1.2). The association with celiac disease was found in a case-control study comparing 1950 children born at term attending gastrointestinal clinics, of whom 157 had celiac disease, with 862 control children visiting opthalmalogic, orthodontic, and dental clinics.[31] After adjustment for age, sex, postnatal complications, and duration of breastfeeding, children with celiac disease were more likely (OR 1.8) to be delivered by cesarean. More children with celiac disease were breastfed than controls (87% vs. 77%), which may have been due to chance or, as the investigators speculate, that women with celiac disease may have been advised to breastfeed as a preventive measure, in which case breastfeeding may mask an even stronger association.

13. Prior cesarean results in more maternal and neonatal morbidity at the next delivery.

Investigators prospectively collected data on birth outcomes in 10,654 multiparous women, of whom 7974 had prior vaginal birth and 2680 had prior cesarean surgery.[45] Among women with prior cesarean, the planned VBAC rate was 21%, of whom 80% had a vaginal birth. Women with prior cesarean were more likely to have blood transfusion (1.9% vs. 0.7%, RR 2.7), intensive care admission (1.6% vs. 0.4%, RR 3.9), and hospital readmission (1.3% vs. 0.9%, RR 1.5), and their newborns were more likely to require ventilation (2.7% vs. 1.7%, RR 1.5) and have > 7 d hospital stay (5.8% vs. 4.4%, RR 1.3). Maternal type 1 and type 2 diabetes or hypertension did not affect results.

14. Even one prior cesarean increases the risk of abnormal placental attachment in ensuing pregnancies.

Note: See chapter 6 mini-reviews for escalating risk of abnormal placental attachment with accumulating cesarean surgeries.

Three studies adjusted for the increased possibility of placental abruption or recurring abnormal placentation by excluding women with complications such as hypertension or abnormal attachment in the first pregnancy.[27, 89, 150] Population sizes ranged from nearly 100,000 to over 5 million. Rates of placenta previa ranged from 3.3 to 6.9 per 1000 with first delivery cesarean vs. 2.2 to 4.7 per 1000 with first delivery vaginal, and absolute differences varied from 1.1 to 2.2 per 1000. Rates for placental abruption ranged from 6.8 to 13.7 per 1000 with first delivery cesarean vs. 4.8 to 10.9 per 1000 with first delivery vaginal, and absolute differences varied from 2.0 to 3.6 per 1000. One of these studies reported on placenta accreta in second pregnancy as well.[27] Rates were higher with first delivery cesarean (0.6 per 1000 vs. 0.3 per 1000). In addition, three studies looked at the percentage of women with placenta previa who also had placenta accreta according to prior mode of delivery.[51, 100, 136] Rates of accreta in combination with previa ranged from 8% to 14% in women with one prior cesarean vs. 0.3% to 4% with no prior cesareans, and absolute differences varied from 8% to 10%.

15. Abnormal placental attachment can have severe consequences for women with prior cesareans and their babies, and outcomes can be worse compared with women with no prior cesarean.

Women with even one prior cesarean and their babies are more likely to experience severe morbidity with placenta previa than when women with previa do not have prior cesareans. A study comparing outcomes in 252 women with placenta previa and one prior cesarean with 488 women with previa and no prior cesareans reported that women with one prior cesarean were more likely to have a hysterectomy (23% vs. 15%), abnormal coagulation (4% vs. 1%), admittance to intensive care (4% vs. 1%), or major morbidity (one or more: transfusion, hysterectomy, operative injury, coagulopathy, thromboembolism, pulmonary edema, or death) (23% vs. 15%).[51] One woman in the cesarean group died. A second, smaller study of previa in women with history of one or more cesareans (n = 43) vs. no history (n = 378) reported similar results: women with history of cesarean were more likely to have transfusion > 4 units (16.3% vs. 5.5%), abnormal coagulation (2.3% vs. 0.3%), or hypovolemic shock (7.0% vs. 0.8%).[136] The excess risk with prior cesarean is likely explained by the strong association between prior cesarean and having placenta accreta in conjunction with previa. Placenta accreta is associated with especially severe morbidity. (See chapter essay.) As for perinatal morbidity and mortality, 35% of babies born to mothers with placenta previa in the pregnancy following primary cesarean were delivered at < 35 weeks and 15% at < 32 weeks, 49% were admitted to intensive care, 26% developed RDS, 2% developed necrotizing enterocolitis, 1% had seizures, 0.4% had intraventricular hemorrhage grade 3 or 4, and 2% died.[51]

Abnormal placental attachment and abruption increase the risk of hysterectomy. Three studies of hysterectomy report that abnormal placental attachment is the primary reason for hysterectomy in women with prior cesareans. In one, abnormal placental attachment (previa, accreta, or both) caused the hemorrhage that led to 66% of women with prior cesarean having hysterectomy.[71] The second study reported that placenta accreta was the reason for hysterectomy in 75% (9/12) of women with multiple prior cesareans.[96] The third study analyzed trends in peripartum hysterectomy (n = 358) between 1966 and 2005 in 872,379 women.[43] The maternal mortality rate was 1.1%. By the last decade, placenta accreta had become the most common indication (n = 47), accounting for nearly half of hysterectomies. All women having hysterectomy for accreta had prior cesareans, half of them

(n = 21) also having placenta previa. Placenta previa was the third most common reason for hysterectomy (n = 12) (hemorrhage ranked second, and uterine rupture contributed only one case), but the investigators did not provide information on the relationship with prior cesarean. In addition, a case-control study of 1365 placental abruptions in 185,476 births found that women having abruptions were more likely to have prior cesareans (19% vs. 12%; OR 1.8).[110] Hysterectomy was more likely in cases (0.5% vs. 0.1%), and abruption was independently associated with perinatal death (19.4% vs. 1.1%; OR 2.7).

16. Planned cesarean is associated with fewer traumatic and hypoxic injuries, but the relationship is not straightforward.

Notes: The studies summarized here should be read with these caveats in mind:

- Trauma and hypoxic injury rates depend on modifiable labor management factors such as use of instrumental delivery, induction, and augmentation. These in turn are related to factors such as use of epidural analgesia and continuous electronic fetal monitoring (cardiotocography). (See chapters 7, 9, 10, and 12.)
- Seizure, often considered a signal symptom of intrapartum hypoxia, is a nonspecific diagnosis with multiple etiologies, including congenital neurologic abnormality, antepartum hypoxia, hyponatremia (low blood sodium) secondary to IV fluid overload, and maternal fever, which may be secondary to epidural analgesia. Moreover, most infants with neonatal seizure do not meet criteria for intrapartum hypoxia and recover without neurologic impairment.[49]
- It is likely that most damage resulting in encephalopathy occurs before labor. Most newborns with encephalopathy have only antenatal risk factors and no intrapartum factors.[3,4]
- Results from analyses of large databases may be confounded by the inability to distinguish infants whose traumatic or neurologic injury arose from nonmodifiable causes such as clotting or bone mineralization abnormalities.
- Studies do not report long-term outcomes. Most babies will recover from traumatic injury.

A large study reported on a composite measure of major trauma (one or more: fracture, various nerve palsies, spinal cord trauma, traumatic intracranial hemorrhage, or grade III or IV intraventricular hemorrhage) in singleton term infants with no congenital anomalies.[84] Rates were 3 per 1000 with spontaneous vaginal birth (n = 99,679), 14 per 1000 with instrumental vaginal delivery (n = 15,987), 2 per 1000 with intrapartum cesarean (n = 16,508), and 1 per 1000 with non-labor cesarean (n = 10,755). All differences were statistically significant, but the absolute difference between spontaneous vaginal birth and non-labor cesarean was only 2 per 1000, and we do not know what proportion of injured newborns had fractures alone, which have no long-term effects.

We exclude CNS injury from a second study of singleton infants weighing 2500-4000 g born to nulliparous women because investigators made no adjustments for conditions that

could affect both mode of delivery and neurologic outcome,[139] but we include nerve injury from mechanical trauma on grounds that this omission would not affect rates of facial-nerve palsy and brachial plexus injury. (The NIH systematic review on elective cesarean did not make this exclusion.[145]) Facial nerve palsy rates were 0.3 per 1000 with spontaneous vaginal birth (n = 387,799), 0.5 per 1000 with vacuum extraction (n = 59,354), 0.3 per 1000 with intrapartum cesarean (n = 84,417), and 0.5 per 1000 with non-labor cesarean (n = 33,008). Rates of brachial plexus injury were 0.8 per 1000 with spontaneous vaginal birth, 1.8 per 1000 with vacuum extraction, 0.2 with intrapartum cesarean, and 0.4 per 1000 with non-labor cesarean. Differences between rates with spontaneous birth vs. non-labor cesarean were not statistically significant.

A third study of term singleton normally formed infants compared rates of intracranial hemorrhage and seizure in three groups: 17,828 women planning vaginal birth (includes vaginal birth and intrapartum cesarean), 825 women planning cesarean (cesarean performed > 8 h after decision), and a subset of 814 women planning cesarean after exclusion of cesareans for fetal indication (growth restriction, immunization, antenatal fetal stress).[73] Rates of intracranial hemorrhage were 0 per 1000 in the planned vaginal birth group and 1 per 1000 in the other two groups. Seizure rates were 2 per 1000 in the planned vaginal birth group and 1 per 1000 in the other two groups.

In addition, high cesarean delivery rates have no impact on cerebral palsy. A systematic review found that cerebral palsy rates in the early 1980s were virtually identical in Sweden, Australia, England, Ireland, and the United States while cesarean rates ranged from 7-12% in the first four countries vs. 22% in the United States.[119]

Finally, fetal laceration is unique to cesarean surgery. Five studies reported on rates ranging from 0.7% to 3.2%.[1, 37, 52, 128, 148] Injury was less likely during planned cesarean and most likely during rapid or urgent cesareans.[1, 52, 128] For example, by far the largest and therefore the most powerful of the studies (272 cases vs. 13-92 cases in the other four) reported rates of 0.4% with elective repeat cesarean vs. 0.7% overall.[1] This study did not report on seriousness of injury, but three studies reported that some infants required suturing or wound closure with staples.[37, 52, 128]

17. Cesarean surgery does not protect against sexual dysfunction.

Note: Studies may not take into account modifiable confounding factors that affect perineal and vaginal pain. These include instrumental vaginal delivery, episiotomy, and whether episiotomy is mediolateral or median. No study considers the effects of pushing position and technique, which can affect pelvic floor muscle tone (and therefore sexual satisfaction) or cesarean wound pain. Breastfeeding can also cause dyspareunia (painful intercourse),[70] and women having cesareans are less likely to breastfeed. (See chapter essay.)

A systematic review summarized data from six studies.[59] In all but one, reviewers report outcomes at three months or less, before healing can be said to be complete. Even so, a study surveying women at seven weeks reported that equal percentages of women with spontaneous

vaginal birth and with cesarean surgery had resumed intercourse. Another study failed to find a significant difference in perineal pain persisting longer than eight weeks in women with cesareans (2%) vs. spontaneous vaginal birth (7%), but this may have been because so few women had cesareans (n = 65). No data were reported on percentages experiencing cesarean wound pain. The sole study surveying women after three months asked women about their experience in the prior 8 weeks at 24 weeks. It found significantly fewer women with perineal pain with cesarean delivery (0.9%) than spontaneous vaginal birth (3.3%) but no differences in sexual problems. One study reported a greater prevalence of dyspareunia at three months with vaginal birth but did not distinguish between spontaneous vaginal birth and instrumental vaginal delivery. A secondary analysis published subsequent to the review found that dyspareunia rates (44% vaginal vs. 39% cesarean) were similar by six months.[9] The secondary analysis also found that even at three months, dyspareunia rates were similar between spontaneous vaginal birth (n = 173) and cesarean and between cesarean with labor (n = 56) and cesarean without labor (n = 38), although differences might have been found had there been more planned cesareans.

Four studies have been published since the review's close date. One reported similar rates of feeling sexually attractive, desire for sexual intercourse, and frequency of intercourse at three months in women having cesarean delivery compared with women having vaginal birth as well as similar rates of painful intercourse in primiparous women (31-32%).[70] Too few multiparous women (n = 5) responded to the question for a meaningful comparison. Primiparous women having cesarean delivery were less likely to report sexual dissatisfaction (54% vs. 70%), while dissatisfaction rates were similar in multiparous women. It is likely, though, that the gap in dissatisfaction rates would close as perineal healing continued, and the study does not stratify for instrumental vaginal deliveries. A second study compared sexual function in primiparous women at six months postpartum of whom 124 had a planned cesarean, 390 had a vaginal birth without anal sphincter laceration, and 407 had anal sphincter injury.[18] Women with planned cesarean were less likely to have resumed sexual activity compared with vaginal birth with no anal injury (86% vs. 94%), and no differences were found for sexually active women among the three groups with respect to desire, satisfaction, dyspareunia, or fear of incontinence or prolapse inhibiting sexual activity. The third study surveyed sexual function 12 to 18 months postpartum in primiparous women having spontaneous vaginal birth without episiotomy or anal sphincter tear (n = 55) and women having planned cesareans (n = 44).[69] Both total scores and scores in all survey domains (desire, sexual arousal, lubrication, orgasm, satisfaction, pain) were similar. Investigators in the fourth study interviewed primiparous women 10 months postpartum who had spontaneous vaginal birth (n = 100) or cesarean surgery (n = 184).[77] Contrary to all other studies, at six months or later, women were more likely to report dyspareunia with vaginal birth (46% vs. 28%), but it is unclear whether women were reporting current dyspareunia or dyspareunia at any time since delivery.

18. Cesarean surgery does not protect against anal incontinence.

A systematic review of anal incontinence (spontaneous leakage of solid or liquid fecal material, often including mucoid discharge, or gas) according to birth route encompassing 21 studies (6028 cesareans and 25,170 vaginal births) failed to find a protective effect with cesarean surgery.[106] The same held true for the seven studies that assessed incontinence after four months postpartum, adjusted for maternal age, and categorized women as having

only cesarean deliveries. Rates did not differ between planned and intrapartum cesarean in the six studies making this comparison. A 12-year follow-up published after the review's close date likewise found that neither exclusive cesarean delivery nor planned cesareans protected against fecal incontinence (involuntary loss of fecal material).[93]

19. Planned cesarean surgery offers modest protection against urinary incontinence and probably no protection against moderate to severe incontinence.

> **Note:** No study took all confounding factors into account, and some may not have taken any. These include BMI, age, urinary incontinence during or before pregnancy, and pushing position and technique.¶[40] None considered whether incontinent women had engaged in pelvic floor exercises to restore continence. Cohort studies were limited to those reporting outcomes at ≥ 6 months postpartum.

A systematic review evaluated data from 12 prospective cohort studies and 6 cross-sectional studies.[111] (Reviewers note that both designs have strengths and limitations. Cohort studies are useful for determining incidence but have small sample sizes and short follow-up times. Population-based cross-sectional studies allow evaluation of prevalence but are subject to recall and sampling bias.) Among the cross-sectional studies, no significant difference was found in the occurrence of urge incontinence (sudden need to void followed by involuntary loss) according to mode of delivery. Combining data from four studies, cesarean surgery reduced the incidence of developing stress incontinence (incontinence associated with exercise, laughing, sneezing, or coughing) of any degree (1102 cesarean vs. 15,881 vaginal) from 16% to 10%, and the sole study reporting on planned cesarean (36 cesarean vs. 1042 vaginal) found no significant difference (36% vs. 41%). The two studies reporting stress incontinence according to parity reported differences favoring cesarean delivery in both primiparous women (364 cesarean vs. 2182 vaginal) (9% vs. 14%) and multiparous women (383 cesarean vs. 10,116 vaginal) (11% vs. 18%). No significant differences were found in the three studies (988 cesarean vs. 14,677 vaginal) reporting on severe (based on frequency of pad use, what events precipitated episodes, or according to a scale using frequency and amount of leakage) stress incontinence (1.3% vs. 2.1%). Turning to the cohort studies, three reported incontinence at > 1 year of follow-up. Here, too, no significant differences were found for urge incontinence. Differences were found for stress incontinence in the group overall (580 cesarean vs. 2486 vaginal) (10% vs. 23%), among women having planned cesarean (257 cesarean vs. 2799 vaginal) (7% vs. 22%), in the two studies reporting on primiparous women (198 cesareans vs. 1159 vaginal) (11% vs. 23%), and in the sole study reporting on multiparous women (156 cesareans vs. 1182 vaginal) (13% vs. 26%). Also similar to the cross-sectional studies, no difference was found for severe incontinence (1.7% vs. 2.0%) in the two studies (353 cesarean vs. 2341 vaginal) reporting this outcome.

Since the review's close date, five studies with follow-up at six months to a year have been published. One will be considered separately as it is an outlier. Three of the other four

¶ Instrumental vaginal delivery and anal sphincter injury are not associated with urinary incontinence.

compared outcomes in primiparous women having planned cesarean with those having vaginal birth,[16, 25, 40] and the fourth also looked at primiparous women but did not distinguish planned from intrapartum cesareans.[143] As was found in the systematic review, mode of birth had no significant association with urge incontinence in the three studies measuring this.[16, 40, 143] Reported prevalence of stress incontinence of any degree was 5% and 22% with cesarean vs. 7% and 41% with vaginal birth, and absolute differences were 2% and 19% in the two studies (419 cesarean vs. 461 vaginal) measuring this outcome,[25, 143] while with planned cesarean prevalence ranged from 2% to 14% vs. 14% to 15% with vaginal birth, and absolute differences varied from 0% to 10% in the three studies reporting on association with planned cesarean (407 planned cesarean vs. 689 vaginal).[16, 25, 40] The difference was significant in two of the three studies. Only one study evaluated moderate to severe stress incontinence separately.[40] In that study (220 planned cesarean vs. 215 vaginal), women with cesarean delivery were slightly less likely to report episodes of stress incontinence more often than once a week (1% vs. 4%) or to report wearing a pad (1% vs. 3%). The study (57 cesarean vs. 287 vaginal) that reported by far the highest prevalence of stress incontinence (22% vs. 41%) also evaluated its effect on quality of life in the domains of mobility, physical function, social function, emotional function, and embarrassment.[143] Scores (scale 1-100 with higher score indicating greater effect) in each of the domains were low—none was greater than 10—and did not differ significantly according to mode of birth. In the outlier study, investigators interviewed primiparous women 10 months postpartum who had vaginal birth (n = 100) or cesarean surgery (n = 184).[77] Rates of any stress incontinence were substantially higher (33% cesarean vs. 54% vaginal) (rates were similar between planned and intrapartum cesarean) than the other studies summarized here, rates of severe incontinence extraordinarily so: 7% continuous pad use with cesarean vs. 17% with vaginal birth, compared with severe incontinence rates of 1-2% with cesarean and 2-3% with vaginal birth in the others. However, these differences did not affect social functioning or depression rates. Investigators attribute the difference to better ascertainment with face-to-face interview, but a questionnaire should be adequate to determine the presence and severity of stress incontinence. One possible explanation is that women were reporting incontinence at any time since delivery.

The issues of urinary incontinence may be less straightforward than commonly thought. One would think that incontinence would decrease over time as recovery proceeded, but one of the studies reported an *increase* in stress incontinence from 3 months to 12 months postpartum that was especially marked in women with cesarean delivery (8% at 3 months vs. 22% at 12 months).[143]

20. Cesarean surgery offers modest protection against symptomatic pelvic floor prolapse, but studies do not control for modifiable elements of vaginal birth management.

All four studies comparing symptomatic pelvic floor prolapse according to mode of birth found that vaginal birth bore a dose-dependent relationship with prolapse and that cesarean surgery was protective.[78, 116, 133, 141] Women with only cesarean deliveries had a prolapse risk similar to that of nonparous women.[116] But there are caveats. First, protective effect is minor. Two of the studies are population-based and permit calculation of absolute differences. One study of 1.4 million women reported a diagnosis of prolapse of 1.2% in women younger

than age 60 with prior vaginal birth vs. 0.2% with women with only prior cesarean deliveries (absolute difference 1%),[78] and the other, of 2001 women older than age 40, reported a symptomatic prolapse rate of 5% in women with one vaginal birth, 7% with two, and 9% with three or more, vs. 3% with only cesarean deliveries (absolute differences 2-6%).[116] One must consider, too, that the vaginal births in these studies were unlikely to have been managed optimally. For example, mediolateral episiotomy may be associated with pelvic floor prolapse as may severe vaginal tearing and anal injury,[133, 141] and no study considered pushing position or technique as potential contributing factors. In addition, a long list of nonobstetric factors was associated with pelvic floor prolapse including smoking, hysterectomy, hormone replacement therapy, constipation, irritable bowel syndrome, and urinary tract infections.[116]

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The Case Against Elective Repeat Cesarean

"After a thorough discussion of the risks and benefits of attempting a vaginal delivery after cesarean section, a patient might ask, 'But doctor, what is the safest thing for my baby?' . . . [M]y unequivocal answer is: elective repeated cesarean section."

Greene 2001, p. 55[42]

"The failure to offer access to VBAC to . . . eligible women . . . inevitably involves a high and growing level of iatrogenic harm and excess costs. . . . As many women will have additional children, future childbearing is difficult to predict, and hazards increase as the number of previous cesareans grows, it would be wise for women without a clear and compelling need for cesarean section in the present pregnancy to avoid the extra risks of surgery and to get off the repeat cesarean track."

Sakala 2008, p. 58[77]

Vaginal birth after cesarean (VBAC) has almost disappeared in this country because obstetricians have permitted self-interest to trump their patients' right to refuse surgery. (See chapter 4.) But let us suppose that the only consideration is how best to advise and care for individual women with one or more previous cesareans. Let us, then, sort through the complexities and difficulties of the research to determine as best we can the answers to the questions: What are the tradeoffs between planned VBAC and elective repeat surgery? Who should labor? What scar rupture and VBAC rates should be achievable? And what policies and practices produce the best outcomes in women planning VBAC?

Will the Real Elective Repeat Cesarean and Planned VBAC Please Stand Up?

Most studies do not distinguish "planned VBAC" from "elective repeat cesarean" (ERC), that is, planned repeat cesarean in women without new indication, a flaw that could affect results. For example, one study defined planned VBAC as any vaginal birth or unplanned cesarean at term,[86] which means intrapartum cesareans credited to the planned VBAC group may actually be women who planned elective repeat surgery but began labor before the date of surgery or women planning medically indicated

cesareans who did the same. Another included women presenting in early labor who underwent cesarean in the ERC category,[60] although they might have been planned VBACs. Some used planned cesareans as their comparison group, which would include cesareans for indications such as placenta previa. Studies might even include all prelabor cesareans, which could include emergent cesareans. Some studies describe their comparison group as "elective" surgeries without clarifying how they distinguished true ERC from "planned" or "prelabor" cesareans, including the Agency for Healthcare Research and Quality (AHRQ) (2010) systematic review[44] (the major source of data in this chapter's mini-reviews), and, in fact, reviewers include studies that were not of true planned VBAC and ERC. For simplicity's sake, we will use "planned cesarean" and "planned VBAC," recognizing that these may not be strictly accurate either.

WHAT ARE THE TRADEOFFS BETWEEN PLANNED VBAC AND PLANNED REPEAT SURGERY?

Despite the failure to distinguish true elective repeat cesarean (see textbox "Will the Real Elective Repeat Cesarean and Planned VBAC Please Stand Up?"), the AHRQ (2010) systematic review provides us with the most thorough analysis available of the tradeoffs between planned VBAC and ERC.[44] Beginning with maternal mortality and morbidity, the chances of maternal death, although small, favor planned VBAC. According to a meta-analysis of studies of term pregnancies comprising 380,000 women, 9 more women per 100,000 planning repeat cesarean die. One of the included studies, an analysis of the large U.S. Maternal-Fetal Medicine Units (MFMU) cohort, distinguished true VBAC and true ERC. Investigators found that 21 more women per 100,000 having ERC (28 per 100,000 vs. 7 per 100,000) died.[88] Hysterectomy rates would probably have favored planned VBAC had the review's meta-analysis not been skewed by a large study reporting extraordinarily low rates with planned cesarean. Thromboembolism rates also appear to favor planned VBAC while infection rates may be lower with planned cesarean, and surgical injury and transfusion rates were similar. (See mini-reviews 1 and 2.) In other words, ERC imposes a small but important excess in maternal deaths and probably severe morbidity. Moreover, most morbidity in planned VBACs occurred in labors in which the scar gave way or that ended as intrapartum cesareans. As we shall see, unlike surgery, where the risks are mostly intrinsic, VBAC rates and rates of scar rupture depend heavily on labor management. One must consider postpartum recovery as well: no studies reported on postpartum problems that occur more frequently with cesarean surgery than vaginal birth. These include more severe and prolonged pain, difficulties breastfeeding, and the difficulties of caring

for an older child or children and an infant while recovering from surgery. Repeat surgery also increases the likelihood of forming dense adhesions (see mini-review 6), which may cause chronic pain and which makes any future abdominal surgery, not just future cesareans, more difficult and risky.

Turning to perinatal morbidity and mortality, scar rupture is more common with VBAC, but severe adverse consequences for the baby are rare. The AHRQ (2010) systematic review reported a pooled scar rupture rate of 0.47% and a perinatal mortality rate (PMR) (death ≥ 20 w gestation to 28 d postpartum) secondary to scar rupture of 6.2%. Multiplying the two yields a PMR of 3 per 10,000 VBAC labors. This is identical to the maternal mortality rate with true ERC (3 per 10,000), in the MFMU cohort.[88] The systematic review does not report hypoxic-ischemic encephalopathy (HIE) (abnormal neurologic symptoms believed to be caused by hypoxia during labor) associated with scar rupture, but analysis of the MFMU database revealed a rate of 5 per 10,000.[88] The database did not, however, include information on long-term outcomes. (See mini-review 3.) Planned VBAC per se imposes excess risk of adverse perinatal outcome, but this, too, is small. The systematic review's meta-analysis reports a higher PMR with planned VBAC (1.3 per 1000 vs. 0.5 per 1000; absolute excess 0.8 per 1000), but the largest study, the analysis of the MFMU cohort, includes antepartum demise whereas three and possibly all four of the others* confine analysis to intrapartum plus neonatal deaths. Antepartum deaths are overrepresented in the VBAC group because obstetricians are less likely to subject women with fetal demise to repeat cesarean. Remove them, and the PMR with planned VBAC in the MFMU study falls to 0.9 per 1000, 4 more deaths per 10,000 compared with the pooled rate with planned cesarean. Data on neonatal mortality rates (NMR, first 28 d) conflict. The review reports a pooled excess with planned VBAC (1.1 per 1000 vs. 0.5 per 1000), but the MFMU analysis reported identical rates with true planned VBAC and ERC (0.8 per 1000), and a large U.S. analysis of ultra-low-risk women, which effectively ensured comparison of true ERC with true planned VBAC, reported a 20% excess with ERC (0.8 per 1000 vs. 0.7 per 1000). Furthermore, some deaths and cases of HIE with planned VBAC might have been avoided by more judicious use of induction and augmentation in what may be a more vulnerable fetus. Results are mixed for respiratory morbidity. The AHRQ review finds that resuscitation rates favor planned cesarean (2.5% vs. 5.4%), and rates of transient tachypnea of the newborn (overly rapid breathing) are similar. Respiratory morbidity rates will depend on timing of cesarean surgery and on scar rupture and intrapartum cesarean rates with planned VBAC. (See mini-review 4.)

We cannot, however, limit the discussion to the next pregnancy even for women who plan only one more child. Women may change their minds or continue

* We say "possibly" because one of the four cited studies is an erratum. It does not report on perinatal mortality.

with unplanned pregnancies. When we look at accumulating cesarean surgeries, the advantage tips strongly toward planning VBAC. With each additional surgery, the likelihood of placenta previa, placenta accreta, and the two in combination goes up, as does the risk of dense adhesions. Abnormal placental attachment is associated with severe maternal and perinatal morbidity and mortality. (See mini-reviews 5 and 6.) For this reason, studies find a dose-dependent increasing risk of operative injury, postoperative maternal ventilation, admission to intensive care, severe hemorrhage, ileus (paralyzed bowel), and hysterectomy with increasing number of cesareans. Furthermore, studies do not evaluate long-term outcomes consequent to postpartum complications and adhesions such as postpartum debility and chronic pain. Data also suggest increasing risk of preterm delivery and its concomitant morbidities: low birth weight and respiratory complications. (See mini-review 6 and chapter 5.)

In contrast, once a woman has had a VBAC, she is almost certain to go on having uneventful repeat VBACs, as both the likelihood of scar rupture and the likelihood of unplanned repeat cesarean fall markedly in subsequent VBAC labors. (See mini-review 7.) Given the facts about accumulating cesarean surgeries and the unpredictability of completed family size, it becomes clear that women who have no new indication for cesarean surgery should be encouraged to plan vaginal birth.

WHO SHOULD LABOR? . . . ANY WOMAN WHO WANTS TO

Under almost every circumstance in which studies find an increase in risk of scar rupture rates—including more than one prior cesarean, single-layer uterine closure at the prior cesarean, low vertical uterine incision, prior preterm cesarean, short interpregnancy/interdelivery interval, older maternal age, macrosomic baby, and longer pregnancy duration—a minimum of 95% of women, and generally more, labor without scar problems. Nor is thin scar a useful predictor. (See mini-review 8.) Moreover, even with characteristics for which some studies report 5% scar rupture rates, other studies of the same characteristic report lower rates. This suggests other factors are in play, and as we shall see, some of them are modifiable. (See mini-review 11.)

Unknown or Uncommon Scar Type: Too Dangerous for VBAC?

Because the low-transverse incision has been standard for decades, a woman with no records would almost certainly have a low-transverse scar, which means that inability to determine scar type should not deter VBAC. Moreover, intrapartum scar rupture rates of uterine incisions other than low-transverse or low-vertical may be lower than commonly believed. The AHRQ (2010) systematic review cites a study reporting no

ruptures among 145 women laboring with classical vertical scars,[44, 66] and an older systematic review reports none among 26 VBAC labors with classical scars, making 171 cases in all with 0 ruptures.[76] In addition, in the MFMU cohort, 98% (103/105) of women with classical, inverted T, or J-shaped uterine incisions labored without scar problems.[60] (Inverted T and J-shaped incisions are included with classical incisions because they enter the muscular portion of the uterus.[44]) Unfortunately, no information is given about specific scar type in the two ruptures or how many women had which type of incision.

As for VBAC likelihood, studies find that most women will give birth vaginally if given the chance, despite having factors that diminish their odds. This includes women with more than one prior cesarean, with prior cesarean for labor dystocia, with a baby weighing 4000 g or more, who are older, of high body mass index (BMI), and who have longer pregnancy duration. (See mini-review 10.)

The wide range in VBAC rates with any given factor suggests that modifiable factors are in play, and, indeed, they are. One study found, for example, that women with prior cesarean for labor dystocia were given less time during the VBAC labor than women with prior cesareans for nonreassuring fetal heart rate or breech.[82] Another reported that one-third of women who had repeat cesareans for poor progress or failed induction had them before 5 cm dilation, which means many women were still in latent labor.[104] A third study reported that the VBAC rate with more than one prior cesarean increased from 58% to 74% over the 5-year study period, presumably as doctors gained confidence.[4] The choice to induce also plays a role. Studies document that high-BMI women, women suspected of carrying macrosomic babies, and women beyond 40 weeks' gestation who are induced are less likely to have a VBAC than similar women who begin labor spontaneously.[41, 48, 101, 103]

Women who have had vaginal births either before or after the cesarean section do much better by planning VBAC. As we saw earlier, women with previous VBACs have low probability of scar rupture and high probability of repeat VBAC. The same holds true for women who have had one or more vaginal births before the primary cesarean surgery. And while some have theorized that multiple VBACs might overstress the scar,[70] the scar rupture rate with two or more prior VBACs remains the same as for one prior VBAC, and there is no upward trend.[70] (See mini-reviews 7 and 9.) The safety and odds of repeat VBAC compared with accumulating cesareans makes an argument for planning VBAC even in less-than-optimal situations.

Attempts to develop a means of accurately predicting VBAC have failed. The strongest studies, in which scoring models were validated by applying them to

a new population, found that half of women with unfavorable factors still birth vaginally.[44] We would argue that attempts to predict VBAC are doomed because they assume the problem is centered in the woman rather than her care providers, but regardless of circumstances, most women will birth vaginally if their care providers believe in their ability to do so and treat them accordingly. We think efforts to restrict VBAC to optimal cases should be abandoned in favor of giving women accurate information about their likelihood of vaginal birth, encouraging all women who want to plan VBAC to do so with rare exceptions such as women who have had symptomatic scar problems in a prior birth, and instituting policies and practices that maximize every woman's chance of safe vaginal birth. As one obstetrician said of VBAC, "Obstetricians should remember that to allow a patient to labour is not a treatment, it is a virtually unavoidable consequence of pregnancy" (p. 1201).[74]

WHAT SCAR RUPTURE AND VBAC RATES SHOULD BE ACHIEVABLE?

According to the AHRQ (2010) systematic review, scar rupture rates of 0.5% can be achieved, although VBAC studies often report scar rupture rates of 1% or more. Studies point the finger at induction with unripe cervix, induction using prostaglandin E2 (PGE2), induction with misoprostol (now contraindicated[2]), high oxytocin dose and duration at high oxytocin dose, and prior single-layer uterine closure to explain the excess, but matters are not so straightforward. Labor management policies can mitigate adverse effects, as can be seen in a study reporting 0.3% scar rupture rates both in women who began labor spontaneously (n = 1011) and women who were induced (n = 310) in a population in which half the women had prior single-layer uterine closure, PGE2 was used, and oxytocin doses up to 42 mU/min were permitted.[67] The study's authors theorized that the following protocol elements minimized risk of scar rupture:

- no oxytocin with unripe cervix,
- longer time than typical (40 h) for cervical ripening,
- longer interval than typical (12 h) between PGE2 administrations,
- labor augmentation only with engaged head and dilation > 3 cm,
- no PGE2 with multiple scars or multiple gestation,

Not on their list but almost certainly a factor was that protocol also mandated a 40 minute interval before increasing oxytocin dose, longer than is typical and enough time for the current dose to reach peak effect, which also may have helped prevent overstressing the scar. Single-layer uterine closure, however, seems likely to predispose to scar rupture independently despite this study's good results. (See mini-review 8.) Whatever the culprits, the bottom line is that if scar rupture rates of 0.5% or less can be attained, investigators finding scar rupture rates much in excess of 0.5% are documenting not that VBAC labors are excessively risky but

that women did not receive optimal care in the prior cesarean, the current labor, or, more likely, both.

Turning to VBAC rates, the AHRQ (2010) systematic review pooled results of 67 studies and reported a 74% rate.[44] As with scar rupture, rates varied widely, ranging from 49% to 87%, again, an indication of management factors in play, and, in fact, the astonishingly high 87% rate was reported in 1453 women cared for at freestanding birth centers.[65] Nor were the excellent results with physiologic care due to more women having had prior vaginal births. Thirteen studies of doctor-attended VBACs in women with no prior vaginal births reported rates ranging from 61% to 72% compared with 81% in the birth center study.[3, 15, 19, 20, 37, 41, 47, 50, 59, 61, 65, 90, 96] This is an absolute increase of 9% over the highest reported rate among the doctor-attended studies and a whopping 20% increase over the lowest. In other words, as many as 20 more women per 100 with no prior vaginal births would have a VBAC if they received physiologic care in labor.

To reiterate, scar rupture and VBAC rates depend far more on the woman's care provider than the woman. The care provider determines whether and under what circumstances a VBAC will be permitted—indeed, the chances of VBAC are zero for most U.S. women because few care providers allow it at all—what practices and policies govern the woman's care in labor, and when to proceed to cesarean. The care provider's philosophy and approach also determine whether the woman feels encouraged and relaxed or the opposite, which can affect labor progress as well. Thus, both her safety and her odds of VBAC are maximized by physiologic care.

WHAT POLICIES AND PRACTICES PRODUCE THE BEST OUTCOMES IN WOMEN PLANNING VBAC?

Best practice for VBAC labors begins with the prior cesarean surgery. Studies conflict, but it seems probable that single-layer uterine closure increases the risk of scar rupture in a subsequent VBAC labor. Gretchen Humphries (2007),[54] a veterinary surgeon, points out that one reason for differences among studies is that scar strength may also depend on suture material and technique, and studies varied in this regard; but while we still have no data on technique, a case-control study reported no association with chromic catgut versus Vicryl or Polysorb. We could find no randomized trials evaluating the effects of suture material or technique on scar strength in subsequent labors—a surprising omission, considering the importance of the issue. We do know, however, that older studies, conducted when double-layer closure was the norm, report scar rupture rates of 0.5% or less. It would seem prudent, therefore, to use double-layer closure until such time as we have better data. Double-layer closure may have other advantages as well: the case-control study found increased likelihood of adverse perinatal outcome when scar rupture occurred with single-layer suturing, and another study found that women

with double-layer suturing were less likely to have bladder adhesions. (See mini-review 8.)

Inducing labor is associated with decreased VBAC rates. Indication for induction may explain why inducing labor decreases VBAC rates, and, in fact, one study reported that the difference between induced and spontaneous labor onset groups disappeared after controlling for diabetes, birth weight, and prior cesarean for labor dystocia. Still, evidence supports induction exerting an independent effect on the likelihood of vaginal birth either directly or via a provider effect: studies have found that elective induction in non-VBAC labors increases the likelihood of primary cesarean (see chapter 7), and as noted earlier, high-BMI women, women suspected of carrying macrosomic babies, and women beyond 40 w gestation who are induced are less likely to have VBACs than similar women who begin labor spontaneously.[41, 48, 101, 103] The adverse effect on VBAC rates may be nullified when inducing women with a ripe cervix or in women with prior vaginal birth. (See mini-review 12.)

With regard to scar rupture, almost all studies report more scar ruptures with induction than with spontaneous labor onset, but the effect appears to depend at least partially on readiness for labor and the agents used. Misoprostol, of course, is now contraindicated,[2] but even in the post-misoprostol era the need for cervical ripening appears to confer additional risk. Almost all studies report higher scar rupture rates when comparing induced labors involving PGE2 with labors of spontaneous onset, or they are underpowered to detect a difference. The same holds true when comparing induced labors involving PGE2 with induced labors not involving this agent. The association is less clear with mechanical ripening, such as with a balloon catheter. Among studies comparing scar rupture rates involving mechanical ripening with oxytocin-only induction, one study reported an increase in scar ruptures, but three others did not. (See mini-review 11.)

Augmenting labor, too, appears to increase risk of scar rupture. Both studies looking at scar rupture rates in women laboring with and without uterotonic agents reported more scar ruptures in augmented women. (See mini-review 13.)

Appropriate patient selection and careful induction and augmentation protocols can mitigate adverse effect on the uterine scar. This means that while spontaneous labor is ideal, women with prior cesareans who would truly benefit from labor stimulation need not be consigned to repeat surgery.

As for general labor policies, we have no evidence of benefits from early admittance in labor, routine IV, nothing by mouth, or preset time limits. Nor is there evidence of benefits of these methods in non-VBAC labors, which also have the potential for emergent situations, especially in institutions not practicing physiologic care. We do, however, have evidence for the harms of these practices. (See chapters 9 and 11.) Preset time limits are especially injurious in VBAC labors because we have evidence that they tend to progress more like primiparous than

multiparous labors.[23, 49] Where we have known harms and only theoretical benefits for a practice or policy, we should not impose it.

Continuous electronic fetal monitoring (cardiotocography) poses a more complex problem. According to two studies cited in the AHRQ (2010) systematic review, severely abnormal fetal heart rate (FHR) pattern, especially bradycardia, is the most frequently reported sign of scar rupture. Abnormal FHR reliably indicated scar rupture—91 of 99 cases (92%) in one study and 20 of 23 cases (87%) in the other[11, 64]—but the ability to avert adverse outcome is less clear. One study concluded that prompt delivery (≤ 17 min) after a prolonged heart rate deceleration would prevent serious perinatal morbidity and mortality because with longer delay, four cases of intubation and one of asphyxia occurred.[64] (When the prolonged deceleration was preceded by severe late decelerations, severe morbidity occurred sooner. Study authors recommended prompt delivery with these symptoms as well.) However, an earlier AHRQ systematic review pointed out that the four intubated newborns were extubated within 24 hours and were discharged without adverse sequelae.[45] If we remove them from consideration, the sole case of asphyxia occurred with delivery at 32 minutes after onset of prolonged deceleration, although we cannot know whether the four newborns who required ventilation would have deteriorated with longer delay before delivery. In addition, study authors acknowledged that their urban indigent Hispanic population was likely to represent a worst case scenario because 90% of them had unknown obstetric history and unknown scar type, to which we would add that because the study was conducted in the 1980s, more women had classical incision (11/99) than would today. Furthermore, the earlier AHRQ reviewers point out that a prolonged deceleration can have other causes, including epidural, maternal positioning causing hypotension, rapid descent in second stage, and cervical examination. In other words, using a prolonged deceleration (or episode of bradycardia) as the sole indicator for urgent cesarean is likely to result in unnecessary surgeries. In contrast, the other study reported that two of the three cases of HIE resulting in impaired neurologic development were delivered less than 18 minutes after appearance of severely abnormal FHR, and investigators found no relationship between time to delivery and neonatal outcome.[11]

What can we gather from this? Continuous monitoring seems to confer some benefit, but not all bad outcomes can be prevented regardless of rapidity of delivery, and there is a strong potential for false positives leading to unnecessary surgery because proposed diagnostic criteria are not discriminatory. To this must be added continuous electronic fetal monitoring's association with higher rates of cesarean surgery and instrumental vaginal delivery. If electronic fetal monitoring were harmless and an episode of bradycardia accurately identified scar rupture, a strong case could be made for using it in all VBAC labors, but neither is true. It might make sense, then, to reserve continuous monitoring for women at higher

risk of scar rupture, which would limit use to the women most likely to benefit while minimizing the number of women exposed to its harms.

Epidurals and combined spinal-epidurals, too, pose a dilemma. They can cause episodes of fetal bradycardia (see chapter 12), putting women at risk of a false-positive diagnosis of scar rupture. They also increase the likelihood of labor augmentation, which can precipitate scar rupture. Yet no woman should be denied access to this pain relief option. Best practice would dictate including these concerns in an informed consent discussion in advance of labor and ensuring access to a variety of comfort measures for coping with labor pain.

No evidence establishes the safety or effectiveness of intrauterine pressure catheters (IUPCs) or manual scar exploration to diagnose scar rupture. IUPCs are supposed to identify scar rupture by a loss in pressure, but an analysis of 76 cases of scar rupture reported that in no case did an IUPC diagnose the problem,[75] and another study reported that loss of intrauterine pressure occurred in only 2 of 12 cases of scar rupture.[6] In a third study, investigators simulated scar rupture in 20 women by recording uterine pressures in laboring women before and after incising the uterus during cesarean section.[31] Neither fluid-filled nor solid IUPCs showed a pressure change in any of the women. Finally, investigators studying induction of VBAC labors wrote that the IUPC recording "contributed to the diagnosis of uterine rupture or dehiscence in three out of five cases [4 scar rupture, 1 dehiscence]" (p. 454), but they do not specify how.[57] Study results reveal that the FHR was also abnormal in the three cases where scar problems were suspected, and an IUPC was in place in the two cases where they were not. On the downside, IUPCs require rupture of membranes, which opens a pathway for ascending infection and can restrict mobility. Case reports of severe complications include intrauterine infection, placental abruption, placental or fetal vascular damage—one case, at least, resulting in perinatal death—and uterine perforation.[99] Manual exploration of the scar after birth produces false positives and false negatives. A study of over 1000 women with prior cesareans reported that fewer scar defects were detected by manual palpation than observed during elective repeat cesareans.[38] In two cases exploratory surgery was performed after doctors thought they felt a defect, only to find one woman had an intact scar. Another study reporting on a postpartum maternal death from hemorrhage noted that the scar had been palpated after the birth, but the rupture was missed.†[34] The first study's investigators questioned the value of identifying asymptomatic scar windows because they seem to pose little risk in subsequent pregnancies, an observation later supported by an ultrasonography study finding that most women with prior cesareans have scar defects.[71] They argued that manual exploration could increase the risk of infection or convert a small, harmless gap

† This is the sole case of maternal death associated with VBAC scar rupture reported in the literature; however, because the AHRQ (2010) reviewers did not include the source study in their analysis of maternal outcomes, they report no maternal deaths associated with VBAC scar rupture.

into a problem. To this we add that manual scar palpation is excruciatingly painful if the woman does not have an epidural. On these grounds, both IUPC use and postpartum manual exploration should be abandoned.

STRATEGIES FOR OPTIMAL CARE

Physiologic care produces the greatest probability of an uneventful vaginal birth. Only under rare circumstances is the risk of scar rupture so high, the likelihood of VBAC so low, or both, that women should be discouraged from planning VBAC. Even these circumstances do not negate the right to refuse surgery.

- Provide positive, supportive care: a woman laboring in a low-stress environment surrounded by care providers who are relaxed and confident of her ability to give birth, who make decisions collaboratively with her, and who help her deal with any fears and anxieties is more likely to do well in labor and progress to vaginal birth than a woman who feels she needs to be in defensive mode or who feels unsafe, doubtful, or frightened.

The Language of VBAC

The language of VBAC is rife with covert implication of uncertainty and risk: "trial of labor," "attempted vaginal delivery," "uterine rupture," "successful" or "failed" VBAC, quoting scar rupture rates. This has a powerful subliminal effect on women and caregivers alike. Convert loaded language to neutral terms: "planned VBAC"; the scar "gives way" or "opens and causes problems"; "VBAC" or "vaginal birth" without the modifier "successful"; repeat cesarean, not "failed" VBAC; and the odds of intact scar—odds that should be better than 99% with optimal care.

- Avoid inducing labor: in most cases, when benefits are weighed against harms, awaiting spontaneous labor onset is as viable an option as inducing or scheduling a cesarean. When labor induction is truly indicated, await cervical ripening if possible.
- When inducing or augmenting labor, start low and go slow.
- With the possible exception of continuous electronic fetal monitoring, no extra precautions need be taken: consider limiting continuous electronic fetal monitoring to induced or augmented labors and to women with risk factors for scar rupture such as single-layer uterine closure or an incision other than low-transverse.
- Before labor, inform women of the special disadvantages of epidurals in VBAC labors, discuss alternative pain coping techniques, and provide a wide variety of nonpharmacologic alternatives intrapartum.

MINI-REVIEWS

Notes on VBAC research issues: The huge variability among studies makes it difficult to compare studies, synthesize data in a valid or meaningful way, or reach conclusions that can be generalized beyond the population studied. Studies vary in the following respects:

- *Study type.* Designs include straight reports of the experience at a particular institution, retrospective data analyses at single or multiple sites, prospective cohorts at single or multiple sites, and case-control studies.
- *Inclusion and exclusion criteria.* Some VBAC studies allow only women at term with one prior cesarean with a low transverse incision while others may include preterm births, multiple prior cesareans, or women with unknown scar type.
- *How groups are defined.* Most studies and reviews are not confined to true planned VBAC and true ERC, which can affect outcomes. (See essay text box: "Will the Real Elective Repeat Cesarean and Planned VBAC Please Stand Up?")
- *How outcomes are measured.* For example, infection may be endometritis, wound infection, or both. Transfusion may be any transfusion or transfusion of multiple units. Deaths may be reported as neonatal or perinatal and may or may not include deaths unrelated to scar rupture or even planned birth route.
- *Management protocols.* Some protocols permitted induction while others did not. Reasons for induction varied, as did agents and dosages. The use of augmentation also varied, as did augmentation protocols. Management descriptions were not always explicit in describing elements of management like these that could affect outcomes, much less others that would affect the VBAC rate, such as whether preset time limits were imposed or whether women could opt out of VBAC during labor. For example, a study in Washington State reported that maternal request cesarean ended 7% of VBAC labors.[68]
- *Provider practice and philosophy.* These undoubtedly had the greatest influence of all, as can be seen in the variation in percentage of women planning VBAC or undergoing induction and in VBAC rates, yet their effects remain largely invisible or are assumed to be variations in study populations. Case in point: a large U.S. multicenter (12), multiyear (2002-2008) analysis of cesarean surgery reported that one-third of women who had repeat cesareans for poor progress or failed induction had them before 5 cm dilation and over half had them before 6 cm, which could explain the dismal 57% VBAC rate.[104]
- *What, if any, confounding or correlating factors were taken into account during data analysis.* These include induction, use of misoprostol, augmentation, uterine suturing technique in prior cesarean, number of prior cesareans, whether participants have prior vaginal births, and others.

Notes on methodology for this chapter:

- We added additional reasons for exclusion to those listed in chapter 3. We excluded a study if fewer than 100 participants planned vaginal birth. Studies must have defined scar rupture as either producing symptoms or as involving all layers of the uterus, including the peritoneum. Studies that used ICD-9 or ICD-10 diagnostic codes were excluded, as these codes do not discriminate between scar rupture and dehiscence.
- The VBAC literature contains several instances of multiple reports on the same cohort. Care was taken not to double-dip where more than one study reported on the same outcome.
- Whereas our general rule is that differences can be assumed to be statistically significant unless stated otherwise, in this chapter, differences cannot be assumed to be statistically significant in mini-reviews examining factors affecting VBAC and scar rupture rates unless stated as being so. Strictly speaking, absolute differences ought not to be reported unless differences between groups are established as statistically significant, but we make this exception because our purpose is to help clinicians and women make informed decisions by showing agreement or disagreement among studies and the range in magnitude of particular effects.
- We used the AHRQ (2010) systematic review as our primary source for VBAC and scar rupture rates and maternal and perinatal outcomes, but for factors affecting VBAC and scar rupture rates, we used studies cited in the AHRQ review that provided rates (and excluded those that did not) plus others. This is because, with one exception, the AHRQ review only reported odds ratios, and we feel that ranges in rates and absolute differences would be more useful to clinicians and parturient women.

1. Maternal mortality rates favor planned VBAC over planned and elective repeat cesarean.

The AHRQ (2010) systematic review's meta-analysis of 12 studies reporting on 402,883 women with prior cesarean surgery revealed that planned repeat cesarean increased maternal mortality (13.4 per 100,000 vs. 3.8 per 100,000, calculated excess 9.0 per 100,000).[44] Among the four studies limited to term delivery (n = 381,929), the excess remained (9.6 per 100,000 vs. 1.9 per 100,000, calculated excess 7.0 per 100,000). No woman died as a result of scar rupture in a VBAC labor. One of the included studies distinguished true planned VBAC and true ERC. It reported an even larger excess with ERC: 28 per 100,000 (5 in 17,714) with elective repeat cesarean vs. 7 per 100,000 (1 in 15,323), absolute excess 21 per 100,000.[88]

2. Rates of some maternal morbidities (hysterectomy, thromboembolism) appear to favor planned VBAC while other rates appear similar (surgical injury, transfusion), and infection rates may favor planned cesarean; however, most morbidity in planned VBACs occurs in those that end in cesareans.

Notes:

- Misoprostol, now contraindicated for use in VBAC labors,[2] is a potential confounding factor in VBAC studies reporting on maternal morbidity. For example, Blanchette et al. (2001) describes a hysterectomy secondary to scar rupture in a misoprostol-induced labor.[6] The AHRQ (2010) systematic review includes data from several studies analyzing data from the MFMU cohort. One of them, Landon et al. (2004),[60] reports that 52 of the 4708 women who were induced received misoprostol, although no information is given on whether misoprostol was associated with adverse outcomes.
- Since morbidity rates with planned VBAC depend largely on intrapartum cesarean and scar rupture rates, they will vary according to modifiable management factors.
- "Calculated" is the term AHRQ reviewers used to denote risk differences derived from statistical analysis.

According to the AHRQ review, hysterectomy rates probably favor planned VBAC over planned repeat cesarean.[44] Meta-analysis found no difference in three studies (155,763 women) including only women at term (1.4 per 1000 planned VBAC vs. 1.6 per 1000 planned cesarean); however, data were skewed toward nonsignificance by the weight of a study much larger than the other two (128,960 women) that reported an extraordinarily low hysterectomy rate with planned cesarean (0.08 per 1000 vs. 2.0 and 2.8 per 1000 in the other two studies). Among five studies including women at any gestational age (11,947 women), rates were significantly lower with planned VBAC (2.2 per 1000 vs. 4.3 per 1000), which calculated to 2.6 fewer hysterectomies per 1000 planned VBACs. The overall pooled rate among the eight studies was 1.7 per 1000 planned VBAC vs. 2.8 per 1000 planned cesarean, a difference that did not achieve statistical significance. Again, though, results were skewed by the large study. The AHRQ review also describes a study comparing hysterectomy rates with planned VBAC ending in vaginal birth vs. ending in cesarean that reported higher rates with intrapartum cesarean (9.3 per 1000 vs. 4.4 per 1000). Additional evidence that planned cesarean increases the risk of hysterectomy compared with planned VBAC comes from a case-control study of 896 hysterectomies within 30 days after delivery.[8] The study found that confining analysis to the delivery admission will undercount hysterectomies associated with repeat cesarean. Investigators found that 13% of hysterectomies were performed at hospital readmission and that women with repeat cesarean were at increased risk of readmission hysterectomy while women with VBAC were not.

Thromboembolism rates also appear to favor planned VBAC. The AHRQ review cites three studies, reporting outcomes from one: a multicenter study found the lowest rate in women laboring after one cesarean (0.4 per 1000) compared with either planned cesarean or labor or after multiple cesareans (1 per 1000 in both cases).

The AHRQ review reported similar pooled rates of surgical injury between planned VBAC and planned cesarean in the seven studies reporting on this outcome.[44] Injury was more likely during intrapartum than planned cesarean. A cohort study reporting specifically on bladder injury found a statistically significant excess with planned VBAC, but the difference was not clinically significant (0.5 per 1000 vs. 0.4 per 1000). A case-control study likewise reported that among women with bladder injuries, more women (64% vs. 22%) had intrapartum cesareans than planned cesareans. Likelihood of surgical injury rises with increasing numbers of cesareans. (See mini-review 6.)

Pooled transfusion rates were also similar for planned VBAC and planned cesarean (9 vs. 12 per 1000) in the nine studies reporting this outcome;[44] however, studies were heterogeneous with respect to rates (0.5-4.3% planned VBAC vs. 0.1-5.5% planned cesarean) and direction of difference. Among the four term pregnancy studies, pooled rates were consistently higher with planned VBAC (7 vs. 5 per 1000), which calculated to 1.4 more transfusions per 1000 with planned VBAC. As with hysterectomy, the same extremely large trial skewed data by finding much lower transfusion rates in both groups than the other three studies. The five studies of women at any gestational age all reported higher rates in the planned cesarean group. Combined rates were 12 per 1000 with planned VBAC vs. 24 per 1000 for planned cesarean, which calculated to 12.6 fewer transfusions per 1000 with planned VBAC. Two studies reported that planned VBACs ending in vaginal birth had the lowest rate of transfusion followed by planned VBAC ending in cesarean and planned repeat cesarean.

Infection rates may be higher with planned VBAC. The AHRQ review includes six studies reporting on endometritis, two on chorioamnionitis, and three on wound infection.[44] Giving no numbers, reviewers report that rates of endometritis were significantly higher with planned VBAC, that rates varied widely among studies (0.8-30% planned VBAC vs. 1.2-18% planned cesarean), and that rates were highest in a study of women weighing over 300 lb, suggesting a relationship between BMI and infection that is confirmed in other studies. Three studies found that the excess endometritis risk lay in planned VBACs that ended in cesareans. Both studies of chorioamnionitis reported higher rates with planned VBAC, which makes sense because chorioamnionitis in the absence of labor is rare, and none of the three studies of wound infection reported a significant difference between planned VBAC and planned cesarean.

We could find no research that evaluated short- or long-term postpartum outcomes with planned VBAC vs. ERC, such as likelihood of adhesions; duration and severity of pain; or effects on breastfeeding, quality of life, or general health. The AHRQ reviewers, too, note this gap.

3. Scar rupture is more likely to occur in VBAC labors, but planned cesarean is not completely protective, and perinatal mortality and severe morbidity associated with scar rupture are rare.

Notes:

- Misoprostol, now contraindicated for use in VBAC labors,[2] is a potential confounding factor in studies of scar rupture rate. For example, Blanchette et al. (2001) describes three scar ruptures, one resulting in a neonatal death, in misoprostol induced labors.[6] Spong et al. (2007), by far the largest study included in the AHRQ (2010) meta-analyses of scar rupture, does not report on induction technique,[88] while Landon et al. (2004), which uses the same dataset, tells us that 52 women received misoprostol of the 4708 women who were induced.[60] Neither study, however, gives information on whether misoprostol use was associated with scar rupture or adverse perinatal outcomes.
- Morbidity and mortality rates with planned VBAC depend largely on scar rupture rates, and thus vary according to modifiable management factors.
- "Calculated" is the term AHRQ reviewers used to denote risk differences derived from statistical analysis.

Pooling data from four studies (N = 47,202) reporting scar rupture rates in both VBAC labors and planned repeat cesareans, the AHRQ systematic review reported a combined rate of 4.7 per 1000 in VBAC labors vs. 0.3 per 1000 with planned cesarean.[44] Adding four other studies reporting solely on rates with VBAC labors (N = 10,217) did not appreciably alter the rate (4.6 per 1000). This calculated to an excess 5 women per 1000 experiencing scar rupture in VBAC labors compared with planned repeat cesarean. Subsequent to the AHRQ review's close date, a study of scar rupture in 29,008 women with one prior cesarean and no prior vaginal births was published.[29] Similar to the AHRQ review, the overall scar rupture rate was 4.0 per 1000 VBAC labors and 0.2 per 1000 planned repeat cesareans. Induction and oxytocin augmentation in labors with spontaneous onset increased scar rupture rate in VBAC labors. The AHRQ reviewers note as well that labor induction increases scar rupture rates (see mini-review 11), but they do not know what proportion of women were induced. We would add that single-layer suturing at the prior cesarean may increase it too. A case-control study reported a scar rupture rate of 1.5% among the 3276 women laboring after a cesarean,[97] three times the rate reported in the pooled AHRQ review. It is suggestive, although by no means conclusive, that more than 90% of the population had single-layer suturing. Also of note is that planning elective repeat cesarean reduces, but does not eliminate, scar ruptures.

Scar rupture in a VBAC labor, itself uncommon, rarely results in perinatal death (death ≥ 20 w gestation to 28 d postpartum). The AHRQ review calculated a pooled risk of perinatal death (N = 4) of 6.2% secondary to scar rupture in a VBAC labor among six studies of women delivering at any gestational age.[44] This means that in a VBAC population where the scar rupture rate is—as should be achievable—0.46%, the PMR subsequent to

scar rupture with planned VBAC can be calculated as the likelihood of scar rupture (0.46%) multiplied by the PMR associated with scar rupture (6.2%), which equals 0.0003 or 3 deaths per 10,000 planned VBACs. Moreover, one of the four deaths occurred in a woman with a fetal heart rate of 55 bpm at hospital admission after laboring at home, suggesting that the death may have been preventable by earlier admission, and the other five studies provide no details. The AHRQ reviewers did not include perinatal death rates from by far the largest of the eight studies reporting on scar rupture rates because that study did not report this outcome. A different study of the same cohort, however, did: 1 per 10,000 (2 in 17,900 VBAC labors),[60] a rate similar to 3 per 10,000, the *maternal* mortality rate associated with true ERC in that same cohort,[88] whereas the AHRQ review reported no maternal deaths from scar rupture.[44] A case-control study published after the close date of the AHRQ review reported a PMR of 12.2% in the 41 cases of scar rupture; however, investigators used a different definition of scar rupture (separation of the uterine wall accompanied by clinical symptoms), which may have selected for more severe outcomes.[97]

As for hypoxic-ischemic encephalopathy (HIE) (abnormal neurologic symptoms believed to be caused by the consequent damage of insufficient oxygenated blood reaching the brain), the AHRQ review does not report HIE rates associated with scar rupture.[44] Spong et al. (2007), however, does, reporting a rate of 5 per 10,000 (7 in 15,323) associated with scar rupture in VBAC labors.[88] No follow-up data are reported so we do not know what proportion of cases resulted in permanent disability. Long-term outcome depends on severity of injury.[28]

4. It is questionable whether PMR favors planned repeat cesarean over planned VBAC; data conflict on NMR; HIE rates appear to favor planned cesarean; resuscitation rates may also favor planned cesarean; and rates of transient tachypnea are similar.

Notes:

- Because perinatal mortality and morbidity are associated with intrapartum cesarean in general and scar rupture in particular, rates with planned VBAC depend on modifiable factors during the current labor (e.g., induction, oxytocin dose, preset time limits for making progress) and prior cesarean (e.g., layers of uterine closure). In addition, any calculus of the risk of planning VBAC vs. ERC should consider the increasing perinatal risks in subsequent pregnancies incurred by accumulating cesarean surgeries.
- "Calculated" is the term AHRQ reviewers used to denote risk differences derived from statistical analysis.

According to the AHRQ (2010) systematic review, meta-analysis of five studies (76,889 babies) finds that PMR in term, nonanomalous infants favors planned repeat cesarean (0.5 per 1000 vs. 1.3 per 1000, absolute excess 0.8 per 1000).[44] However, weaknesses in the studies and the reviewers' analysis cast doubt on that conclusion. First and foremost, unlike three

and possibly four‡ of the five studies,[73, 84, 86] Spong et al. (2007), the largest of the studies (n = 39,111),[88] reports on antepartum demise as well as intrapartum and neonatal mortality, and the AHRQ reviewers chose to include antepartum deaths in their calculation. Antepartum demise is overrepresented in the planned VBAC group (30/15,319 vs. 15/17,713), as one would expect since few obstetricians would subject women to elective repeat surgery in cases of fetal death. This inclusion roughly triples the PMR in the Spong study compared with the other four: 2.9 per 1000 vs. 0.6-1.3 per 1000. Remove antepartum deaths, and the PMR falls to 0.9 per 1000, a rate within the range of the other four. In addition, the second-largest study (n = 24,529) defined planned VBAC in a way that would include women who began labor but were planning medically indicated repeat cesareans.[86] Perhaps, then, the best data come from Spong et al. (2007) because of its size and because it distinguishes true planned VBAC and ERC.[88] The intrapartum plus neonatal mortality rate with planned VBAC (0.9 per 1000) still exceeds that with ERC in the AHRQ meta-analysis (0.5 per 1000), but the excess is half as great (0.4 per 1000).

The AHRQ review also reports pooled NMR (first 28 d) rates.[44] Among six studies reporting NMR in term, nonanomalous infants, rates again favor planned repeat cesarean (0.5 per 1000 vs. 1.1 per 1000, absolute excess 0.6 per 1000). Rates ranged from 0.8 to 2 per 1000 for presumed planned VBACs and from 0.1 to 0.8 per 1000 with planned repeat cesarean. (Three smaller studies [n = 497, 395, and 175 planned cesareans] reported no deaths in the cesarean group.) This statistic, too, deserves closer examination. To begin with, Spong (2007), which isolates true planned VBAC and ERC, reported identical rates (0.8 per 1000).[88] Furthermore, an analysis published after the AHRQ review's close date reported an excess NMR with ERC.[69] Investigators analyzed U.S. birth certificate data between 1998 and 2002 in 158,586 women with prior cesarean at "no indicated risk" (singleton, > 37 w, vertex, and none of 16 medical risk or 15 labor risk factors indicated on the birth certificate), a subgroup that effectively ensured a comparison of true planned VBAC and ERC. The NMR with planned VBAC was 6.6 per 1000 vs. 7.9 per 1000 with ERC, which, after adjustment for maternal age, race/ethnicity, education, birth weight, gestational age, and birth order, amounted to a 20% increase (OR 1.2) with ERC that just missed achieving statistical significance (CI 0.99 – 1.55).

The AHRQ review includes just one study reporting specifically on HIE with planned VBAC vs. planned cesarean and then only reports that rates with planned VBAC were similar to rates with planned repeat cesarean in women with > 1 prior cesareans.[44] Spong et al. (2007), a study of the same cohort, provides more detail: 0 (0/17,714) among ERCs, 5 per 10,000 (3/6080) among indicated repeat cesareans, and 8 per 10,000 (12/15,323) VBAC labors, of which 7 of the 12 were associated with scar rupture.[88] The HIE rate in VBAC labors might have been reduced with less use of oxytocin—scar rupture rates were 4 per 1000 with spontaneous labor, 9 per 1000 with augmented labor, and 10 per 1000 with induced labor[60]—and possibly less aggressive oxytocin regimens. Moreover, the reasons for indicated cesarean, which also resulted in HIE cases, may have been attributable to prior cesarean surgeries.

Turning to respiratory morbidity, the AHRQ review reported that pooled results of three studies of bag-and-mask ventilation favored planned cesarean over planned VBAC

‡ We say "possibly" because one of the four cited studies is an erratum. It does not report on perinatal mortality.

(5.4% vs. 2.5%, calculated risk difference 2.5%), but rates in pooled results of three studies of transient tachypnea of the newborn were similar (3.6% planned VBAC vs. 4.2% planned cesarean).[44] Neonatal respiratory morbidity rates will be affected by modifiable factors such as intrapartum cesarean rates in VBAC labors, gestational age at time of elective cesarean surgery, and IV fluid volume instilled before and during surgery (see chapter 11).

5. Accumulating cesarean surgeries is associated with a dose-dependent increase in risk of placenta previa, placenta accreta, and the two in combination.

> **Note:** The risk of placental abruption in subsequent pregnancies is increased after the primary cesarean but does not appear to escalate with accumulating cesarean operations.[44]

The AHRQ (2010) systematic review reports results from eight studies looking at rates of placenta previa with increasing number of prior cesareans.[44] The combined rate with one prior cesarean was 0.9% (7 studies), 1.7% with two prior cesareans (4 studies), 2.6% with two or more prior cesareans (3 studies), and 3.0% with three or more prior cesareans (3 studies). The likelihood of hysterectomy secondary to placenta previa also rises with the number of prior cesareans. In the three studies reporting this, rates were 10% with one prior cesarean, 45% with two, 50-67% with three or more, and 50% with four or more. One study reported that the likelihood of major maternal morbidity (one or more: transfusion, hysterectomy, operative injury, coagulopathy, venous thromboembolism, pulmonary edema, death) with placenta previa rose from 15% with no prior cesareans to 83% with three or more prior cesareans. The increase in severe morbidity is probably because the incidence of placenta accreta in combination with previa rises with the number of prior cesarean surgeries. Two studies reported that in women with previa, accreta incidence rose from 11-14% with one prior cesarean surgery to 23-40% with two, to 30% with two or more, to 35-61% with three, to 50-67% with four, to 67% with five or more prior cesareans. The AHRQ review adds that a study not included because case collection occurred before the 1980 cutoff date reported accreta rates in women with previa of 24% with one prior cesarean, 47% with two, 40% with three, and 67% with four.

The AHRQ review also found that the risk of placenta accreta increases with accumulation of cesarean surgeries.[44] Two studies reporting accreta rates according to number of prior cesareans reported rates of 0.3-0.6% with one prior cesarean surgery, 0.6% with two, 1.4% with two or more, 2.1% with three, 2.3% with four, 4.7% with four or more, and 6.7% with five or more. The AHRQ review notes an increased risk of hysterectomy with placenta accreta (OR 43 to 99) but gives no rates and states that additional severe adverse outcomes were reported too inconsistently for meaningful analysis. Two studies not cited by the AHRQ review provide some data on this point. One reported a trend toward increased risk of severe outcome (hysterectomy, transfusion > 4 units, disseminated intravascular coagulopathy, intensive care admission, placenta percreta, maternal death) with increasing number of prior cesareans after taking correlating factors into account (OR 3.3), although statistical significance was not achieved.[39] The other, a study of emergency

peripartum hysterectomy (N = 48), found that the likelihood of requiring a hysterectomy because of accreta was 2 per 1000 with 1 prior cesarean, 3 per 1000 with 2 prior cesareans, 51 per 1000 with 3 prior cesareans, and 91 per 1000 with four or more.[58]

Placenta previa and placenta accreta greatly increase the risk of severe adverse outcomes in both mother and child. (See mini-review 15 in chapter 5.) This means that the risk of maternal and perinatal mortality and severe morbidity in subsequent pregnancies also necessarily rises with repeat surgeries.

6. Accumulating cesarean surgeries is associated with a dose-dependent increased risk of severe adverse outcomes.

Two bodies of research provide evidence of the adverse effects of accumulating cesarean surgeries. The first, explored in the previous mini-review, correlates the increasing risk of abnormal placental attachment with its consequences. The second, reviewed here, correlates incidence of severe maternal and neonatal harms with number of prior cesareans regardless of etiology.

All studies cited in the AHRQ (2010) systematic review reported an increased likelihood of hysterectomy with multiple prior cesareans compared with one.[44] Among studies reporting rates, one study reported a peripartum hysterectomy rate of 7.4 per 1000 with one prior cesarean rising to 10.8 per 1000 with one or more. Another reported that the rate increased from 2 per 1000 with one prior cesarean to 11 per 1000 with two or more, but this did not achieve statistical significance. A third study reported hysterectomy rates of 4.2 per 1000 with one prior cesarean, 9.0 per 1000 with two, 24.1 per 1000 with three, 34.9 per 1000 with four, and 89.9 per 1000 with five or more.

The AHRQ review found increased likelihood of adhesions with increasing numbers of cesareans.[44] One study reported a rate of 26% with one prior cesarean vs. 49% with two or more. Another reported a 46% rate with ≥ 2 prior cesareans. A third, a case-control study comparing women with ≥ 3 prior cesareans to the next cesarean in a woman not in the case group (i.e., she had < 3 prior cesareans), likewise reported greater incidence of adhesions in cases (18% vs. 3%). Reviewers cite a fourth adhesion study in a different section without reporting details: an adhesion rate of 24% with one prior cesarean, 43% with two, and 48% with three or more.[95] Adhesions increase the potential for experiencing operative injury during any future surgeries—not just future cesareans—and bowel obstruction.[44] Adhesions are also associated with chronic pain.[63]

The increase in adhesions explains the rising likelihood of operative injury, especially to the bladder, found in the AHRQ review with accumulating cesarean surgeries.[44] One study reports bladder injury rates of 0.9 per 1000 with one prior cesarean, 2.8 per 1000 with two, 11.7 per 1000 with three, 19.4 per 1000 with four, and 44.9 per 1000 with five or more. Another reports a rate of 16 per 1000 with two or more prior cesareans. Reviewers also report that risk of bowel and ureteral injury rose with increasing numbers of prior cesareans but that overall incidence was < 12 per 1000.

The likelihood of severe bleeding also rises with number of cesareans according to the AHRQ review.[44] One study reported transfusion rates of 1.8% with one prior cesarean, increasing to 2.6% with two, 4.3% with three, 4.6% with four, and 14.6% with five or more. Another found higher rates (7.9% vs. 3.3%) of "excessive blood loss" (> 1000 mL or transfusion of ≥ 2 units) with two or more prior cesareans compared with one prior cesarean.

According to Silver et al. (2006), one of the MFMU analyses, incidences of other adverse maternal outcomes also rise significantly as the number of prior cesareans increases from one to five or more.[85] These include the need for postoperative ventilation (2 per 1000 rising to 11 per 1000), ileus (paralyzed bowel) (5 per 1000 rising to 34 per 1000), and admission to intensive care (6 per 1000 rising to 56 per 1000).

Data suggest that incidence of adverse perinatal outcomes rises with number of cesareans as well. A study compared women having their fourth or greater cesarean (n = 154) with two control groups: women having a second or third cesarean (n = 148) and women having their fourth or greater vaginal birth (n = 132).[80] (Including a vaginal birth control group of the same parity allowed investigators to eliminate parity as a factor.) Compared with women having a fourth or greater vaginal birth, women having a fourth or greater cesarean were more likely to have an infant born < 37 w gestation (16.2% vs. 2.3%), an infant weighing < 2500 g (16.1% vs. 5.3%), an infant with RDS Type II (transient tachypnea of the newborn) (5.3% vs. 0%), and an infant admitted to intensive care (7.1% vs. 0.8%). Infants were also more likely to need ventilation (2.6% vs. 0%), but this did not achieve statistical significance. Rates with a fourth or greater cesarean exceeded those with a second or third cesarean for these same outcomes: preterm birth rate 16.2% vs. 11.5%; LBW rate 16.1% vs. 12.8%; RDS Type II 5.3% vs. 0.7%; need for ventilation 2.6% vs. 0%; and intensive care admission 7.1% vs. 4.1%. Only RDS incidence achieved statistical significance for these comparisons, but the study was likely underpowered to detect differences of these sizes. Of particular interest, investigators state that the "majority" (p. 10) of preterm deliveries were nonelective cesareans, which suggests that the scar accumulation may affect pregnancy duration.

7. Having a VBAC reduces the likelihood of scar rupture in future labors and increases the likelihood of repeat VBAC.

Three studies agreed that having a VBAC reduces the likelihood of scar rupture in subsequent labors. The first (1261 women) reported a rate of 0.6% with one or more prior VBACs vs. 1.9% with no prior VBACs.[47] The second (2204 women) reported a rate of 0.3% with prior VBAC vs. 1.4% with no prior VBAC.[50] The third (13,532 women) reported a 0.5% rate with one prior VBAC compared with 0.8% with no prior VBAC.[70] Absolute decreases varied from 0.3 to 1.7%. The third study also evaluated whether multiple VBAC labors would increase the risk of scar rupture and found that the scar rupture rate with two or more prior VBACs was 0.4%, and there was no upward trend with increasing number of VBACs.

Having a VBAC also increases the likelihood of vaginal birth in future labors. Seven studies reported VBAC rates of 90-97% with prior VBAC[20, 37, 40, 47, 50, 59, 61]: six of the seven reported rates of 70-76% with no prior VBAC,[20, 37, 40, 47, 50, 59] and the seventh reported a 64% rate with no prior VBAC.[61] An eighth study reported VBAC rates of 81% with one prior VBAC and 60% with no prior VBACs.[19]

8. In most cases where care providers deter women from VBAC on grounds of excess risk of scar rupture, at least 95% of women and generally more will have no problem with the scar.

Note: Some of these factors increased the likelihood of being induced compared with women without that factor. This could influence outcomes because some studies were carried out when misoprostol was still used in VBAC labors and because induction in general and induction with PGE2 in particular are associated with higher risk of scar rupture. (See mini-review 11.)

More than one prior cesarean: 0-5.4% range in scar rupture rate, pooled rate 1.4% among 16 studies (5666 women) of planned VBAC after two cesareans;[92] 0 scar ruptures among 89 women planning VBAC after three or more prior cesareans.[17] Authors of the systematic review of 16 studies note that investigators in one of the larger included studies observed that the majority of scar ruptures occurred in women who had been induced or augmented.[92] Review authors also compare outcomes between women planning a third cesarean and women planning VBAC after two cesareans, finding similar rates of hysterectomy, transfusion, and neonatal intensive care admission, and a statistically insignificant excess (9 per 10,000 vs. 1 per 10,000) in perinatal death/asphyxial injury with planned VBAC. Authors of the study of planned VBAC (n = 89) vs. planned cesarean (n = 771) after three or more prior cesareans reported similar rates of a composite of severe maternal morbidity (one or more: scar rupture, bladder or bowel injury, uterine artery laceration) (0% planned VBAC vs. 2.2% planned cesarean).[17] (Information was only available for maternal outcomes.) The authors conclude that while the number of VBAC women was limited, planned cesarean did not reduce severe maternal morbidity.

Prior low vertical uterine incision: The AHRQ (2010) systematic review reports two scar ruptures of low vertical incisions during VBAC labors and one scar defect (study definition did not meet the review criteria for rupture) discovered at planned cesarean delivery among six studies encompassing 336 women, or a total scar defect rate of 1.8%.[44] (Scar defects discovered at repeat surgery are more common than scar ruptures during VBAC labors, which means that some women labor uneventfully with a defect,[33, 38] and ultrasonography 6-9 months after cesarean reveals that most women have scar defects.[71]) Reviewers conclude that while data are limited, they do not suggest significantly increased risk for low-vertical incisions compared with low-transverse incisions.

Prior preterm cesarean: Low vertical incisions may sometimes be done at preterm deliveries because the lower uterine segment has not developed sufficiently to permit a transverse incision. A study of scar rupture rates in 108 VBAC labors in women with a prior cesarean with low transverse incision at < 32 w gestation reported a 1.9% scar rupture rate.[33] A study in 2488 women with prior cesarean at < 37 w reported a 1.0% scar rupture rate.[79] Prior preterm cesarean increased risk compared with prior term cesarean after controlling for confounding variables, but incision type was not a factor.

Single-layer uterine suturing: 0-3.1% range in scar rupture rate.[10, 21, 94] The largest study reported a rate of 3.1% with single-layer closure (15/489) vs. 0.5% with double-layer suturing

(8/1491).[10] Single-layer closure remained a factor after accounting for confounding variables. A case-control study of factors associated with 96 cases of scar rupture during VBAC labor after one prior cesarean vs. 288 similar women with no scar rupture found single-layer suturing to be an independent risk factor after adjusting for birth weight, interdelivery interval, induction with an unfavorable cervix, oxytocin use for induction or augmentation, and gestational age ≥ 41 w.[13] Of note, suture material (chromic catgut vs. Vicryl or Polysorb) was not associated with scar rupture. (We have as yet no data on suture technique, another possible confounding factor.) Investigators point out that a cohort study of 10,000 women undergoing VBAC labor would be required to detect a 50% increase in scar rupture if the baseline scar rupture rate were 1%.§

Single-layer suturing increases other risks as well. The case-control study reported increased likelihood of adverse perinatal outcome with single-layer suturing (< 7.0 pH, 5-minute Apgar < 4, perinatal death) when scar rupture occurred.[13] Also, an analysis of adhesion formation in 127 women at first repeat cesarean reported a strong association (24% vs. 7%, OR 7.0) between bladder adhesion and single-layer suturing (n = 56) but not adhesions at other sites.[7] Investigators theorized that double-layer closure reduces raw surgical surfaces and that traumatized surfaces generate fibrotic tissue.

Management undoubtedly plays a role in scar rupture with single-layer suturing. One study reported an extremely high rate of scar rupture with single- vs. double-layer closure: 8.6% (3/35) vs. 1.3% (12/913).[46] Investigators thought this might be attributable to inducing with misoprostol (we excluded this study for this reason) while another found that despite half the women having single-layer closure, the scar rupture rate even with labor induction was only 0.3%.[67] (For more details on effects of induction and augmentation protocols, see mini-reviews 11 and 13.)

Thin uterine scar: Both a systematic review of scar thickness and rupture prediction (12 studies, 1834 women) and the AHRQ systematic review (3 studies) reject using scar thickness as a predictor because studies do not establish a cut-off with good positive predictive value.[44, 55] A major problem noted by the scar thickness reviewers was that most investigators measured uterine scar defects, but the predictive value of defect for rupture is unknown. Both reviews note that other factors such as uterine closure or previous vaginal birth influence scar rupture rates.[44, 55]

Shorter interpregnancy/interdelivery interval: 1.1-4.8% range in scar rupture rate.[12, 14, 53, 62, 83, 91] The research is difficult to synthesize because studies use different intervals and because some studies use interpregnancy interval and others use interdelivery interval (although a 6-month interpregnancy interval is equivalent to a 15-months term gestation interdelivery interval). Bujold and Gauthier (2010), the study reporting the 4.8% rate, confined itself to term pregnancies in women with one prior cesarean and no prior VBACs.[12] Investigators found that more women with short interdelivery interval had single-layer closure (40% ≤ 18 mo vs. 25% ≥ 24 mo), and while interdelivery interval ≤ 18 months remained a factor after adjustment for other factors, including uterine closure, we do not know the scar rupture rate in women with interval ≤ 18 mo who had double-layer closure. The only other study reporting scar rupture rate with interdelivery interval ≤ 18 months reported half the rate (2.3%) of

§ We included this study despite having fewer than 100 cases because it sheds light on an important issue about which we have little evidence.

Bujold and Gauthier.[83] Of note, Bujold and Gauthier reported no significant difference with interdelivery interval 18-23 months compared with ≥ 24 months. Also of note, a study reported that scar rupture rates did not increase with long interpregnancy interval (≥ 60 months).[91]

Longer pregnancy duration: 1.1-2.7% range in scar rupture rate.[25, 48, 101] One study reported a rate of 1.1% with pregnancy duration ≥ 40 w and 1.5% with pregnancy duration ≥ 41 w.[25] A second study reported an overall rate of 1.3% with pregnancy duration > 40 w, but the excess scar rupture rate resided in the subset who were induced (2.6% induced vs. 1.0% spontaneous labor onset).[101] A third study reported a rate of 2.7% with pregnancy duration ≥ 41 w.[48] Here too, the excess lay in women who were induced, specifically women induced with an unfavorable cervix. Rates were 1.4% with spontaneous onset, 3.9% induction overall, 1.3% induced with favorable cervix, and 5.4% induced with unfavorable cervix. These data suggest that women should not be induced for passing their due date. Induction both increases their risk of scar rupture and decreases likelihood of VBAC. (See also mini-review 12.)

Suspected macrosomia: 0.7-2.8% scar rupture rate with birth weight ≥ 4000 g.[32, 56, 62, 103] No VBAC study looks at scar rupture rates in women suspected of carrying macrosomic babies, which is problematic because many babies suspected to weigh > 4000 g turn out to weigh less.[22, 26] Elkousy et al. (2003) reported a rate of 2.8% but did not adjust for confounding variables such as greater likelihood of labor induction when macrosomia is suspected.[32] Zelop et al. (2001) reported a scar rupture rate of 1.6%,[103] and while investigators performed a multiple logistic regression, they did not adjust for induction, and, moreover, the study encompassed a time period in which VBAC labors were induced with misoprostol. Jastrow et al. (2010) reported a rate of 2.6%.[56] After adjustment for confounding factors, including induction, the odds ratio compared with babies weighing < 3500 g barely achieved statistical significance (CI 1.001 – 6.9). Data in this study too came from a time period in which misoprostol was used for induction. Landon et al. (2006) reported a scar rupture rate of 0.7% and did not find birth weight ≥ 4000 g to be a risk factor for scar rupture.[62]

High BMI women: 0.8% scar rupture rate.[51] The largest of the studies (n = 8051 BMI ≥ 30; 6091 BMI < 30) reported no difference in scar rupture rates between high BMI women and women with BMI < 30 (0.7%). The AHRQ systematic review also includes another study that found no difference by BMI group and a third study that found an excess in high BMI women compared with low BMI women, but the difference was no longer significant after controlling for layers of uterine closure.[44]

Older maternal age: 1.2-1.4% range in scar rupture rate.[81, 89] One study reported a rate of 1.4% with age > 30 that was significantly different from the rate at age < 30 after controlling for confounding variables.[81] The other study reported a rate of 1.2% with age > 35 that did not differ significantly from the rate at < 35.[89]

External cephalic version for breech: Five studies comprising 150 women undergoing external cephalic version report no scar ruptures.[1, 24, 27, 36, 78] This is too few to establish the safety of version for breech, but it suggests that risk is probably not unduly high.

9. Prior vaginal birth increases the likelihood of VBAC and decreases the likelihood of scar rupture.

Two studies reported on scar rupture rates in women who had vaginal birth before the primary cesarean compared with women who had no prior vaginal births. (See also mini-review 7 for prior VBAC.) One study reported a scar rupture rate of 1.3% with a prior spontaneous

vaginal birth compared with 1.6% in women with no prior spontaneous vaginal birth.[47] Investigators suggest that misoprostol use in labor inductions may explain such high rates, a speculation made more likely by nearly half the women being induced. The other study reported a scar rupture rate of 0.5% in women who had vaginal birth before the cesarean vs. 1.4% in women with no prior vaginal birth.[50]

These same two studies plus six others looked at the effect of vaginal birth before the primary cesarean on VBAC rates.[20, 37, 40, 47, 50, 59, 61] All eight reported an increase with prior vaginal birth. VBAC rates with prior vaginal birth before the primary cesarean ranged from 79% to 95% while rates with no prior vaginal birth ranged from 60% to 79%, and absolute increases varied from 9% to 26%.

Two studies examined the effect of any prior vaginal birth (before or after the primary cesarean) on scar rupture rates. One reported a scar rupture rate of 0.4% with prior vaginal birth vs. 1.9% with no prior vaginal birth, a 1.5% difference.[15] The other, a large study of 4021 women, reports extraordinarily low rates of scar rupture in both groups (0.2% with prior vaginal birth vs. 0.3% with no prior vaginal birth).[96]

These same two studies plus four others also compared VBAC rates with any prior vaginal birth with rates in women with no prior vaginal birth.[3, 15, 37, 41, 90, 96] All six reported a marked increase with prior vaginal birth. VBAC rates ranged from 86% to 91% with prior vaginal birth or VBAC, rates with no prior vaginal birth ranged from 67% to 70%, and absolute increases varied from 16% to 23%.

10. In almost all cases where care providers deter women from VBAC on grounds that VBAC is less likely, the majority of women will birth vaginally.

Note: Some of the following factors increased the likelihood of being induced, which could affect outcomes because inducing labor is independently associated with reduced likelihood of VBAC. (See mini-review 12.)

More than one prior cesarean: 45-89% range in VBAC rate, pooled rate 72% among 16 studies (5666 women) planning VBAC after 2 cesareans;[92] 80% among 89 women planning VBAC after ≥ 3 prior cesareans.[17] Even among women with ≥ 3 prior cesareans and no prior vaginal births (n = 42), the VBAC rate was 74%. (It was 91% with prior vaginal birth.) VBAC rates are highly dependent on clinician judgment. Investigators in one study included in the systematic review of 16 studies observed that the VBAC rate increased from 58% to 74% over the 5-year study period.[4]

Prior cesarean was for labor dystocia: 57-72% range in VBAC rate.[40, 41, 47, 61, 82, 87, 90, 98] Two studies reported that compared with women whose prior cesareans were for indications other than dystocia, prior cesarean for dystocia remained a factor in reducing VBAC rates after adjusting for confounding variables.[47, 61] Nonetheless, clinician judgment plays a role. One of the studies noted that women whose prior cesareans were for labor dystocia were given significantly less time in the VBAC labor (11.5 ± 5.8 h) than women whose prior cesarean was for nonreassuring fetal heart rate (13.4 ± 5.7 h) or breech (13.9 ± 5.6 h).[82]

High BMI women: 55-68% range in VBAC rate with BMI ≥ 30 in four studies included in the AHRQ (2010) systematic review in which data that allows this calculation are provided.[44] Three studies reported VBAC rates ranging from 52% to 70% in women with BMI > 40. Surely here, too, the clinician's doubt that a large woman can birth vaginally would affect VBAC rates.

Macrosomic baby: 59-68% range in VBAC rate with birth weight ≥ 4000 g.[19, 47, 56, 61, 103] Three of the studies reported that birth weight remained a factor in reducing VBAC rates after adjusting for confounding variables.[47, 56, 61] Another study reported VBAC rates with birth weight ≥ 4000 g according to whether the woman had had no prior vaginal birth (48%), a vaginal birth prior to the cesarean (70%), a prior VBAC (89%), or both (87%).[32] Among women with no prior vaginal birth, the VBAC rate did not fall below 50% until birth weight exceeded 4249 g. This study too found that increasing birth weight had an independent effect after adjusting for confounding variables. The problem with discouraging VBAC when macrosomia is suspected is two-fold: first, ultrasound predicts macrosomia poorly;[22, 26] second, as we saw before, clinician judgment is a potent, hidden factor. Several studies have shown that women are much more likely to have cesareans when their doctors incorrectly believe the baby to be macrosomic than when the baby actually weighs 4000 g or more, but their doctors didn't suspect it. (See chapter 7 mini-review 5.)

Older women: 75-77% range in VBAC rate with maternal age ≥ 35.[41, 89] A third study reports a 64% rate with age > 30, substantially lower, but the rate in women < 30 was low as well (67%).[19]

Longer pregnancy duration: 63-74% range in VBAC rate with pregnancy duration ≥ 41 w;[19, 25, 40, 41, 48, 61] 65-69% range in VBAC rate with pregnancy duration > 40 w.[25, 101] Two studies reported substantially lower VBAC rates (57-58%) when women were induced,[48, 101] but one of them found that the decrease in VBAC rates was confined to the subgroup induced with an unfavorable cervix.[48] The VBAC rate with induction with a favorable cervix was similar to the rate with spontaneous labor onset. Three studies reported that pregnancy duration remained an independent factor affecting VBAC rates after adjustment for confounding variables.[25, 48, 101]

11. Inducing labor is associated with increased probability of scar rupture, although variation in rates suggests that the effect likely depends on patient selection and induction protocol.

Note: Because misoprostol is contraindicated in VBAC labors, data on scar rupture rates with misoprostol induction were excluded.[2] Landon et al. (2004) reported 52 misoprostol-induced labors among the 4708 induced VBAC labors;[60] however, we judged the proportion to be small enough not to warrant exclusion for this reason.

Scar rupture rates vary according to method of induction. Five studies reported scar rupture rates in women whose inductions involved mechanical ripening (such as with a balloon catheter).[5, 9, 52, 60, 72] Two of the five reported higher rates with mechanical ripening than with induction overall. In one study, the rate with mechanical ripening was 1.6% vs. 1.3% overall,[9] and in the other, the rate was 6.5% vs. 3.8% overall, a statistically significant

difference.[52] The other three studies reported similar rates: 0% inductions with mechanical ripening vs. 0.1% with spontaneous labor onset,[5] 0.9% inductions with mechanical ripening vs. 1.0% inductions overall,[60] and 0.8% inductions with mechanical ripening vs. 0.7% inductions overall.[72]

Ten studies reported scar rupture rates in women whose inductions involved use of PGE2 vs. spontaneous labor onset.[5, 30, 35, 57, 59, 60, 67, 72, 100, 102] Seven reported an increase in scar rupture rates.[30, 35, 57, 59, 60, 72, 102] Rates with spontaneous labor onset ranged from 0.1% to 1.0%, rates with induction ranged from 1.1% to 5.4%, and absolute increases varied from 0.6% to 4.6%. Two of the three exceptions, both reporting no scar ruptures in the PGE2 group, had too few women in that group (55 and 97) to detect a difference.[5, 100] The third reported a rate of 0.3% both in the 310 women whose inductions involved PGE2 and the 1101 women who began labor spontaneously.[67]

Seven studies compared scar rupture rates in inductions involving PGE2 vs. induction not involving PGE2.[30, 57, 59, 60, 72, 93, 102] All seven reported more scar ruptures in inductions involving PGE2. Rates with induction not involving PGE2 ranged from 0.6% to 2.0%, rates with induction involving PGE2 ranged from 1.1% to 10.3%, and absolute increases varied from 0.2% to 9.2%.

Ten studies compared scar rupture rates with labor induction not involving use of PGE2 with rates with spontaneous labor onset.[5, 9, 30, 52, 57, 59, 60, 66, 72, 102] With one exception, scar rupture rates were higher with labor induction. Rates with spontaneous labor onset ranged from 0% to 1.9%, rates with induction ranged from 0.6% to 3.8%, and absolute increases varied from 0.2% to 1.9%. The exception reported no scar ruptures in the PGE2 group vs. a 0.1% (2/1432) rate in the group with spontaneous onset; however, only 55 women were given PGE2, too few to detect a significant difference.[5]

What might explain the association between scar rupture rate and mechanical cervical ripening or use of PGE2? It may be that unfavorable cervix indicates a uterus that is not ready to labor and therefore a uterus that requires more forceful contractions over a longer time period despite cervical ripening. (See also "Longer pregnancy duration" in mini-review 8.) It may also be that PGE2 has a direct effect on scar rupture. PGE2 ripens the cervix by softening connective tissue, a property that could affect the scar as well. Grobman et al. (2007), a study comparing induction outcomes with and without prior vaginal birth in 11,778 women with one prior cesarean, appears at first glance to support the first theory.[43] Investigators found that inducing labor increased scar rupture in women with no prior vaginal birth (1.5% induced vs. 0.8% spontaneous onset) but not in women with prior vaginal birth (0.6% induced vs. 0.4% spontaneous onset). Women with prior vaginal births would be more likely to progress more easily, induced or not. Further analysis, however, contradicts both theories. Among women with no prior vaginal birth (1701 induced, 4431 spontaneous onset), neither unripe cervix nor use of PGE2 (n = 506) increased risk of scar rupture. Still, Grobman (2007) differed from the other five studies of induction with and without PGE2, including Landon et al. (2004), an analysis of more women in the same cohort (926 PGE2, 3555 no PGE2).[60] More women overall in Grobman (2007) had scar rupture when induced *without* PGE2 (1.2%) than *with* it (0.8%), and the same was true for women with no prior vaginal birth (1.0% vs. 1.8%).[43] Grobman (2007) poses two conundrums: Why do results differ, and if neither cervical ripeness nor agent explain the increase in scar rupture rate with induction, what does? Oxytocin dose is the likely candidate. A

retrospective analysis found that scar rupture rate correlated with increasing maximum oxytocin dose.[16] A follow-up case-control study found that the likelihood of scar rupture correlated in dose-dependent fashion with duration at maximum oxytocin dose but not with duration of labor or duration of oxytocin treatment.[18] In summary, it seems likely that the effect of induction on scar rupture depends on the interaction between uterine resistance to effective labor and what measures attending clinicians take to remedy it.

12. Inducing labor is associated with reduced likelihood of VBAC.

Ten studies reported VBAC rates in induced labors vs. labors of spontaneous onset.[30, 32, 40, 41, 43, 47, 59, 67, 72, 90] All reported a decrease in VBAC rate with induction. Rates with induction ranged from 62% to 73%, rates with spontaneous onset ranged from 76% to 84%, and absolute decreases varied from 7% to 14%. One of the six studies found that the difference was not significant after controlling for diabetes, birth weight, and prior cesarean for labor dystocia.[47] However, evidence suggests that despite this finding, induction exerts an independent effect on likelihood of vaginal birth. (See essay section "What Policies and Practices Produce the Best Outcomes in Women Planning VBAC?")

Four studies compared VBAC rates with induction not involving cervical ripening with rates with spontaneous labor onset.[3, 9, 52, 72] Rates ranged from 73% to 79% among the studies regardless of whether labor began spontaneously or was induced. These results support the argument that readiness for labor affects likelihood of VBAC.

That explanation is further supported by five studies that report VBAC rates in induced labors involving cervical ripening (mechanical, such as balloon catheter, or PGE2) with rates with spontaneous labor onset.[5, 9, 35, 52, 72] All five reported major decreases in VBAC rates in induced labors involving ripening. Rates with induction ranged from 46% to 61%, rates with spontaneous onset ranged from 65% to 79%, and absolute decreases varied from 13% to 33%. Notice that the variation in absolute decreases when ripening agents are used is much greater than the variation in the studies reporting on induction overall (7-14%). A sixth study, however, was an exception.[3] It reported a 74% VBAC rate with induction involving PGE2 (n = 54) vs. a 76% rate with spontaneous labor onset (n = 1969).

Prior vaginal birth strongly affects the likelihood of VBAC with induction. Two studies reported that rates with induction were 90% and 83% with prior vaginal birth and 67% and 51% with no prior vaginal birth (absolute increases 23% and 32%).[3, 43]

13. Augmenting labor may increase risk of scar rupture.

Among three studies reporting scar rupture rates with augmentation, rates ranged from 0.9% to 1.9% with augmentation and 0.2-0.8% with spontaneous labor, and absolute increases varied from 0.5-1.7%.[29, 59, 60] As with induction, it is likely that patient selection and augmentation protocol affect risk of scar rupture.

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CHAPTER 7

Induction of Labor: Patience Is a Virtue

"Findings . . . suggest that the [preventive induction] approach to obstetric risk leads to healthier babies and better birth outcomes for mothers."

Medical News Today, June 3, 2008[1]

"Labor inductions should be performed for specific indications and women should be fully informed of the possible risks, including failed induction leading to cesarean delivery."

Glantz 2010, p. 76[70]

As with cesarean surgery, induction of labor holds many attractions for obstetricians and hospitals. These include the ability to practice "daylight obstetrics":

> Scheduling an induction can make everyone's life easier," [Dr. Leveno] said. . . . "I am not capable of constantly doing my best work in the middle of the night."[183]

and economic benefits both to hospitals,[147]

> Although improvements in Intermountain's appropriate elective induction rates [elective induction rate fell from 28% to 2%] saved the citizens of Utah more than $50 million per year through reduced payments, Intermountain's costs fell by only about $41 million. Intermountain thus lost more than $9 million per year in operating margins (p. 1190).[94]

> [Because it shortened labor,] if all 815 patients . . . had received high-dose oxytocin (compared with low dose), a total of $211,900.00 would have been saved (p. 460).[129]

and clinicians: when obstetric call remuneration was changed from individual fee-for-service to group revenue sharing at a Canadian hospital, the rate of elective induction fell by 22%.[20] Inducing labor fits with obstetricians' self-perception of their status:

> It is no longer feasible for individual physicians who have invested 12 years in training at a cost of hundreds of thousands of dollars to dedicate extended periods to observing one normal woman in labor (p. 1697).[121]

and it fits medical-model beliefs that every pregnancy incurs ineradicable and unpredictable fetal risks, beliefs that have led to ever-narrowing definitions of normal and, consequently, an ever-lengthening list of reasons to induce labor. It is not surprising, then, that obstetricians would defend liberal use:

> Patients scheduled for induction start labor with an empty stomach and are psychologically prepared to enter the hospital. Family members can be easily assembled and the entire hospital's resources are readily available.[115]

> Says Charles J. Lockwood, MD [speaking for the American Congress of Obstetricians and Gynecologists (ACOG)], "Over the past ten years a number of excellent clinical trials have suggested that various conditions, which were previously treated by observation, are better managed by the induction of labor."[5]

> If spontaneous labor has not occurred before the upper limit of optimal time of delivery, then preventive labor induction, with cervical ripening if needed, is used to increase the likelihood that labor occurs before the fetus has grown too large for the maternal pelvis and/or before the placenta has grown too old to support the fetus during labor (p. 318).[140]

> Women [with a low Bishop score] traditionally have been viewed as poor candidates for induction of labor. However, . . . without induction, they are highly likely to remain pregnant for the next week, in many cases without significant cervical change, and thus potentially incur the negative outcomes associated with advancing gestational age in addition to those associated with induction of labor with an unfavorable cervix (p. e7).[101]

> Once delivery occurs, the ongoing risk of stillbirth disappears (p. 700).[31]

Obstetricians wanting to induce can always invent a reason, by, as one study euphemistically put it, recording "medical and/or obstetrical indications for the induction" that "were not supported by the medical record" (p. 94),[90] or by, as another dubbed it, "creative coding" (p. 26).[182] One elective induction study found doctors inducing for "postterm" at less than 41 weeks,[55] another for "postdates" as early as 36 weeks of gestation and in which only one-third of women induced for "macrosomia" had babies weighing more than 4000 g.[194] Obstetricians may also

induce for no reason at all, as in "impending" postdates or macrosomia,[89, 162, 184] rationales of which ilk are now elevated to legitimacy as "preventive induction" or "timed delivery."[63, 140] Little wonder, then, that an analysis of 230,000 medical records of U.S. women giving birth from 2002 to 2008 in a consortium of 19 hospitals reported an induction rate of 44% among women planning vaginal birth.[195]

All arguments for maintaining a high induction rate depend on a number of assumptions: that liberal use improves outcomes; that tests accurately measure gestational age, predict birth weight, and identify fetuses who would benefit; and that modern induction methods and protocols have eliminated its main drawbacks: excessive cesarean rates and increased morbidity. This chapter challenges the validity of those assumptions.

ELECTIVE INDUCTION

A Rigged Election: Are Women Asking for Elective Induction?

Many believe that elective induction is a matter of women requesting early delivery with no medical reason and doctors responding to consumer demand. But new research contradicts this belief. Predicated on this explanation, researchers in a large U.S. teaching hospital studied the effect of educating women about the risks, benefits, and evidence-based indications for induction of labor.[164] While this modestly reduced elective induction rates among women who had "elective" inductions (38% of class attendees vs. 50% of those not attending the class), 75% of those induced electively indicated in a postpartum survey that the physician suggested it while only 25% indicated that elective induction was their own idea. Not surprisingly, women whose doctors offered them elective induction were far more likely to choose it regardless of whether they were exposed to the educational intervention.

And therein lies the problem: it turns out many women having "elective" inductions think they are having medically indicated inductions. In a secondary analysis by the same team,[165] macrosomia was the indication for 27% of inductions in their medical records, but 40% of women said that their physician told them they needed to be induced because "my baby was too big." and 20% believed they had an induction because they were "due now or overdue," yet only 6% who had an elective induction were 41 completed weeks of gestation and none were more than 41 3/7 weeks. Most women who indicated they were induced for being "overdue" were still in week 40. The term "elective" implies a free and informed choice in the absence of medical indication, but as with "elective" repeat cesarean, it turns out that this implication is often far from the truth.

Elective Induction: Does Baby Know Best?

Studies of elective induction allow us to determine the benefits versus harms of the procedure itself, because we eliminate conditions that can lead both to induction and increased likelihood of cesarean surgery, the main concern with induction. Numerous observational studies have, with one exception,* consistently reported excess cesareans in women induced electively at term compared with women beginning labor spontaneously after adjustment for such factors as gestational age and birth weight. Nulliparous women roughly double their risk of cesarean with excesses ranging from 3 to 31 more women per 100,[22, 30, 52, 55, 68, 113, 118, 121, 126, 149, 162, 178, 181, 182, 184, 194] with the wide variation largely depending on proportion with an unfavorable cervix, a factor not overcome by cervical ripening agents, and baseline cesarean rates. Some studies find multiparous women to be at excess risk as well.[82, 85, 181]

This makes biological sense. Initiating and continuing effective labor involves a complex cascade of feedback mechanisms that mutually reinforce and limit each other.[29] It is an elegant and delicate interplay of hormones and other substances between the baby, who initiates and regulates the process, and the mother. It involves not just cervical changes but changes in the uterine muscle itself, including proliferation of oxytocin receptors and the formation of gap junctions, which permit propagation of coordinated contractions. One would therefore expect simplistic attempts to overcome the natural timing and unfolding of the process to fail.

How, then, do we make sense of a more recent body of research concluding that elective induction is not only harmless but beneficial? The flagship paper is a 2009 Agency for Healthcare Research and Quality (AHRQ) systematic review headed up by A. B. Caughey,[33] on the record as favoring elective induction.[31, 32, 139] The reviewers dismiss the findings of observational studies, contending that the question is not whether women do better with induced or spontaneous labors in any given week but whether women reaching term are better off with planned induction at a predetermined time. They say this is the relevant question because planned expectant management will end in substantial numbers of women being induced later and having even higher cesarean rates as a result, and cesarean rates rise with gestational age even with spontaneous onset. The reviewers turn to randomized controlled trials (RCTs) of elective induction, mostly between 41 and 42 weeks. The RCTs consistently find higher cesarean rates in the planned expectant management groups as well as more incidence of meconium-stained

* The difference was no longer statistically significant after investigators adjusted for use of cervical ripening agents and oxytocin, but these, of course, are components of inducing labor.[149]

amniotic fluid, although virtually identical rates of meconium aspiration,† the real concern since meconium staining in the absence of other symptoms merely represents normal variability in maturing intestinal tracts. Based on these findings and a decision tree of their devising, they conclude that elective induction at 41 weeks and potentially earlier appears to be a cost-effective means of improving outcomes while reducing cesarean rates.

How can this be? Let us look closer. To begin with, the trials suffer from methodological problems. The Hannah et al. (1992) "postterm" trial, actually an elective induction trial because women were induced after reaching 41 weeks, is by far the largest, making up more than half of all participants in Caughey et al.'s pooled data analyses. It epitomizes the problems found in all the RCTs, and therefore a critique of it will serve generally.[75] Hannah et al. is a mixed-parity trial of 3400 women with no medical or obstetric complications assigned either to planned induction after reaching 41 weeks of gestation or to planned expectant management. Perinatal outcomes were similar, and cesarean rates were lower with planned induction compared with planned expectant management (21% vs. 25%). One major weakness is that failing to stratify for parity masks the effect of induction because multiparous women with no prior cesarean are at low risk of cesarean. Another is that the Hannah trial, as do most of the others, has an extraordinarily high rate of crossover. One-third of the group assigned to induction began labor spontaneously before they could be induced, and one-third assigned to planned expectant management were induced, which, since results are reported according to "intent to treat," diminishes differences between arms. We can gauge the effect because this trial has a secondary analysis that reports cesarean rates according to parity and actual mode of labor onset.[76] With *planned* induction versus *planned* expectant management, 4 *fewer* women per 100 had cesareans with planned induction, but with *actual* induction versus *actual* expectant management, 8 *more* women per 100 had cesareans. Induction increased cesarean rates in nulliparous women (34% vs. 26%), parous women (8% vs. 5%), and in the population overall (26% vs. 20%). Furthermore, when expectant-management women were electively induced (that is, for reasons other than abnormal fetal surveillance test), the cesarean rate was 27%, versus 21% in women in the planned elective induction group.‡ (For more on the masking effect of crossover, see mini-review 3.)

† Wennerholm et al. (2009), a systematic review of trials of induction post 41 weeks, which we use as a source in mini-review 3, reports an excess of meconium aspiration syndrome with planned expectant management.[189] However, while Wennerholm and colleagues include Hannah et al. (1992) in their review,[75] they omit it from the meconium aspiration meta-analysis. Hannah was by far the largest trial, and aspiration rates were identical (95/1698 vs. 96/1700), which explains the difference between the two reviews.

‡ The fact that prostaglandin E2 was used less often in expectant management inductions does not explain the discrepancy. Cesarean rates were identical in expectant-management-group inductions with or without use.

This last datum brings us to a recurring theme in this chapter and book: the hidden effects of medical-model management. Women in Hannah et al.'s planned expectant management group underwent nonstress tests and assessments of amniotic fluid volume two to three times weekly, and both tests have notoriously high false-positive rates. Testing resulted in 17% of them being induced for an abnormal test. Concern would almost certainly be unfounded but would lead to induction without regard for cervical ripeness and resort to cesarean at the least sign of a problem. And, in fact, we find that inducing labor in the planned expectant management group doubled the cesarean rate for fetal distress compared with induced labors in the planned induction group (14% vs. 7%).[76] Even more glaring, 26% of nulliparous women with spontaneous labor onset had cesareans, as did 5% of multiparous women, and more than 20% of labors in both trial arms ended in cesarean despite all participants being healthy women with intact membranes and no prior cesareans who were carrying healthy, full-term, singleton, vertex babies. In other words, they had not one reason at hospital admission that would predict possible need for cesarean surgery. Cesarean rates this high tell us something was terribly wrong with the management of these women, although neither trial investigators nor systematic reviewers take any notice.

Furthermore, even large RCTs are too small to detect differences in rates of rare, severe, adverse effects of induction. Induction is an independent risk factor for severe hemorrhage, disseminated intravascular coagulation, amniotic fluid embolism, umbilical cord prolapse, and cerebral palsy (CP), and all pharmacologic agents have been implicated in uterine rupture in women with unscarred uterus and no predisposing factors. (See mini-review 2.) We have as well case reports from U.S. hospitals of catastrophic outcomes in women with unscarred uteruses associated with no more than 50 mcg doses of misoprostol. (See mini-review 12.) ACOG acknowledges induction's inherent potential for serious harm in its induction guidelines: "Monitoring FHR [fetal heart rate] and uterine contractions is recommended as for any high-risk patient in active labor. . . . [A] physician capable of performing a cesarean delivery should be readily available" (p. 389).[§6] Severe outcomes, however rare, are a crucial consideration when proposing medical intervention in healthy pregnancies.

Studies and trials fail to consider the psychological impact of induction as well. Oxytocin, secreted deep within the brain, is produced in connection with sexual intimacy, birth, breastfeeding, and during times of social intimacy such as sharing a meal. It mediates feelings of connection, caring, pleasure, and relaxation.[29] Unlike endogenously produced oxytocin, exogenously administered oxytocin cannot cross the blood-brain barrier, so it has none of these effects, while at the same time disrupting endogenous secretion. We do not know the harms of depriving women of the benefits of endogenously produced oxytocin, nor do we

§ It is interesting that this requirement, unlike the case with VBAC, does not deter labor inductions.

know the harms of inculcating in a woman the idea that her body is not capable of safely birthing her child on its own timetable.

Preventive Induction: Induce Now and Avoid the Rush

The validity of the theory that inducing at early term will avoid greater risk of cesarean and adverse outcomes as pregnancy advances has been explored via two research pathways. The first is database analyses, which seem to confirm it,[31, 32, 150] but Glantz (2010) points out that comparing outcomes with induction in a given week with outcomes of all other women after that week is invalid.[70] It biases in favor of induction by excluding women who labored spontaneously during that same week. The correct comparison is induction in a given week compared with expectant management of all other women *in or after* that week. Glantz analyzes data on 38,000 women according to the two strategies and finds that induction does not increase likelihood of cesarean after adjustment for parity, risk, and demographic factors using the "after that week" strategy but it does using the "in or after that week" strategy, amounting to 1 to 2 additional cesarean surgeries per 25 inductions. Induction was also associated with higher rates of admission to neonatal intensive care compared with spontaneous labor onset, a difference that persisted until 41 weeks, after which the difference was no longer statistically significant.

The second research strand includes studies of what its proponents term "preventive" induction or Active Management of Risk in Pregnancy at Term (AMOR-IPAT).[138-140] Practitioners of AMOR-IPAT assign women an optimal delivery date based on risk factors, not the presence of actual complications, and induce labor if they do not deliver by that date (although not before 38 completed weeks) in the hopes that this will avert cesarean delivery for the increasing likelihood of "cephalopelvic disproportion" (CPD) and "uteroplacental insufficiency" and improve perinatal outcomes. AMOR-IPAT practitioners establish the ideal date by applying a scoring system that subtracts days from 41 weeks 6 days for the presence of any among a long list of factors.[140] Some factors are at least plausible, such as 6 days for history of chronic hypertension and 7 days for previous baby weighing more than 4000 g; others are less explicable, such as 3 days for elevated alpha-feto protein level, 4 days for first-trimester anemia, and immediate delivery at 38 completed weeks for "increasing or severe depression" or "actual or high risk for domestic abuse."¶ Observational studies of this approach reported reduced cesarean rates and improved outcomes,[138, 140] results replicated in an RCT, a trial in which, estimating from a graph, about 15% of women assigned to AMOR-IPAT were induced before 39 weeks, versus roughly 3% in the control group, and less than 10% in the AMOR-IPAT group made it past their due date.[139]

¶ AMOR-IPAT inventors provide no information on how increased risk translated into a particular number of days or, for the less obvious factors, what evidence supported the association with adverse perinatal outcomes or cesarean delivery with advancing gestational age at term.

As it has the strongest research design, an analysis of this trial will serve for all. Investigators randomly allocated 270 women reaching 37 weeks 4 days who had one or more risk factors for cesarean (age ≥ 35, height ≤ 62 in, BMI ≥ 30 at conception, blood pressure elevation in the first trimester, first-trimester anemia, prior baby weighing ≥ 3850 g) to AMOR-IPAT or standard management. Women in the AMOR-IPAT group then had their optimal due date calculated using the scoring system. Women in the AMOR-IPAT group were more likely to be induced (58% vs. 22%), less likely to have cesareans (10% vs. 15% overall, 19% vs. 26% in nulliparous women), a difference that did not achieve statistical significance, and less likely to have the newborn admitted to intensive care (2% vs. 7%). They also had a higher "uncomplicated vaginal birth" rate (74% vs. 63%), and they had a lower mean "adverse outcome index" score. AMOR-IPAT women were also more likely (although this difference did not achieve statistical significance either) to have a low-birth-weight infant (< 2500 g) (7/136 vs. 2/134).

The potential for bias is, perhaps, the most serious weakness of the trial.[93] The trial was carried out at the institutional home of AMOR-IPAT by avowed AMOR-IPAT enthusiasts who were willing to resurrect long discredited concepts. Write the investigators: "We prefer to use the term 'CPD' rather than 'failure to progress' because CPD implies a multifactorial problem that potentially can be both predicted and prevented" (p. e2).[139] CPD has long since been discarded on grounds that few cases of "baby won't come out" are due to a true misfit between the baby's head and the woman's pelvis, as can be readily proven by the thousands of women who had a cesarean for this reason the first time and went on to birth vaginally a subsequent baby as big or bigger. Nor has research produced evidence supporting increasing risk of "uteroplacental insufficiency," the belief that reaching term in healthy women kicks off a race between a deteriorating placenta and labor onset. Trialists also term babies weighing less than 2500 g merely as "small," not as "low birth weight," deeming the excess in the preventive induction group not to be worrisome because none was admitted to intensive care. Moreover, the trial was not blinded, which opens the door even wider to the influence of bias, and investigators developed two composite outcomes, the "adverse birth outcome index" and "uncomplicated vaginal birth rate," *after* data collection, a practice frowned on in trial methodology because it fits outcomes to data, which amounts to drawing the target after taking the shots.

Flawed research, however, is not the only problem: the theory behind preventive induction is flawed as well. It assumes that high induction and cesarean rates and increased maternal and perinatal adverse outcomes as gestational age advances are an inevitable byproduct of problems of advancing gestational age, and proponents have conducted two database analyses finding exactly this.[32, 38] A much more credible explanation is that conventional obstetric management is to blame.

How do we know this? First, support comes from these analyses themselves. Both studied healthy, low-risk women, yet the cesarean rates in the U.S. national

database analysis were extraordinarily high in nulliparous women (21-23%) for weeks 37 to 40 given that they had no factors that would predispose to need for cesarean, especially considering they were delivering during what preventive induction advocates consider the prime delivery weeks.[38] (The rate was substantially lower during these weeks in the other study, of Northern California Kaiser hospitals, possibly because obstetricians are salaried and work shifts.[32]) More significantly, in both studies, the cesarean rate in nulliparous women remained stable in weeks 37 to 40 but leapt upward from week 40 to 41. In the national study it rose from 23% to 30%, and in the Kaiser study it rose from 15% to 22% and leapt again to 31% from week 41 to 42-or-more. It seems highly unlikely that status changed so radically over a few days in these low-risk, term women. Much more likely is that their care providers' perception and management changed. Second, if the theory behind preventive induction is correct, low induction rates should be associated with higher cesarean rates and worse newborn outcomes, but they are not. Analysis of 10 Level 1 hospitals, i.e. hospitals without neonatal intensive care, which ensured a lower risk population, correlated induction rates in women planning vaginal birth with newborn outcomes.[69] After controlling for a long list of variables potentially affecting newborn outcomes, adjusted induction rates ranged from 11% to 51% and bore no relation to neonatal transfer rates or need for ventilation at birth. Furthermore, studies in physiologic care environments—five planned home birth studies and a sixth study of a rural hospital with no cesarean surgery capability—report induction rates ranging from 2% to 14% and cesarean rates ranging from 4% to 8% with equally good outcomes compared with similar women planning hospital birth.[3, 96, 98, 114, 180, 193] That equally low or lower cesarean rates can be achieved with good outcomes and much lower induction rates demolishes the rationale for "preventive induction," substituting a compelling argument for physiologic care. As with "Active Management of Labor," what is being "actively managed" in "Active Management of Risk in Pregnancy" is not the patient but her care provider's perceptions.

Nevertheless, debunking AMOR-IPAT leaves us with a conundrum: it seems to work. It has achieved remarkably low cesarean rates and lower neonatal intensive care admission rates despite early elective induction. The answer lies in another inherent flaw of RCTs: factors not captured in descriptions of trial methods. Intensive care admission depends on a judgment call, and the difference in newborn intensive care admissions is explained by more admissions for "sepsis: suspect or actual." We are not told the criteria for suspicion of sepsis, and, predictably, more women in the control group (25% vs. 14%) had ruptured membranes at admission. It could simply be that clinicians had a low threshold for admitting babies whose mothers had prelabor membrane rupture. Not reported in any AMOR-IPAT study is that AMOR-IPAT inductions differ in important ways from standard practice. They involve serial induction sometimes over several days, using

multiple techniques to achieve a ripe cervix if necessary, with overnight breaks, and including meals and ambulation.[108] This approach will achieve high success rates and low uterine hyperstimulation rates, but induction is rarely practiced in this manner,[89, 151] nor is it ever likely to be: "Clinicians who are responsible for simultaneous provision of intrapartum and outpatient obstetric care may experience both economic and time pressures to minimize the length of labor. This may be particularly problematic when allowing additional time in labor may help achieve a vaginal delivery" (p. e7).[101] In proof of this, data from a consortium of 19 hospitals found that half of induced nulliparous women had cesareans for failure to progress while still in latent labor (≤ 5 cm dilation).

The sweet voice of reason is unlikely to prevail when preventive induction fits so well with medical-model concepts and has so much to recommend it to obstetricians and hospitals, including the false promise of fewer cesareans. Thanks to Caughey and Nicholson's rehabilitation of elective induction, the notion that the only caveat is to wait until 39 weeks is exploding through the U.S. obstetric community,[6, 25, 39] and even that limitation may be ignored by many obstetricians.[89] Indeed, under the guise of protecting women and babies, preventive induction opens the floodgates for the bad actors who engage in "Pit to distress."[39, 97] We hope it will prove otherwise, but we fear it will be "après Nicholson and Caughey, le déluge."

PROPHYLACTIC INDUCTION

The three most frequent reasons given for induction are impending postdates (i.e., before 42 completed weeks), predicted macrosomia, and prelabor rupture of membranes (PROM) at term. In all three cases healthy women are carrying a healthy fetus, which demands a strong justification for imposing an invasive medical procedure with considerable potential for harm. Do these indications meet that standard?

Impending Postdates: "She's Late, She's Late for a Very Important Date"

Postdates induction no longer means induction for unusually long pregnancy. The intent is preventing fetal demise by preemptively inducing at an ever earlier gestational age. In the 1990s, 41 weeks became the new 42 weeks, and in the 2000s researchers have proposed routinely inducing even earlier.[50, 169] One proponent even likened ongoing term pregnancy to playing Russian roulette.[80] The validity of this strategy depends on the answers to the questions "How does perinatal mortality relate to gestational age at term?" and "What are the harms of preemptive labor induction?"

How Long Is Normal Pregnancy?

The 40-week due date was set by fiat in the early 1800s by a German obstetrics professor who declared that pregnancy lasted 10 lunar months (10 months of 4 weeks each) from the beginning of the last menstrual period, hence the eponymous Naegele's rule.[14] Two modern-day studies of pregnancy duration with reliable dates found that the true median length (half of births before, half after) is longer and varies by parity, falling at 284 days in nulliparous women and 282-283 days in parous women.[17, 170] A third study also found that after adjustment for other factors, nulliparous women beginning labor spontaneously averaged pregnancy durations three days longer than similar multiparous women.[132] One of the studies establishes that a 41 week (287 d) definition of "postterm" is not physiologic. Investigators found that, depending on age and parity, at least 25% of women had not given birth by 41 completed weeks (287 d), whereas by 42 weeks only 10% remained undelivered.[17] Ten percent is a defensible definition for postterm; 25% or more is not, and there is more: by curtailing pregnancy, induction confounds duration. The same study found a dip in gestational length in pregnancies ending in December, which investigators attributed to elective inductions before the Christmas holidays,[17] and an analysis of U.S. data between 1989 and 1998 found that large increases in the percentages of induced labors at all periods of gestation over the decade had shifted the distribution curve of pregnancy duration to the left.[120] None of these studies establishes the length of normal pregnancy in healthy women because the inclusion of preterm births and complicated pregnancies also pulls the distribution curve to the left.[132] The only study we have on pregnancy duration in uncomplicated pregnancy at term reports a median of 288 d in nulliparous women and 283 d in parous women, longer than the other two studies but still within their possible ranges.[131]

The conventional method for determining the relationship between gestational age at term and perinatal mortality is to look at the probability of fetal death per week (number of fetal deaths at a given age divided by the number of live births plus fetal deaths at the same age). An analysis of U.S. births in 2005 reported a rate of 1.4 per 1000 in weeks 37 to 39, a dip to 0.9 in weeks 40 and week 41, and a rise to 1.7 at or after week 42,[119] a pattern that does not support induction before 42 weeks. However, some argue that this is wrong because the real issue is the point at which the rising cumulative stillbirth rate (antepartum plus intrapartum mortality rate divided by the number of ongoing pregnancies) intersects the falling

neonatal mortality rate in singleton pregnancies with nonanomalous fetuses. Accordingly, proponents of this strategy analyzed 650,000 Swedish pregnancies and 700,000 pregnancies in Scotland over a similar time period.[50, 169] (The U.S. analysis also presented cumulative stillbirth data.[119]) (See table.) The Swedish analysts concluded that 283 days (40 w 3 d) constituted a "functional" definition of prolonged pregnancy because, on this day, the cumulative stillbirth rate consistently became significantly greater than the neonatal mortality rate (≤ 28 d after live birth) with delivery on any particular day, which would mean inducing about half the population. (See text box "How Long Is Normal Pregnancy?") The Scottish investigators, noting that the neonatal death rate fell from 1.3 per 1000 to 0.6 per 1000 between week 37 and 38 and remained stable thereafter, concluded that delivery at 38 weeks was associated with the lowest risk of perinatal death.

TABLE. Cumulative antepartum plus intrapartum stillbirth rate at term (per 1000 ongoing pregnancies)

Country (years)	37 w	38 w	39 w	40 w	41 w	42 w
Scotland (1985-1996)	0.04	0.08	1.3	2.2	3.4	5.3
Sweden (1987-1996)	0.03	0.3	0.7	1.24	2.08	4.36
United States (2005)*	0.30	0.38	0.40	0.50	0.58	0.70

* The U.S. rate is estimated from a graph.

These attempts to calculate an optimal delivery date suffer from several hidden assumptions. Chief among them is that all women are at similar risk, when manifestly they are not. The U.S. analysis found that the risk of fetal death varied according to race, marital status, and extremes of maternal age, characteristics that may be markers for other factors such as poverty, substandard care, or prior cesarean (see chapters 5 and 6). A study of 627,000 singleton Missouri pregnancies lasting 20 weeks or more also found that, in addition to race and age, antepartum stillbirth was associated with high parity, smoking in pregnancy, fewer than 8 years' education, maternal underweight, chronic medical conditions (hypertension, insulin-dependent diabetes, renal disease), preeclampsia, placental abruption, and small for gestational age (SGA).[66] The authors noted that data were not available on other risk factors likely to affect stillbirth rates such as drug use, genetic factors, metabolic disorders, and psychosocial conditions, nor did they consider prior cesarean as a factor. Second, it is assumed that rates apply across populations, but the table shows that this is not the case. Variation may reflect differences in population characteristics, changes in care between the two time periods, or a combination of these factors. It may even reflect differing accuracies in the databases. But regardless, rates from one time or place cannot be extrapolated to another. A third

assumption is that all deaths can be prevented by preemptive delivery, but they cannot. Finally, proponents of preemptive induction assume no harm in inducing labor, which we have seen is not the case.

On theoretical grounds, then, preemptive induction doesn't make sense. As one critic wrote, "Women are induced before 42 weeks in order to 'prevent' them from becoming postdate. In other words, they are subjected to a risky medical intervention in order to prevent them from reaching a point in pregnancy—a point that is still low-risk, and one that they are unlikely to reach anyway. . . . It's as if I were to push you down the stairs in order to prevent you from falling down the stairs" (p. 26).[79] Actual studies, however, appear to support it. A recent systematic review of RCTs of planned induction before 42 weeks reported fewer perinatal deaths (0 vs. 5) and a slight reduction in cesarean rates (20% vs. 22%). (See mini-review 3 for details.)

This would seem to settle the dispute, but as with the systematic review of elective induction, appearances are deceiving. First, among the five perinatal deaths in the planned expectant management group, not one was documented as an antenatal demise occurring in a healthy woman before 42 completed weeks. (See mini-review 3 for details.) Second, as we saw earlier, reporting cesarean rates in mixed-parity populations masks the effect of induction on nulliparous women. Multiparous women are also less likely to be induced because they tend to have shorter gestations (see text box "How Long Is Normal Pregnancy?"), and, for the same reason, they are less likely to be induced with an unfavorable cervix. Furthermore, as obstetricians shorten the allowable duration of pregnancy, cesarean rates will increase as more women—nulliparous and parous alike—are induced before they are ready to labor. (See mini-review 1.) As we also have seen in the Hannah "postterm" trial, crossover has a powerful confounding effect. (See mini-review 3 for details.) Validating these arguments, a study found that a policy change from induction at 41 weeks 3 days to induction at 42 weeks reduced the cesarean rate from 33% to 24% in nulliparous women.[102]

If the intent of postdates induction is to reduce perinatal mortality, then the consequences of preventable cesarean surgeries must be taken into account because they can be dire *and include excess perinatal deaths* in both current and subsequent pregnancies. (See chapter 5.) We also should consider that factors associated with antepartum demise, such as abnormalities of placental attachment, chronic medical problems, smoking, maternal underweight, and racial disparities, can be ameliorated without imposing risks by social support, preventive care, improved management, closer monitoring of high-risk women, and reducing use of cesarean surgery. Wouldn't it be better to take that approach and, absent a good reason to do otherwise, let nature take its course?

Suspected Macrosomia: Ignorance Is Bliss

Inducing labor for suspected big baby is a prime example of medical-model management's failure. Inducing labor is supposed to reduce cesarean sections, shoulder

dystocias, and delivery injuries, but systematic reviews report higher cesarean and similar shoulder dystocia rates with induction. (See mini-review 4.) Even ACOG's clinical guidelines (2000) state, "Current evidence . . . does not support a policy of early induction of labor in term patients with suspected macrosomia" (p. 6).[4] Nevertheless, a survey of 1600 U.S. women giving birth in 2005 reported that 17% agreed to medical induction because of "caregiver concern about size of baby."[48]

Several strands of evidence support that the cesarean rate for dystocia in labors with larger babies has largely to do with subjective judgment. (See mini-review 5 for details.) Cesarean rates vary enormously in both the induced and expectant management arms in the trials and observational studies of management of suspected macrosomia, which tells us something is going on besides a relationship between rising fetal size and ability to birth vaginally. Providers with major differences in induction rates for suspected macrosomia have similar cesarean rates, which further suggests a provider effect. Every study evaluating the effect of suspicion of macrosomia on cesarean rates has found that, when obstetricians believe the baby is going to weigh more than 4000 g but are mistaken, women are much more likely to have a cesarean than if the baby actually weighs 4000 g or more but doctors do not suspect it. One study found that obstetricians did not need to think the baby would be macrosomic, just bigger than average. Another found that women in the predicted macrosomia group were much more likely to have a cesarean for labor dystocia before 4 cm dilation, whether induced or not. In other words, doctors gave up without giving women a real chance at vaginal birth. With medical-model management, a woman's best chance of healthy vaginal birth of a large baby is for her doctor not to suspect it.

The research also hints at better ways to reduce shoulder dystocia and delivery injuries than liberal use of induction and cesarean delivery. A study of midwifery care found that women giving birth supine or in the lithotomy position were five times as likely to have a shoulder dystocia than women giving birth side-lying.[141] Another study compares a case series of 82 cases of shoulder dystocia treated primarily with the all-fours maneuver with seven other series of 11-59 cases using other techniques.[28] Only one infant was injured (fractured humerus) and one had a 5-minute Apgar score of 6. No infant died, but deaths occurred in every one of the other series. With a big baby, physiologic care—patience, positioning, letting nature take its course—produces the best outcomes with the fewest cesareans.

Prelabor Rupture of Membranes at Term (PROM): Ideology Trumps Science

Writes Mayri Sagady Leslie (2009), "The release of ACOG Practice Bulletin No. 80, Premature Rupture of Membranes, in April 2007 should be marked as a red letter day in the downfall of evidence-based maternity care in the United States."[156] The version it replaced, she continues, gave obstetricians the option of inducing or awaiting spontaneous labor for 24 to 72 hours. The new version recommends inducing

labor as soon as possible. New evidence may justify a change in recommendation, but in this case opposing recommendations have been made *citing the exact same study*, the 1996 TermPROM trial, as their source. Sagady Leslie enumerates some of the problems with TermPROM trial, including that women in the trial who had group B streptococcus (GBS) rarely had antibiotic prophylaxis, which they would today, and that women had digital vaginal exams and the number of digital exams correlates with infection. Sagady Leslie laments that ACOG's guidelines powerfully influence care, and in this case, will mislead physicians wanting to practice according to the evidence into thinking we have new evidence when, in fact, we do not.

Sagady Leslie's critique is not the half of it. The primary reason to induce labor after term PROM is to avoid neonatal infection, which ACOG's 2007 guidelines duly note in the introductory section as a risk associated with term PROM.[7] ACOG also states that intrauterine infection is the most significant maternal risk. The actual recommendation, however, reads, "Labor should be induced at the time of presentation . . . to reduce the risk of chorioamnionitis" (p. 1014). What happened to neonatal infection and endometritis? In point of fact, the TermPROM trial did not find an increase in neonatal infection rates, and it did not report uterine infection rates, only chorioamnionitis rates, which may be diagnosed solely by intrapartum fever.[77] Chorioamnionitis is presumed to be of infectious origin, but epidurals, too, can cause intrapartum fever. Clinicians reading the new guidelines can be forgiven for thinking early induction will reduce neonatal and uterine infections. ACOG, which gave them this impression, cannot.

If these criticisms were not enough, ACOG also fails to reference a Cochrane systematic review published the year before that includes the TermPROM trial along with 11 other trials.[45] Systematic reviews of RCTs rank higher than any single RCT in the evidence hierarchy, although here this distinction makes little difference, as the TermPROM trial makes up three-quarters of the participants. Still, ACOG should have used the review as its source. The Cochrane review reported similar neonatal infection rates (as well as all other neonatal morbidity rates) with expectant management. (See mini-review 6 for details.) Finding a difference in neonatal infection rates would be even less likely today now that women have routine testing and treatment for GBS. Chorioamnionitis and endometritis rates were increased by a few percent, but this difference could be reduced, and probably eliminated, by modifying labor care. On the other hand, early induction did not increase cesarean rates regardless of parity, cervical ripeness, or induction agent. Taken together, these two findings support early induction, but not compellingly so, especially considering that, as the reviewers point out in their introduction, 79% of women with term PROM will begin labor within 12 hours and 95% within 24 hours. The Cochrane reviewers conclude: "Since planned and expectant management may not be very different, women need to have appropriate information to make informed choices" (p. 2). In other words, ACOG got it right the first time.

The Problem of GBS

First, the facts:[34] GBS is an intestinal organism that can migrate to the vagina. Roughly 10-30% of U.S. women are colonized. Among all colonized women, 1-2% of newborns will develop early-onset (< 1 w after birth) disease if women are not treated, and in babies born at term, 2-3% of cases end in death. This calculates to a range in mortality of 2 to 6 per 10,000 in babies born to untreated colonized women. About one-quarter of all infections occur in preterm babies, however,[71] which means the likelihood of colonization leading to disease in term infants is lower, making the calculated death rate in term infants of untreated colonized mothers likely higher than it really is. In women without risk factors (< 37 w, membrane rupture > 12 h, intrapartum fever > 99.5 degrees F), the incidence of early-onset newborn disease was 0.5%, which reduces the risk of death to 1 to 2 per 10,000. Other factors such as whether a woman is lightly or heavily colonized with the bacteria also moderate the likelihood of her newborn contracting disease.[71] In addition, screening and treatment do not affect the rate of late-onset (> 1 w) disease nor completely prevent early-onset disease.[34] Furthermore, none of the analyses that generated these statistics controlled for practices that can introduce the organism into the cervix and uterus, i.e. membrane stripping, mechanical or pharmacologic cervical ripening, amniotomy, digital vaginal exams, internal monitoring, or a combination of these. Internal fetal monitoring and multiple vaginal exams are associated with GBS infection, and some of the other factors are under suspicion.[34]

Current recommendations mandate a "one size fits all" approach: screen all women at 35-37 weeks gestation and administer intravenous antibiotic during labor to all women with positive vaginal or rectal cultures.[34] One problem is that this approach does not consider individual risk of contracting disease. This would not matter if antibiotics were harmless, but they are not. Antibiotic therapy increases the risk of yeast infection in mother, newborn, or both,[142] which can play merry hell with breastfeeding. Breastfeeding failure deprives mother and child of an important contribution to their health and wellbeing. Anaphylactic shock has occurred,[34, 142] and antibiotic treatment may increase the risk of newborn exposure to antibiotic-resistant enterobacterial infections,[142] a particular worry in preterm infants. Finally, antibiotic-resistant strains of GBS are beginning to emerge, although they do not yet affect ability to treat disease.[34, 142] A more discriminating approach would delay this eventuality.

A second concern is the complacent belief that universal screening and antibiotic treatment have solved the problem. This leads to ignoring

other measures that might prove equally effective and have no downside. Would fewer women have vaginal colonization if care providers advised women to wipe from front to back after using the toilet and avoid vaginal penetration after anal intercourse? What would infection rates be in colonized women whose care providers refrained from procedures that inoculate the cervix and provide entry into the uterus, procedures research shows lack benefits with frequent or routine use and sometimes with any use at all? We do not know and never will. Intrapartum antibiotic therapy works, which makes it unethical to conduct a trial in which colonized women were not treated. We wonder, though, if antibiotics had existed in Semmelweis's time, would doctors today be washing their hands?

ANTENATAL TESTS: THE EMPEROR HAS NO CLOTHES

Antenatal testing uses ultrasonography to determine due date, estimate fetal size, and evaluate fetal wellbeing. It is assumed that usage is safe, although, in fact, studies establishing safety of imaging were almost all of one or two abdominal ultrasounds in the second or third trimester.[176] We do not know if the results of those studies can be extrapolated to multiple sonograms; to first-trimester sonograms, which expose the entire, rapidly growing embryo; to vaginal ultrasound, in which there is much less tissue to absorb energy between the transducer and the embryo or fetal brain; or to the use of newer equipment, which, because of increasing acoustic output, may increase exposure almost eight-fold.[176] Nor is attention paid to the potential psychological impact of vaginal ultrasound, which may be experienced as "rape with a foreign object," especially by women with a history of sexual abuse or assault. If antenatal testing improves outcomes, concern should focus on ensuring exposure according to the ALARA principle (As Low As Reasonably Achievable to obtain the necessary diagnostic information) and to ensuring that women make an informed choice of vaginal versus abdominal technique. But does antenatal testing improve outcomes?

Establishing a Due Date

According to a systematic review, ultrasound dating has a modest effect (1 fewer induction per 100 women) on induction for postdates,[190] but given the shift to liberal use of induction, we do not know what effects would be were those trials to be repeated. As for reliability, a narrative review states that agreement between crown-rump length and gestational age in the first trimester in women with reliable dates varied by 3 to 5 days, depending on when the scan was done.[49] In the second trimester, before 20 weeks, the biparietal diameter is accurate within plus or minus 7 days. Head circumference may be more accurate, although studies disagree on

that point, and multiple measurements improve accuracy. Home pregnancy tests are not mentioned anywhere that we could find, although for many women this unequivocally establishes when pregnancy began. Clearly, ultrasound dating can help in women with uncertain dates, but arguments for routine application seem unpersuasive. Quite reasonably, ACOG's 2009 Practice Bulletin advises that dates based on the last menstrual period should not be altered unless the discrepancy from sonographic measurement exceeds 7 days in the first trimester and 10 days in the second trimester (up to 20 weeks) according to the mean of multiple measurements.[8] We would add that since accuracy decreases with increasing gestational age, dates based on measurements made earlier should not be changed by measurements made later. Unfortunately, as the numerous anecdotes of "musical due dates" make clear, these principles are all too often ignored.

Fetal Weight Estimates

The theoretical benefit of knowing that the baby is macrosomic is so that management can minimize adverse outcomes, although, as we have seen, it does not. Even if it did, a systematic review of studies estimating fetal weight (51 using formulas, 12 using fetal abdominal circumference) reported only modest to moderate ability using either strategy to rule macrosomia in or out.[40] The authors conclude: "The poor accuracy of ultrasound suggests that relying on ultrasound findings can lead to . . . an increase in interventions unnecessarily . . . when macrosomia is incorrectly ruled in by ultrasound scanning. . . . Over-reliance on them to guide practice should be avoided" (p. 1465).

Tests of Fetal Wellbeing

The point of fetal surveillance testing is to prevent antenatal demise. Tests of fetal wellbeing are based on two principles: (1) the fetal heart rate (FHR) in a compromised fetus will fail to accelerate in response to movement or will decelerate in response to contractions (nonstress test, contraction stress test),[73] and (2) inadequate oxygenation secondary to uteroplacental insufficiency will result in fetal redistribution of blood flow, which reduces renal perfusion, thereby causing oligohydramnios (low amniotic fluid volume) (amniotic fluid index (AFI), deepest pool/pocket).[27] The question is, how effective are tests based on these theories?

Shocking as it may seem considering the ubiquity of surveillance testing, we do not know. The only way to tell whether a test improves perinatal outcomes is to conduct RCTs in which clinicians have or do not have results. Otherwise, we cannot determine whether intervening for a positive test helps: When the baby is fine at birth, did early delivery avert bad outcomes, or were the identified fetuses merely false positives? And when the baby is not fine, does this mean intervention averted stillbirth in a compromised fetus, or did induction and liberal use of cesarean delivery overwhelm a baby who would have been OK had doctors not intervened? *We have almost no relevant trials!*

A systematic review of antenatal cardiotocography identified only four trials (1636 at-risk women) in which clinicians had or did not have test results.[73] Meta-analysis of perinatal mortality reported similar (2.3% vs. 1.1%) rates with all four reporting *more* deaths in the cardiotocography group overall and in fetuses free of lethal congenital anomalies (1.7% vs. 0.6%). The meta-analyses were underpowered to detect a difference, but, if anything, results favored no cardiotocography.

We could find only one observational study of routine amniotic fluid volume estimation (1584 women) in which results were concealed.[135] Investigators found that amniotic fluid index < 5, the usual diagnostic threshold for oligohydramnios, was significantly associated with cesarean for fetal distress and cord arterial pH < 7.0, but sensitivity (test correctly identifies affected individuals) was too low (29%) to make the AFI a useful test for discriminating women at risk, and with a 41% induction rate, some true positives may have resulted from the excess stress of induction. We also have a trial randomly assigning 883 unselected women at 26 or more weeks' gestation to AFI or not at hospital admission in early labor.[37] The AFI group was more likely to have oxytocin, use of which was associated with diagnosis of oligohydramnios, and twice as many screened women had cesareans for fetal distress (6.5% vs. 3.2%) with no improvement in neonatal outcomes. The authors speculate that clinicians probably saw nonreassuring FHR in combination with known oligohydramnios as more ominous.

We have trials and systematic reviews of trials comparing one form of testing with another that report similar outcomes,[112] but does finding no difference mean tests are equally beneficial or equally useless? An indication comes from a systematic review of the two techniques for estimating amniotic fluid volume.[136] More women having the AFI (22%) were diagnosed with oligohydramnios than women having measurement of the single deepest pocket (9%) and more were induced (14% vs. 7.5%), but no differences were found for any neonatal outcome. Women were worse off with the AFI, but might they be even better off with no amniotic fluid volume estimate, especially in light of typical management? A 2009 survey of members of the U.S. Society for Maternal-Fetal Medicine found that in cases of oligohydramnios with no other complications, only 20% of respondents would let a pregnancy continue beyond 40 weeks regardless of cervical favorability despite insufficient evidence supporting induction for isolated oligohydramnios and despite only one-third of them believing induction would be beneficial.[158]

We would argue, though, that ideally designed trials would still fail to show benefits because of inherent problems with the tests. Numerous variables unrelated to fetal wellbeing can cause false positives and false negatives. These include for cardiotocography:

- fetus is asleep[57]
- gestational age[57]
- intra- and interobserver variability in interpreting tracings[36, 57]

and for amniotic fluid volume:

- transducer pressure on the abdomen[112]
- intruding loops of umbilical cord or limbs[51]
- estimating a volume from a two-dimensional image[51, 158]
- maternal hydration[36, 87]
- gestational age[36]
- interobserver variability in taking measurements.[36]

Doubtless the skill and experience of the operator matter, too.

Recognizing these problems, enterprising clinicians have tried combining and adding tests in the hopes of improving predictive value, which led to the biophysical profile. The biophysical profile combines a nonstress test with amniotic fluid volume estimation and adds ultrasound visualization of fetal breathing movements, gross body movements, and muscle flexion and extension on the theory that a compromised fetus will conserve energy by ceasing these activities.[112] The modified biophysical profile evolved from this, consisting of a nonstress test plus amniotic fluid volume estimation, which is less time-consuming to perform and can be followed up with the complete assessment when indicated.[112]

This solution is equally problematic, at least in healthy women. As the editors of *Guide to Effective Care* (2000) put it, "When used in a low-risk population, the predictive power of any test is low, and the benefits from adequately responding to the few true positive tests can be more than counterbalanced by the harm done in response to the inevitable high proportion of false-positive tests" (p. 85).[57] Moreover, for some true positives, such as with congenital anomalies of the urinary tract or heart or when an anoxic or central nervous system injury has already occurred, delivery will make no difference. Furthermore, no testing schema will avert deaths from sudden events such as cord accident or placental abruption.

Still, in a low-risk woman, a negative test virtually rules out fetal problems. Surely that reassurance is worth something? Not really, because merely knowing the woman is healthy effectively provides the same degree of reassurance. Mohide and Enkin (1992) explain it this way: Let us assume a test with 70% sensitivity (test correctly identifies affected individuals) for fetal death and 98% specificity (test correctly identifies unaffected individuals), both rates falling in the range reported for antenatal FHR tests. In a woman with a probability of antenatal demise of 0.5%, her likelihood of having a live birth is 99.5%.[134] A negative test increases that reassurance level by a mere 0.4%. Meanwhile, 85% of positive tests will be false positives, which inevitably means unnecessary inductions and cesarean surgeries.

Routine Fetal Movement Counts: The Exception to the Rule or More of the Same?

The authors of a systematic review of RCTs of fetal movement counting observe that the results of the largest of the four trials, a trial of routine counting in an unselected population of 68,654 women, suggest that fetal movement counting may reduce late antenatal stillbirth.[124] The trial used a cluster randomization technique, which allocates by groups, not individuals. Trialists compared formal counting with "normal" care, which for some care providers included fetal movement counting. Reviewers speculate that conducting the trial may have led to heightened awareness of the potential value of movement counting in control groups and that this may explain failure to find benefit. In support of this, they point out that the rate of late fetal deaths was much lower in control groups during than before the trial and that control groups paired between rather than within hospitals and groups where control consultants chose not to inform control participants of the trial showed a trend toward reduced rates of unexplained late fetal deaths. The reviewers go on to note that when fetal movements were formally counted, more babies with subsequent unexplained fetal deaths were alive at hospital admittance and more were admitted for reduced or absent fetal movements, but this did not translate into fewer deaths because of falsely reassuring follow-up testing and clinical error.

Is fetal movement counting "more of the same" or an asset? The trial did not report cesarean or induction rates, so we do not know whether, as with other tests, false positives translate into more intervention without improving outcomes. Certainly, a policy of delivering all fetuses testing positive instead of conducting follow-up tests would do so. Given the inherent low predictive value of positive tests, our bet is on "more of the same."

In summary, what we have are imprecise measurements of variable characteristics affected by factors bearing no relationship to fetal condition and where poor outcome may not be preventable, in addition to which the association between the test and plausible surrogate measures in the pathway to clinical outcomes is weak, and the treatment can cause the very problems it is intended to prevent. Fetal surveillance testing might have some value in high-risk women, for whom positive predictive values would be higher, but this is by no means certain; in unselected populations or in healthy women, it has none.

INDUCTION AND CERVICAL RIPENING: THE METHOD IN THE MADNESS

Induction Agents

Generic Names	Trade Names
oxytocin	Pitocin, Syntocinon
dinoprostone, prostaglandin E2 (PGE2)	Cervidil, Prepidil, Prostin E2
misoprostol, prostaglandin E1	Cytotec

In the beginning, there were oxytocin and amniotomy. However, these often fail when the cervix is not ready for labor, which led to a proliferation of techniques (balloon catheters, hydrophilic dilators, membrane stripping), agents (PGE2, misoprostol), and nonconventional measures (herbs, homeopathic remedies, sexual intercourse, castor oil, enema, nipple stimulation, acupuncture) intended to prepare the cervix for labor, some of which also can initiate labor. All except herbs and enema have been studied in RCTs.

Triggering Labor Onset: Unconventional Strategies and Membrane Stripping/Sweeping

Unconventional strategies and stripping/sweeping membranes are intended to bring on spontaneous labor safely with the goal of increasing vaginal births. (Because trials are too small, too problematic, or both to determine their safety and effectiveness we will not evaluate homeopathic remedies,[166] sexual intercourse,[104, 172-174] or castor oil.[105])

Breast stimulation triggers labor onset, but some believe breast stimulation to be unduly risky. This reputation arose from an Indian trial in 57 women assigned to breast stimulation, oxytocin infusion, or no treatment in which three deaths occurred in the breast stimulation arm and a fourth in the oxytocin arm[43] The study included high-risk women and two of the three babies in the breast stimulation arm who died had anomalies. Clearly, the results of this trial cannot be generalized, although the precautionary principle would dictate limiting breast stimulation to healthy women with healthy fetuses. (See mini-review 7.)

Acupuncture trials disagree on whether it brings on labor. Trials in which control-group women received sham acupuncture failed to find differences between groups whereas trials of acupuncture versus usual care report less use of other induction methods. The absence of differences in sham-controlled trials suggests that the placebo effect may explain differences reported in other trials. Since acupuncture appears to be safe, a placebo effect should be no deterrent to its use. (See mini-review 8.)

Stripping/sweeping membranes reduces the number of women reaching 41 or 42 completed weeks of pregnancy and, therefore, labor inductions. Arguing

against membrane stripping, the research suggests a possible association with PROM. (See mini-review 9.)

None of these strategies reduces cesarean surgeries. This means their only benefit is to artificially truncate pregnancy, thereby averting induction, a still riskier intervention, which is justified far less often than it is used. A simpler solution that avoids the risks of all these interventions is simply to await spontaneous labor onset and reserve induction for cases with compelling medical indication. One exception might be to preserve out-of-hospital birth for women approaching the threshold of eligibility. Even here, the concern would be far less acute in an integrated system where women were assured of retaining their chosen care provider and giving birth in an institution supportive of physiologic care.

Inducing Labor: General Considerations

Before we look at formal labor induction strategies, we must first take issue with something that has muddied the waters ever since a group of Cochrane reviewers in the 1990s chose to make "vaginal delivery within 24 hours" a primary outcome, apparently on grounds that shorter labors were preferable.[10] Much has been made since of which agents work faster in Cochrane and non-Cochrane reviews alike. One would think that slower, gentler labors would be less stressful for the fetus—as has been said, "An accelerated labor is as safe as a streamlined parachute," (p. 366)[175]—and, in fact, systematic reviews confirm that this is so. Faster induction to delivery intervals are associated with more uterine hyperstimulation in conjunction with abnormal FHR (hyperstimulation syndrome), while cesarean rates overall—the clinically important outcome—are similar.[10, 42] We think the only pertinent questions are, "Which induction technique is safest and most effective?" and secondarily, "Which are cost-effective?"

Determining safety and effectiveness will not be easy. The research is difficult to interpret: trials differ in population characteristics, outcome definitions, agents being compared, induction protocols, dosage regimens, and labor management. Moreover, the point of cervical ripening and induction agents is to achieve vaginal birth rates comparable to those with spontaneous onset, but "effective" almost always means in comparison with other agents. Nevertheless, with this caveat in mind, we may still draw some overall conclusions.

Cervical Ripening: Balloon Catheter

Mechanical methods (balloon catheters, hydrophilic dilators) are intended to ripen the cervix as a precursor to formal labor induction with oxytocin, amniotomy, or both, thereby reducing the excess cesarean rate associated with inducing labor with an unfavorable cervix. (We confine ourselves to balloon (Foley) catheters because hydrophilic dilators are associated with higher rates of infectious symptoms and are rarely used as a result.[83]) Balloon catheters, PGE2, and misoprostol

result in similar cesarean rates while balloon catheters reduce risk of excessive uterine activity (abnormally frequent or long contractions with or without abnormal FHR)—especially compared with misoprostol—and postpartum hemorrhage > 1000 mL, making balloon catheter the strategy of choice. Studies disagree on whether women have a small increased risk of infectious symptoms with balloon catheter, but rates may be affected by labor management practices such as amniotomy, vaginal exams with ruptured membranes, internal monitoring, and GBS prophylaxis. (See mini-review 10.) Balloon catheters have the additional advantage of costing much less than PGE2.

Inducing Labor: Oxytocin and Amniotomy

Oxytocin and amniotomy, whether alone or in conjunction, are meant to induce labor, not prepare for induction. We exclude amniotomy because of its serious drawbacks: unlike all other methods of cervical ripening and induction, rupturing membranes commits to delivery, opens a pathway for ascending infection, increases risk of umbilical cord prolapse (see mini-review 2), and permits cord compression. No advantages could offset these overwhelming disadvantages, although, in fact, amniotomy appears not to confer any benefits.[26]

Pitocin Label Excerpt[107]

Administration: The initial dose should be 0.5-1 mU/min . . . . At 30-60 minute intervals the dose should be gradually increased in increments of 1-2 mU/min . . . . [I]nfusion rates up to 6 mU/min give the same oxytocin levels that are found in spontaneous labor. . . . [R]ates exceeding 9-10 mU/min are rarely required. *Overdosage:* Hyperstimulation with strong (hypertonic) or prolonged (tetanic) contractions or a resting tone of 15 to 20 mm H_2O or more between contractions can lead to tumultuous labor, uterine rupture, cervical and vaginal lacerations, postpartum hemorrhage, uteroplacental hypoperfusion, and variable deceleration of fetal heart, fetal hypoxia, hypercapnia, perinatal hepatic necrosis or death.

Oxytocin, the oldest of the labor induction drugs, should not be taken lightly—indeed, its risks have earned it a place on the short list of "high-alert medications"[91]—but the main problem is nonphysiologic dosing protocols, protocols predating the technology to understand how oxytocin is metabolized. High-dose regimens increase uterine hyperstimulation without decreasing cesarean rates compared with a physiologic regimen. (See text box "Pitocin Label Excerpt," mini-review 11, and chapter 9.) Flooding oxytocin receptors also triggers down regulation of oxytocin receptors as a protective response, inhibiting uterine muscle response,

weakening contractions, and increasing the risk of postpartum hemorrhage.[123] Because oxytocin is an antidiuretic, high-dose regimens (> 20 mU/min) also increase risk of maternal and neonatal hyponatremia (low blood sodium) even when administered in solutions containing electrolytes.[143] Hyponatremia can cause fluid in the lungs and, in extreme cases, water intoxication, seizure, and coma.

The decades-old use of nonphysiologic oxytocin regimens, however, has resulted in what Clark et al. (2009) call "normalization of deviance" (p. e3).[39] This, they explain, is practice based on what has always been done contrary to what the research evidence and understanding of physiology support, a cavalier attitude seemingly justified by the rarity of adverse outcomes thanks to the resilience of most fetuses.** Indeed, ACOG's 2009 induction guidelines state, "Any of the low- *or high-dose* oxytocin regimens outlined in Table 2 are appropriate for labor induction" (emphasis ours) (p. 392), and even the low-dose regimen allows for a dosing interval much shorter (15 minutes) than the time to reach full effect.[6]

Reforming practice will not be easy, as witnessed by nurses who "often feel pressured [by doctors] to 'push the Pit' and believe that safe care is often sacrificed on the basis of the demands of a particular provider, productivity, and cost effectiveness" (p. 259),[123] and by doctors who think this "suboptimal response" to the "dilemma" of time management and sleep deprivation "inevitable" (p. e3).[39] (See also chapter 9.) With a naturally ripe cervix, a physiologic protocol, and a patient care provider, however, oxytocin administration can be safe and effective, and unlike other pharmacologic agents it has the overwhelming advantage of a short metabolic half-life (10-12 minutes).[123] Should oxytocin hyperstimulate the uterus, the uterus will relax and contractions diminish within minutes of turning the infusion rate down or off.

Agents That Do Both: Prostaglandins

Prostaglandins E2 and misoprostol blur the line between cervical ripening and inducing labor because they do both. The obstetric community's love affair with misoprostol mystifies us, especially given its aversion to anything that increases liability. Misoprostol offers no clinical advantages over other agents and strategies but increases harms. Systematic reviews report an increase in uterine hyperstimulation syndrome compared with other agents, which may be causally related to its vaunted virtue of shorter labors. Misoprostol is dangerous in women with prior cesareans and possibly women with severe hypertension, and there may be other subgroups at special risk as yet unidentified. Case reports and series document

** Clark and colleagues advocate for evidence-based oxytocin protocols, but they are far from proponents of physiologic care. They recommend resorting to cesarean surgery with inadequate progress after an undefined "appropriate" (p. e5) time with adequate contractions because "given the safety of cesarean delivery today, any increase in neonatal morbidity cannot be justified by attempts to achieve an arbitrary rate of cesarean delivery," and continue, "To quote Dr Roger Freeman, 'Every woman deserves an easy vaginal delivery or an easy cesarean delivery'" (p. e4).

catastrophic outcomes in women with unscarred uteruses at doses deemed safe by ACOG, and doubtless there are more cases and many more near misses not recorded in the literature. (See mini-review 12.)

An ulcer medication, misoprostol's propensity to provoke uterine contractions and extreme low cost—pennies per dose—led to increasing off-label use in the 1990s as an induction agent despite its "black box" designation (that is, its use being contraindicated in pregnancy).[64] In 2000, reports of uterine rupture led to consultations between Searle, its manufacturer,[64] and the FDA, culminating in Searle's repudiating obstetric use in a letter to physicians warning that

> serious adverse events reported following off-label use of Cytotec in pregnant women include maternal or fetal death; uterine hyperstimulation, rupture or perforation requiring uterine surgical repair, hysterectomy or salpingo-oophorectomy; amniotic fluid embolism; severe vaginal bleeding, retained placenta, shock, fetal bradycardia, and pelvic pain.[159]

Far from deterred, hundreds of obstetricians wrote letters to ACOG, incensed that Searle's letter might restrict their access to the drug.[74] ACOG sprang into action on their behalf. They issued a membership newsletter stating that "off-label use of misoprostol, based on sound scientific evidence is justified" and affirming that "misoprostol is a safe and effective drug for cervical ripening and induction of labor when used appropriately" (p. 60).[74] They placed a narrative review and accompanying editorial in the *New England Journal of Medicine*.[72, 74] The editorial attacked Searle, claiming that "the real victims are pregnant women who receive treatment in hospitals that will not allow the use of misoprostol" (p. 59). Citing the review, the editorial further claimed that "more than 200 studies involving more than 16,000 women" had shown misoprostol to be "one of the most important medications in obstetrical practice" (p. 59), although, in fact, only 14 of their review's studies were about induction of labor, the rest being of other reproductive uses, and that "alternative medications are . . . relatively ineffective" (p.59), although the review reported similar cesarean rates compared with PGE2 and more uterine hyperstimulation syndrome. A Cochrane systematic review cited in misoprostol's defense actually said this:[86] "The increase in uterine hyperstimulation with fetal heart rate changes found in this review is a matter for concern. Although no differences in perinatal outcome were shown, the studies were not sufficiently large to exclude the possibility of uncommon serious adverse effects. . . . [Misoprostol] cannot be recommended for routine use at this stage" (p. 2). So much for "sound scientific evidence" supporting misoprostol for cervical ripening and labor induction.

By 2002, ACOG's lobbying had convinced the FDA to remove the black box labeling, not on grounds that further research had established misoprostol's safety,

but because "the drug has a recognized use by obstetricians and gynecologists . . . to induce labor,"[59] a rationale amounting to "all the kids are doing it." The FDA has never rescinded misoprostol's package insert warnings, however. (See text box "FDA (2009) Package Insert: Cytotec.")

FDA (2009) Package Insert: Cytotec[58]

A major adverse effect of the obstetrical use of Cytotec [misoprostol] is hyperstimulation of the uterus which may progress to uterine tetany with marked impairment of uteroplacental blood flow, uterine rupture (requiring surgical repair, hysterectomy, and/or salpingo-oophorectomy), or amniotic fluid embolism. Pelvic pain, retained placenta, severe genital bleeding, shock, fetal bradycardia, and fetal and maternal death have been reported.

ACOG continues to maintain that misoprostol is safe "when used appropriately" (p. 387),[6] although as case reports and series document, even "appropriate" use can result in catastrophe (see mini-review 12), and the research finds other options to be less problematic, equally effective, and cost effective. Why, then, are obstetricians so enamored of misoprostol? The answer is summed up by this enthusiast in Ob. Gyn. News (2004): "The best part about it is that you can block-schedule your nurses so that you have enough on hand. . . . [I]f we start our inductions at 7 a.m., we know that we're going to have X number of patients in labor being admitted by 4 p.m. That's helped our hospital tremendously, . . . [Cytotec is] a great agent. It works very, very efficiently. . . . And it's ungodly inexpensive: 27 cents per tablet."[95] In other words, misoprostol's real benefits are convenience for obstetricians and helping the hospital's bottom line. We do not find this justification over other, safer, equally effective options compelling, and if women were informed of this rationale—as is their right—we think they would agree.

Note: As we go to press, interest is shifting from vaginal to oral misoprostol administration on grounds that the oral route does away with misoprostol's objectionable characteristics.[88] True, dissolving the tablet permits accurate dosing, and uterine hyperstimulation syndrome rates are lower, but we have no reason to think that it will reduce cesarean rates compared with other agents and every reason to think that hyperstimulation syndrome rates will exceed those with balloon catheter. (See mini-review 12.)

Misoprostol's pharmacologic competitor, PGE2, can be administered intracervically or vaginally, but the Cochrane review of intracervical PGE2, which includes comparisons with vaginal administration, concludes that vaginal administration is the preferred route.[21] No method of vaginal administration (gel, tablet, suppository, pessary) or dosing strategy (single, multiple, sustained release) was superior to another. Cesarean and hyperstimulation syndrome rates were similar, although sustained release administration showed a trend toward higher hyperstimulation syndrome rates. Hyperstimulation syndrome rates were increased with higher doses, and lower doses did not result in higher cesarean rates, which would make lower doses preferable. PGE2 has the drawbacks of high cost and need for refrigeration and offers no advantages over balloon catheter followed by oxytocin. (See mini-reviews 10 and 13.)

General Considerations, Reprise

The cognitive dissonance in the discourse on cervical ripening and induction methods takes the breath away. Clinicians subject women to early and frequent ultrasounds in an effort to stave off a tiny proportion of inductions, then cajole a substantial number of healthy women into inductions anyway. They use cervical ripening techniques with known harms in an attempt to make induction safer, ignoring the elephant in the room: the colossal failure of cervical ripening. Success at ripening the cervix has given rise to the belief that the problem of inducing with an unfavorable cervix has been conquered. It has not, and millions of women have the cesarean scars to show for that error. And while it is true that with a ripe cervix or PROM cesarean rates may be similar, as with any medical intervention, the possibility of harm remains. Absent a compelling reason to do otherwise, the best policy remains letting nature take its course.

STRATEGIES FOR OPTIMAL CARE

When macrosomia is suspected:

- Refrain from induction (and elective cesarean).
- Avoid an epidural: women may be less able to push effectively and will find it difficult to assume positions that might facilitate descent and avert shoulder dystocia, although they can with assistance.
- Request women to give birth side-lying or on all fours:[28, 141] alternatively, advise them that they may be asked to assume a hands-and-knees position after the head emerges if the shoulders hang up.
- Have patience.

When caring for healthy women at term:

- Abandon fetal surveillance testing in otherwise healthy women: the high false-positive rate leads to unnecessary inductions and therefore increased risk of cesarean surgery.

- Refrain from elective induction prior to 42 completed weeks.
- With a favorable cervix at 42 weeks, recommend induction: only a small percentage of women will reach 42 completed weeks, which minimizes exposure to induction, and while still low, rates of fetal demise begin to rise.
- With unfavorable cervix in multiparous women with no prior cesareans, discuss induction versus continued waiting, as the excess risk of cesarean is small.
- With unfavorable cervix in nulliparous women, recommend awaiting cervical ripening, as the excess risk of cesarean is considerable.

When women experience term PROM:

- Refrain from digital vaginal exams until active labor is established and from internal monitoring.
- Wait 18 hours before inducing labor: this will maximize the chance of spontaneous labor onset, thus avoiding complications associated with induction, while minimizing excess chance of infection. (We reasoned as follows: a secondary analysis of TermPROM trial data reported that infection rates with 24 or more hours to onset of labor were 4% versus the background 2% rate.[160] The TermPROM trial reported that median time to *active* labor was 16-17 hours.[77] Combining these data, by 18 hours, half the population will have achieved active labor, and, if induced, the remaining half are likely to have started labor by the 24 hour cut point.) It is also likely that waiting longer would be feasible with a policy of no vaginal exams or internal monitoring.
- Refrain from early induction in group B positive women: this will minimize the likelihood of birth before the full prophylaxis regimen can be administered.
- Avoid cervical ripening agents: meta-analysis reports no difference in cesarean rates between induction with oxytocin versus induction including PGE2,[45] although this finding may depend on lag time allowed in the trials.

When induction is necessary:

- If possible, wait for cervical ripening.
- With a favorable cervix, proceed directly to oxytocin: cervical ripening agents are not needed and introduce unnecessary risk.
- Do not use vaginal misoprostol: other methods produce similar cesarean rates at reasonable cost with less likelihood of adverse effects.
- With an unfavorable cervix, ripen with a balloon catheter followed by a gentle, slow oxytocin induction with a fall-back to PGE2 or possibly low-dose oral misoprostol if catheter insertion fails.
- Use an evidence-based oxytocin dosing interval and dose.

- Conduct a leisurely, serial induction with meticulous attention to achieving cervical ripeness and maintaining maternal wellbeing.[108]
- Refrain from rupturing membranes.
- Turn off the oxytocin drip once in active labor: in most cases, labor will continue to progress without it, and it may reduce the likelihood of cesarean.[44, 67, 177]
- Refrain from vaginal exams if membranes are ruptured.
- Have patience: Induced labors may take longer especially in nulliparous women and in women requiring cervical ripening,[19, 152, 163, 178] but longer labors do not result in worse maternal or neonatal outcomes.[85, 163]

MINI-REVIEWS

Notes:

- We limit our review to induction in healthy women at term.
- Variations in dosage, administration route, and other elements of care unlikely even to be documented, as well as unrecorded variations in trials in populations and individuals within populations, will affect outcomes, making it difficult to synthesize data, come to general conclusions, or apply them to individual cases.
- We confined ourselves to outcomes clinically relevant to safety and effectiveness, rejecting surrogate measures such as vaginal delivery rates within 24 hours, need for augmentation, uterine hyperactivity without accompanying FHR changes, or meconium staining.
- Where feasible, we have confined ourselves to RCTs and meta-analyses of RCTs.
- Assume differences are statistically significant unless otherwise noted.

1. Inducing with an unfavorable cervix increases the likelihood of cesarean surgery in both nulliparous and parous women regardless of the use of ripening agents. In nulliparous women, five observational studies compared cesarean rates among women induced with a ripe cervix and women having spontaneous labor onset with either women induced after cervical ripening for an unfavorable cervix (Bishop score < 5 or 6),[53, 149, 178] or women with an unripe cervix where the ripening was not specified.[113, 121] Intra-study rates differed little or not at all between women induced with a ripe cervix and women with spontaneous onset, but major differences were reported between women induced with a ripe cervix and women starting with an unripe cervix or who received cervical ripening treatment: 8% vs. 25%,[53] 6% vs. 21%,[113] 26% vs. 50%,[121] 10% vs. 21%,[149] and 17% vs. 41%.[178]

The picture was more mixed in four studies of elective induction comparing rates in these same groupings in multiparous women with no prior cesareans.[15, 82, 121, 149] As with nulliparous women, cesarean rates in women induced with a ripe cervix were similar to those with spontaneous onset, but while three of the studies reported an excess with unripe

cervix or use of ripening treatment, the fourth did not.[121] In addition, cesarean rate differences tended to be smaller than in nulliparous women: 6% induction with unripe cervix vs. 5% with a ripening agent vs. 1% with spontaneous onset in one study,[82] and 10% induction with cervical ripening vs. 1% with no ripening in another.[149] The third study did not report cesarean percentages but reported an odds ratio of 1.3 for induction with a ripe cervix vs. spontaneous onset and 1.9 for induced with ripening vs. spontaneous onset.[15]

Similarly, an "intent to treat" case-control study compared outcomes in 102 nulliparous women with unfavorable cervix (Bishop score < 5) at 39 w undergoing elective induction between 39 and 41 w with 102 similar women with planned expectant management, of whom 35% were induced.[144] More women electively induced had cesareans (43% vs. 34%). The difference was not statistically significant, but the study was underpowered to detect an increase of this magnitude.

Two studies evaluating the results of introducing an institutional labor induction policy that included no elective induction with unfavorable cervix reported dramatic decreases in cesarean rates in electively induced nulliparous women. One, using Bishop score < 8 as the criterion, reported a fall from 36-14%;[60] the other, using Bishop score < 6, from 27-18%.[151]

2. Inducing labor increases excess risk of life-threatening complications and severe outcomes.

Although rarely, every induction agent—oxytocin,[99, 130, 148, 171, 186] PGE2,[99, 13, 117, 130] and misoprostol (see mini-review 12)—has been implicated in uterine rupture in women with unscarred uterus and no predisposing factors.

Two database analyses reported on severe hemorrhage and one on idiopathic disseminated intravascular coagulation (DIC). An Australian analysis determined risk factors associated with severe postpartum hemorrhage (one or more: > 1000 mL blood loss within first 24 h, transfusion, symptoms of hemodynamic instability) at vaginal birth after 20 w in 714 cases.[122] After controlling for correlating factors, women having induced labors were more likely (OR 1.5) to experience severe hemorrhage compared with spontaneous onset (3.1% vs. 1.5%). A Norwegian analysis evaluated the impact of labor onset (and delivery mode) on severe postpartum hemorrhage (> 1500 mL blood loss within first 24 h or transfusion, which rarely was done in women with hemoglobin ≥ 7 gm/dL).[9] Rates were higher with induction compared with spontaneous onset regardless of delivery mode in primiparous women: spontaneous birth (1.4% vs. 0.8%), instrumental vaginal birth (3.3% vs. 1.4%), intrapartum cesarean (3.2% vs. 2.7%); and in multiparous women with no prior cesarean: spontaneous birth (0.8% vs. 0.6%), instrumental vaginal birth (1.5% vs. 1.3%), intrapartum cesarean (4.4% vs. 3.6%). Rates overall were 1.8% with induced labors vs. 0.8% in women with spontaneous onset (adjusted OR 1.8). A third study matched 40 confirmed cases of unexplained DIC with 197 control women.[46] Among cases, 13 (33%) ended in hysterectomies and 3 (7.5%) were amniotic fluid embolism diagnoses. Forty-three percent of cases began labor spontaneously vs. 83% of control women, and more induced women had DIC (6.1 per 10,000 vs. 0.7 per 10,000). PGE2 use was more common in cases (38% vs. 12%, adjusted OR 6.7) as was oxytocin (20% vs. 6%, adjusted OR 8.4). No association was found with the indication for induction or with labor length, which suggests that induction itself was the culprit. (See also mini-review 4 in chapter 16.)

Three large database analyses conducted in the U.S., U.K., and Canada reported on risk factors associated with amniotic fluid embolism (AFE) after accounting for confounding factors.[2, 109, 110] All found an association with labor induction, although in one study the increase lost statistical significance after adjustment.[2] Maternal mortality rates ranged from 13% to 22% and the stillbirth plus neonatal mortality rate was 14% in the sole study reporting this outcome.[109]

Undoubtedly because induction usually involves rupture of membranes, database analyses,[100, 120] a chart review,[24] and a case-control study[153] all found an increased likelihood of umbilical cord prolapse with labor induction. The largest of the studies, an analysis of U.S. national data, reported that 39% of term deliveries with cord prolapse were induced labors (OR 1.6) as were 47% of postterm deliveries with cord prolapse (OR 1.5).

The sole study we could find that investigated the relationship between induction and CP reported a positive association with CP overall that did not maintain statistical significance after adjustment; however, the association with one type of CP did.[56] Investigators compared 241 Norwegian children with CP with 176,350 control children. After adjustment for maternal disease, birth weight, SGA, term or preterm PROM, and gestational age, children born at term who developed bilateral spastic CP were more likely (OR 3.7) to have been induced.

3. Trials of induction before 42 w have weaknesses that cast doubt on the conclusion that induction results in fewer perinatal deaths and similar cesarean rates.

> **Note:** We choose to use Wennerholm et al. (2009) as our primary source because it is a contemporary systematic review, and it makes some of the same exclusions we would, i.e., trials available in abstract only, trials published in an era when available technology differed (in this case, before 1980), and trials published in languages other than English.[189]

Wennerholm et al. (2009) included nine RCTs of induction before 42 w (5920 women).[189] The perinatal mortality rate in the planned induction group was 0 among 2968 women vs. 5 among 2952 women (1.7 per 1000) allocated to planned expectant management, a difference that did not achieve statistical significance, but was underpowered to do so. Cesarean rates were 19.8% in the induction group vs. 21.7% among controls (RR 0.87), but the absolute difference was small (1.9%) and lost statistical significance when Hannah et al. (1992), weighted at 56% of the meta-analysis, was removed. We were able to obtain seven of the nine trials. The two unavailable trials were small (22 and 74 participants), and no fetus or newborn died.

Among the five perinatal deaths, one intrapartum death resulted from a true knot in the cord and thus probably also would have occurred in an induced labor;[81] one occurred after 43 w and therefore was not relevant to induction before 42 w;[54] one was possibly post 42 w, as it is described as occurring 5 d after a normal fetal surveillance test in a trial enrolling women at 41 w and testing every 3 d;[75] and one occurred in a trial that gave no information on circumstances of death but included women with pre-eclampsia.[65] This leaves us

with as few as 1 to as many as 3 deaths associated with planned expectant management until 42 w in healthy women, not 5, or a perinatal mortality rate of 0.3-1 per 1000.

As for cesarean rates, percentages of parous women ranged from 27% to 67%, which would mask the effect of induction on nulliparous women because parous women are less likely to have cesareans when induced (unless they have prior cesareans). A follow-up study by Hannah et al. (1992) reported that 34% of induced nulliparous women had cesareans compared with 8% of induced parous women.[76] (The trial excluded planned VBACs.) The only other trial reporting cesarean rates according to parity reported rates of 20% in nulliparous women allocated to induction vs. 2% of parous women.[54] Moreover, the tendency to shorter gestational length in parous women (see text box "How Long Is Normal Pregnancy?") means proportionally more nulliparous women will be induced and will be induced with unripe cervixes, which further increases their risk of cesarean. (See mini-review 1.)

However, crossover between groups (women assigned to induction who began labor spontaneously and vice versa) is the major confounder. In four of the obtainable trials, women allocated to induction were induced immediately[35, 54, 65] and in one within 24 h,[137] but the other three trials reported rates of women beginning labor before induction ranging from 18% to 34%,[12, 75, 81] including Hannah, by far the biggest of the trials, which reported the 34% rate. One trial provided no information on the percentage of women allocated to expectant management who were induced,[35] but among the other six, the rate was low (11%) in one trial[65] and ranged from 21% to 34% in the rest, with Hannah again having the highest rate.[12, 54, 75, 81, 137] The effect of crossover is profound. Hannah et al. (1992) reported cesarean rates of 25% in the planned expectant management arm vs. 21% in the planned induction arm, but among women actually induced the cesarean rate was 26% vs. 18% in women who began labor spontaneously.[76]

Other studies further elucidate the effect of crossover. In one, investigators at an institution that recorded planned management for women reaching 41 w separated 1367 low-risk nulliparous women who had reached 41 w 0 d according to planned expectant management (n = 645) or planned induction (n = 722).[146] They then constructed a proxy group for planned expectant management by combining women with planned expectant management (some of whom would be induced for cause or routinely induced at 42 w) with women for whom induction was planned but who began labor spontaneously and compared the cesarean rate to that of women induced at 41 w as planned. The cesarean rate in the proxy group was 17% vs. 25% in women electively induced at 41 w. One potential study weakness is that less interventionist obstetricians might be more likely to prefer expectant management, but all but 2 of the 20 obstetricians belonged to groups in which obstetricians provided intrapartum care according to a call schedule. Another study reported the effects of a policy change from planned induction at 41 w 3 d (n = 124) to induction at 42 w (n = 104).[102] The cesarean rate fell from 33% (22/67) to 24% (27/112) (OR 0.7) in nulliparous women. (Rates were also lower in parous women [7% vs. 5%], but the difference did not achieve statistical significance.)

In addition, fetal surveillance testing in expectantly managed populations in the RCTs will inflate the cesarean rate. Almost all positive tests will be false positives (see essay discussion of fetal surveillance tests), but inducing for suspected fetal compromise would likely lead to a low threshold for cesarean. In Hannah et al. (1992), the cesarean rate in women induced for reasons other than abnormal fetal surveillance test was 27% but rose to 38% with induction for this reason.[76]

Practice variation is yet another confounder. In three trials, cesarean rates in these low-risk cohorts were extraordinarily high in one or both arms. In Dyson, Miller, and Armstrong (1987),[54] the rate in the planned induction arm was a reasonable 15%, but it was 27% with planned expectant management; in Chanrachakul and Herabutya (2003),[35] rates were 27% with planned induction vs. 22% with planned expectant management; and in Hannah et al. (1992),[75] rates were 21% with planned induction vs. 25% with planned expectant management.

4. Prophylactic induction for suspected macrosomia reduces neither cesarean rates nor shoulder dystocia rates.

A Cochrane systematic review reports on three RCTs (N = 372 women) allocating women to induction vs. expectant management.[92] Cesarean rates (24%) and shoulder dystocia rates (5%) were identical in both groups, which suggests that larger numbers would not change results. Two infants experienced a brachial plexus injury and four a fracture in the expectant management group vs. none in the induction group, but no information is given on the long-term effect of the brachial plexus injury, and fractures heal.

Another systematic review analyzes nine observational studies (N = 3751 participants) in addition to two of the same trials as the Cochrane review.[157] In all nine studies, the cesarean rate in the induced group exceeded that of the expectant management group, and no differences were found in rates of shoulder dystocia (6% expectant vs. 7% induced).

5. Clinician bias and practice variation determine cesarean rates with suspected macrosomia.

Studies provide ample evidence of the effect of clinician bias. Six studies of the effect of suspicion of macrosomia all found that the erroneous belief that the baby would weigh ≥ 4000 g increased the likelihood of cesarean surgery compared with fetuses believed to weigh < 4000 g.[116, 128, 145, 155, 187, 188] A seventh study in nulliparous women having bedside sonograms before induction found that a ≥ 15% overestimate of fetal weight was enough to increase the cesarean rate for labor arrest (35% vs. 13%) despite most of the women in the group not being suspected of carrying a baby weighing ≥ 4000 g.[18] Interstudy cesarean rates vary enormously among studies of induction vs. expectant management. Among the three RCTs included in the Cochrane systematic review, cesarean rates ranged from 19% to 37% in the induction arms vs. 22-38% in the expectant management arms.[92] Among the nine observational studies in another systematic review, rates in the induced groups ranged from 4% to 57%, and in spontaneous onset groups from 3% to 38%.[157] One study found that women in the predicted macrosomia group were much more likely to have a failed induction of labor (60% vs. 33%) and to have a cesarean for lack of progress before 4 cm dilation (49% vs. 17%) whether induced or with spontaneous onset.[187] Finally, a study of 1432 women whose babies weighed ≥ 4000 g were grouped according to their doctors' induction rates (20-40%, 40-60%, > 60%).[90] Cesarean rates were similar (26-28%) regardless of the group to which they belonged. If some obstetricians can induce labor three times more often than their colleagues yet have similar cesarean rates, then inducing labor has little to do with cesarean rates but practice variation is a significant factor.

6. Inducing labor for term PROM has minimal effect on maternal infectious symptoms and does not reduce neonatal infection rates, but neither does it increase cesarean rates.

> **Note:** The relationship between infection and induction methods and between infection and timing of induction in women with PROM is difficult to determine because almost all women undergoing conventional obstetric management are exposed to interventions (cervical ripening, amniotomy, vaginal exams, internal monitoring) that promote intrauterine transmission of infectious organisms. Determining the true relationship is further confounded by many studies using intrapartum fever as the sole criterion diagnostic of chorioamnionitis because epidurals are also associated with intrapartum fever. (See chapter 12.)

A Cochrane systematic review included 12 trials totaling 6814 women,[45] and 74% of participants came from the TermPROM trial.[77] The prime motivation for inducing for PROM is to prevent neonatal infections. Meta-analysis (9 trials, 6406 infants) found almost identical neonatal infection rates, a failure all the more striking because the TermPROM trial rarely treated women with prophylactic antibiotics (10%). Women were somewhat less likely to experience endometritis (6% absolute difference; 4 trials, 445 women) or chorioamnionitis (3% absolute difference; 9 trials, 6611 women) with induction. Despite similar rates of neonatal infection and symptoms of poor condition at birth, more newborns in the expectant management arm were admitted to special care nurseries, which reviewers speculate may reflect hospital policies. (Some hospitals admit all babies born after a prespecified number of hours of ruptured membranes to special care for a period of observation.) Meta-analysis (12 trials, 6814 women) also reported nearly identical cesarean rates overall, nor were differences found between induced and expectant management according to induction agent (oxytocin or prostaglandin), parity, or cervical favorability. Crossover rates are unlikely to explain this. In the TermPROM trial, whose results would outweigh all other trials, only 10% of women assigned to induction began labor spontaneously and 21-23% of women assigned to expectant management were induced.

Infection rates results are the worst case. As already noted, clinicians rarely prescribed prophylactic antibiotics in the TermPROM trial, and a secondary analysis of its data reported that having a vaginal exam at trial entry increased the risk of neonatal infection 2.5-fold even after taking into account GBS status.[78] This difference is likely to be larger than it appears because authors combined digital and speculum exams, and speculum exams are not believed to increase infection risk. Another secondary analysis reported that the percentage of infections trended upward with the number of vaginal exams independent of other factors, including time from rupture of membranes to labor onset and length of active labor.[160] It rose from 2% in women with 3-4 exams to 5% in women with more than 8. One-third or more of the women had vaginal exams at trial admission and half to two-thirds of the women had ≥ 4 between membrane rupture and birth.[77] Missing as well is information on internal monitoring, another practice that would affect infection rates. Thus we do not know what infection rates would have been in the TermPROM trial or the trials in the aggregate had all women received optimal care.

7. Breast stimulation reduces the number of women not in labor 72 h after beginning treatment but should not be used in high-risk women until safety concerns are resolved.

The Cochrane systematic review of breast stimulation included six trials (719 women).[103] All studies compared hand or breast-pump stimulation of one breast at a time with no intervention, and one trial included a third group that received oxytocin. In the four trials (437 women) comparing breast stimulation with no intervention, breast stimulation reduced the number of women not in labor after 72 h (63% vs. 94%, RR 0.7). This held true in nulliparous women and in women with an unfavorable cervix, although in the latter group, differences were no longer significant, possibly because of smaller sample size. No differences were found across groups or subgroups in mode of birth or serious morbidity. There were four perinatal deaths among the trials, all occurring in one trial conducted in India in which 57 women were assigned to breast stimulation, oxytocin infusion, or no treatment.[43] The study included high-risk women, and two of the three deaths in the breast stimulation arm had anomalies. (The fourth death occurred in the oxytocin arm.)

8. Acupuncture trials disagree on its effectiveness at inducing labor; differences are probably a placebo effect.

Acupuncture trials are difficult to interpret because they are generally small and vary considerably in acupuncture timing, technique, and frequency, as well as in population characteristics such as parity, gestational age, and whether membranes are intact or ruptured. A 2004 Cochrane systematic review included three trials involving 212 women.††[167] None of the studies was sham-controlled. In meta-analysis, acupuncture significantly reduced the need for other induction methods (2 trials, 147 participants). No statistically significant differences were found in any other clinically meaningful outcomes; however, in the smallest of the included trials (56 women), conducted among nulliparous women at term with intact membranes, the time from treatment to birth and cesarean section rate (17% vs. 39%) strongly favored the acupuncture group, but differences did not achieve statistical significance.

Four RCTs were published after the close date for inclusion in the Cochrane review. Three trials comprising 578 women compared acupuncture to sham acupuncture,[11, 133, 168] and the fourth, in 101 women, compared acupuncture with expectant management for up to 48 h in women with PROM.[161] None of the four studies found differences in any measured outcomes, although the non-sham-controlled trial found less use of other induction methods for delayed labor in the acupuncture arm (12.5% vs. 17%).[161] Although the difference was not statistically significant, it adds weight to the significant difference found in the Cochrane meta-analysis.

9. Stripping/sweeping membranes reduces pregnancy duration but has no effect on cesarean surgery rates and may increase PROM rates.

The Cochrane systematic review of membrane stripping (22 trials, 2797 women) reported that it substantially reduced the likelihood of women reaching 41 or 42 w (10 studies, 1387 women) and of having labor induction (12 trials, 1493 women), but it did not reduce

†† Despite its citation (publication date 2004), two of the trials included in the Cochrane review were published in 2006.

cesarean rates either overall (18 trials, 2389 women) or in nulliparous women (2 trials, 378 women).[23] No significant differences in maternal (11 trials, 1680 women) or neonatal (6 trials, 786 women) infection rates were found. Membrane sweeping did not increase the likelihood of PROM (10 trials, 1535 women).

Two trials published subsequent to those included in the Cochrane review reopen the question of the effect on PROM. A trial (300 women) designed specifically to look at the association between serial membrane sweeping beginning at 38 w and PROM reported no significant difference (12% treatment vs. 7% control),[84] which would appear to agree with the Cochrane review. However, women assigned to membrane stripping whose cervixes were closed received cervical massage instead (15%), something also true in the Cochrane review's trials. Looking closer at this subgroup, no woman having cervical massage had PROM in the ensuing week. Moreover, in the subgroup that was > 1 cm dilated, i.e., the group eligible for membrane stripping, 9% of treatment-group women had PROM vs. 0% of the control women, a difference that achieved statistical significance. On the other hand, by far the largest study, a Dutch study of serial sweeping every two days beginning at 41 w (742 women), agreed with the Cochrane review.[47] PROM rates were 19% in both trial arms. Still, this trial, like the trials in the Cochrane review, did not distinguish women who had membrane stripping from women who had cervical massage. Interestingly, too, women were more likely to be induced before 42 w in the treatment group for rupture of membranes longer than 24 h. This could be a Type 1 error (finding a statistically significant difference that is actually due to chance), or it could be that PROM following membrane stripping may be less likely to provoke the cascade of events that leads to progressive labor, a problem that would be exacerbated in the U.S., where clinicians rarely wait to induce as long as 24 hours after PROM.

10. Balloon catheter appears to be the method of first choice for cervical ripening.

Note: Heinemann et al. (2008),[83] a systematic review focusing on infectious symptoms, reported more women (19.4% vs. 2.6%) and more newborns (5.2% vs. 0.7%) with infectious symptoms with hydrophilic dilators than with balloon catheter. For that reason, we do not consider hydrophilic dilators.

Two systematic reviews reported on RCTs of balloon catheters vs. prostaglandins, one of locally applied PGE2 or misoprostol (27 trials, 3532 women) and the other of locally applied misoprostol (9 trials, 1603 women).[62, 179] In addition, Jozwiak et al. (2011), an RCT of PGE2 published after the PGE2 review, performed meta-analyses on its data (819 women) and two other trials (612 women) not included in the PGE2 review.[99] All three meta-analyses found similar cesarean rates with balloon catheter compared with prostaglandins, whether PGE2 or misoprostol. All three meta-analyses reported higher uterine hyperstimulation (abnormally frequent contractions or abnormally long contractions with or without FHR changes) rates with prostaglandin and much greater excesses with misoprostol. In the "any prostaglandin" review, our calculation revealed that the pooled rate with misoprostol greatly exceeded rates with balloon catheter (20% vs. 8%), while

the pooled rate with PGE2 (5 trials, 563 women) was still elevated, but the difference was much smaller (11% vs. 7%).‡‡ [179] (The misoprostol review reported a relative risk of 2.8 but did not provide rates.[62] Jozwiak et al.'s hyperstimulation meta-analysis also reported a higher rate but a small difference compared with PGE2 (1.4% vs. 3.2%).[99] In addition, Jozwiak et al. found that balloon catheter reduced risk (6.0% vs. 10.0%, OR 0.6) of postpartum hemorrhage > 1000 mL, an outcome not reported in the two systematic reviews (2 trials, 1042 women).

Regarding infectious symptoms, a systematic review reported maternal rates of 7.6% with balloon catheter vs. 5.0% with pharmacologic methods (13 trials, 2375 women), although neonatal rates were similar (3 trials, 627 women).[83] In contrast, Jozwiak et al. reported more maternal infectious symptoms (3% vs. 1%) with PGE2.[99] Infectious symptoms rates may be confounded by other practices such as amniotomy, vaginal exams with ruptured membranes, internal monitoring, and whether GBS antibiotic prophylaxis was used, as well as the possibility that mechanical ripening provokes an inflammatory response.

11. Low-dose/long-interval oxytocin protocols achieve similar vaginal birth rates with less uterine hyperstimulation.

A systematic review included 11 RCTs (9 published and 2 delivered as peer-reviewed presentations at the annual meeting of the Society of Obstetricians and Gynecologists; 2002 women among the published trials and number not stated for the unpublished trials) of low- vs. high-dose oxytocin protocols for labor induction.[42] Low-dose regimens ranged from a starting dose of 0.5-2.5 mU/min, increments of 1.0 mU/min, to doubling of dose, intervals of 30-60 minutes, and maximum dose from 16-40 mU/min, with two trials not stating a maximum. High-dose regimens ranged from a starting dose of 0.5-7.0 mU/min, increments of 1.0 mU/min, to doubling of dose, intervals of 15-40 min, and maximum dose from 24-80 mU/min, with two trials not stating a maximum. Meta-analysis of pooled data from all 11 trials found a nonsignificant decrease (OR 0.8) in cesarean rate with low-dose protocols, from which we can conclude that, at worst, low-dose protocols do not increase the cesarean rate. "Excessive uterine activity" (defined as uterine hyperstimulation with or without abnormal FHR) (11 trials) was less likely with low-dose regimens (OR 0.4). A blinded trial of 816 women has been published since the review.[129] The low-dose regimen began at 1.5 mU/min and increased by 1.5 mU/min every 30 min, whereas the high-dose regimen began at 4.5 mU/min and increased by 4.5 mU/min every 30 min. No maximum dose was specified with either regimen. Investigators found a nonsignificant increase in cesareans in the low-dose group mostly explained by differences in cesarean for dystocia, a diagnosis dependent on provider judgment and patience. Women were more likely to have oxytocin decreased or discontinued for hyperstimulation or FHR abnormality in the high-dose group.

‡‡ We chose to exclude an outlier in making the calculation with PGE2. Excessive uterine activity rates with balloon catheter ranged from 0% to 13% in the other six trials but were 65% (49/76) in the outlier, indicating that something was sufficiently different in this study such that its results could not be generalized to other trials.

12. Misoprostol imposes excess risk of harm with no compensating clinical benefits compared with PGE2. (See also mini-review 10.)

> **Note:** Accurate dose is a serious problem with administration of vaginal misoprostol. Splitting a small, unscored tablet results in considerable variation in dose.[191] This may be overcome by dissolving the tablet in water, but the technique is suitable only for oral dosing.[111]

In order to isolate a group at high risk of cesarean section, Crane and colleagues conducted a systematic review of misoprostol (oral, vaginal, sublingual, buccal) vs. PGE2 (vaginal or intracervical) limited to RCTs of women at term with intact membranes and unfavorable cervix (14 trials, 2133 women).[41] Cesarean rates (14 trials, 2133 women) were identical (19%) and hyperstimulation syndrome (13 trials, 2112 women) was more common with misoprostol (5.3% vs. 1.1%; RR 3.7). In the trials confined to nulliparous women, neither cesarean rates (17% vs. 13%; 3 trials, 348 women) nor hyperstimulation rates (8% vs. 1%; 2 trials, 288 women) differed significantly, although either or both might have done so with more women. Stratifying studies according to whether PGE2 was administered vaginally or intracervically also found similar cesarean rates and excess rates of hyperstimulation in the misoprostol group. Misoprostol doses of 25 mcg were less likely to produce hyperstimulation syndrome compared with higher doses (3% vs. 6%), but rates still exceeded that of the PGE2 comparison groups (1%), although the difference was not significant in the pooled 25 mcg studies (3 trials, 304 women).

Similarly, with five trials in common with the Crane review, meta-analyses in a Cochrane systematic review of vaginal misoprostol comparing it with vaginal PGE2 in women with intact membranes and unfavorable cervix found identical cesarean rates (23%) (14 trials, 3011 women) but higher hyperstimulation syndrome rates (6.4% vs. 3.4%, RR 1.9) (13 trials, 2309 women).[88] As before, with two trials overlapping (185 women) between reviews, cesarean rates were similar (15% vs. 18%) in nulliparous women (4 trials, 499 women), and hyperstimulation rates were higher with misoprostol (9.1% vs. 2.0%), this time achieving statistical significance (RR 4.1). The same pattern repeats with vaginal misoprostol vs. intracervical prostaglandin in women with intact membranes and unfavorable cervix: identical cesarean rates (22%) (12 trials, 1433 women) and higher hyperstimulation rates (9.8% vs. 2.5%, RR 3.6) (13 trials, 1433 women), with four trials overlapping between reviews.

A systematic review of low-dose oral misoprostol vs. PGE2, perhaps the last, best chance for misoprostol to prove superiority over other modalities, reported lower cesarean rates (20% vs. 26%; 5 trials, 2281 women) and similar hyperstimulation syndrome rates (5.5% vs. 4.4%; 5 trials, 2224 women).[111] These findings, however, are due to high cesarean and hyperstimulation rates in the pooled PGE2 arms compared with rates in the reviews discussed in the previous paragraphs. If similar cesarean rates and lower hyperstimulation syndrome rates can be achieved with PGE2, then low-dose oral misoprostol is not the superior agent.

ACOG's 2009 induction guidelines assert that misoprostol is safe when used "appropriately" (p. 387), by which they mean in women with an unscarred uterus receiving doses

of no more than 50 mcg.[6] We tested the validity of this statement by searching for catastrophic outcomes in U.S. hospitals after use of misoprostol in women fitting these criteria and found 18 cases. Four were case reports of uterine rupture.[§§127, 148] Three came from a misoprostol trial (522 women) in which one woman died of an amniotic fluid embolism (AFE) and two others had cesarean hysterectomies for atony nonresponsive to medical treatment.[192] The AFE occurred 9 h after a single misoprostol dose and shortly after amniotomy, internal catheter placement, amnioinfusion, and epidural initiation. Both women with cesarean hysterectomies had been induced solely with a single misoprostol dose. Two were single case reports: a uterine rupture leading to hysterectomy in a woman induced solely with two 25 mcg vaginal doses of misoprostol,[16] and a uterine rupture leading to stillbirth and hysterectomy in a woman induced solely with one 25 mcg vaginal dose.[154] The other 9 were reported in a case series of severe adverse events following misoprostol induction in which women were given no more than a 50 mcg dose of misoprostol vaginally or, in one case, orally.[¶¶185] All 9 women experienced uterine hyperstimulation, which in 7 cases was reported as accompanied by severely abnormal FHR, fresh meconium, or both. The 9 cases of hyperstimulation resulted in a total of 2 cases of uterine rupture, 5 cases of permanent fetal neurologic injury, 2 perinatal deaths, and 3 maternal deaths. One woman with uterine rupture experienced disseminated intravascular coagulation, and 3 women had diagnoses of AFE. The 3 AFE cases resulted in a maternal death, a maternal death and a brain-injured child, and a maternal and perinatal death among the mother-baby pairs. Without knowing how many women had similar outcomes in spontaneous labors, the evidence for causation is weak, but taken together these cases contradict ACOG's assurances of safety.

Women with uterine scars are not the only subgroup that may be at special risk with misoprostol. A study compared 95 pre-eclamptic women undergoing pre-induction cervical ripening with vaginal misoprostol with 108 women having ripening with PGE2.[61] Among women receiving misoprostol, 18% had cesareans for FHR abnormalities vs. 8% of those having PGE2, and 13.7% having misoprostol experienced placental abruption vs. 1.9% receiving PGE2. A different study of 403 pre-eclamptic women, however, contradicted those findings.[125] Investigators reported an excess of placental abruptions (1.3% vs. 5.4%) and cesarean sections for FHR abnormalities (28% vs. 52%) in the group receiving PGE2, which is surprising considering that meta-analyses consistently report lower incidence of abnormal FHR with PGE2 compared with misoprostol. It is difficult to know what to make of such marked differences between two studies in similar women. A partial explanation may lie in differing methods of prostaglandin administration: all women given misoprostol in the first study received 25 mcg doses of misoprostol vaginally, whereas in the second study three-quarters of the women had oral doses of 25-50 mcg, and all women having PGE2 in the first study had a vaginal 10 mg pessary, whereas 60% had a 10 mg pessary in the second study and the rest had 2-3 mg vaginal gel.

§§ Three of the cases are presumed to be appropriate doses. Dose is not reported, but Porreco et al. is a case review of deliveries at Hospital Corporation of America hospitals in 2006.

¶¶ The source journal for this reference is indexed in PubMed, but it is not peer reviewed. We have chosen to make an exception and include it because the article's physician author is making a first-hand report from medical records he reviewed as a consultant in medico-legal cases.

13. PGE2 fails to decrease the cesarean rate compared with placebo/no treatment and increases the likelihood of uterine hyperstimulation syndrome.

Note: The Cochrane systematic review of intracervical prostaglandin concluded that it offered no advantages over vaginal administration and was more difficult and uncomfortable to apply.[21] For this reason we report only on this review's trials of vaginal administration.

The Cochrane meta-analysis of vaginal PGE2 compared with placebo/no treatment found similar cesarean rates overall (34 trials, 6399 women).[106] This held true among women with an unfavorable cervix (22 trials, 2173 women) and in nulliparous women (10 trials, 2486 women). It also held true in women with unfavorable cervix and intact membranes (5 trials, 471 women), which is important because PROM is a confounding factor in that it precipitates spontaneous labor within hours in most women. Hyperstimulation syndrome was increased (4.4% vs. 0.5%, RR 4.1; 14 trials, 1259 women). Similar cesarean rates and hyperstimulation syndrome rates were found regardless of whether PGE2 was administered as a single dose, in multiple doses, or in sustained release. Likewise, cesarean rates (5 trials, 881 women) and hyperstimulation syndrome rates (1 trial, 200 women) were similar between administration as a gel vs. a tablet. The meta-analysis of two trials of gel vs. pessary (159 women), both of them in women with intact membranes and unfavorable cervix, found similar cesarean rates, and an excess of hyperstimulation syndrome in the pessary group, but this was almost certainly due to an unusually high pessary dose in one trial resulting in an unusually high hyperstimulation syndrome rate (20%). Sustained release vs. other modes did not differ significantly in cesarean rates but tended toward higher hyperstimulation syndrome rates (6.1% vs. 2.8%; 4 trials 513 women). Low-dose (maximum dose $\leq$ 3 mg) vs. high-dose (> 3 mg) resulted in similar cesarean rates (7 trials, 1466 women), which held true in all women with unfavorable cervix (4 trials, 287 women), and in women with intact membranes and unfavorable cervix (2 trials, 140 women). Hyperstimulation syndrome rates were higher with the higher dose (1.4% vs. 11.3%; 2 trials, 140 women), but this was because one of them was the same trial previously mentioned with the unusually high dose. The other trial reported a rate of 2.7% in the higher-dose arm, which, while not significantly different, still suggests a dose-related relationship.

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Promoting Progress in First-Stage Labor: Yes We Can

"The three main factors which affect the mechanics of active labor are the powers, the passenger, and the passage."

Funai 2010, p. 1 of 6[11]

"Labor progress is facilitated when a woman feels safe, respected, and cared for by the experts who are responsible for her clinical safety, when she can remain active and upright, and when her pain is adequately and safely managed."

Simkin 2005, p. 16[21]

Most women can give birth safely without treatments to hasten labor. Modern maternity care offers several approaches to expedite the birth of the baby, but each imposes risks and can intensify pain and suffering. Optimal care, therefore, entails reserving medical intervention for women who would face greater difficulty without it.

However, minimizing interventions is just one component of optimal care for promoting healthy labor progress and vaginal birth. For instance, when cervical dilation is deemed insufficient, delaying the decision to perform cesarean surgery allows some women to safely avoid cesareans,[13] but this approach will not optimize outcomes while environmental factors and treatments that impede progress remain. In fact, in some cases, allowing more time may cause harm by prolonging exposure to practices that can compromise maternal and fetal wellbeing, such as multiple vaginal exams, epidural analgesia, or directed pushing. In this chapter, we argue that if the goal is optimal labor progress, we must begin by constructing an environment that removes impediments to mobility and autonomy, thereby facilitating and supporting the normal physiologic process. We then contrast this with the conventional hospital environment and explore possible reasons for the disparities. The mini-reviews focus on the effects of maternal mobility on mode of birth, safety, and the maternal experience.

THE FOUR PREVENTIVE P'S

Efforts to help women progress in labor have traditionally emphasized the need to manage the "three P's": the *powers* (i.e., adequacy of contractions or maternal expulsive efforts), the *passenger* (size and position of the fetal presenting part), and the *pelvis* (size, shape, and mobility of the bony pelvis and elasticity of the soft tissues of the genital tract).[7] Because a woman's emotional state and experience of pain can affect labor progress, Simkin and Ancheta (2005) advocate two additional P's: psyche and pain.[21] Together, these "P's" offer a useful framework for identifying and correcting the underlying problem when faced with a labor that is not progressing. However, the factors that cause labor to slow down in the first place are often externally influenced and are missing from the traditional list of P's. We propose retooling the standard labor and birth environment with attention to an alternative list of P's—four factors that promote maternal autonomy and mobility: permission, physical environment, practices, and people.

The overarching principle of the four preventive P's is *permission*.* Without it, women can exercise neither autonomy nor mobility. In a permissive labor environment, women are free to move about and assume the positions of their choosing. They may eat when hungry and drink when thirsty, control lighting and ambient sound, and wear or shed whatever clothing they choose. Providers do not direct or restrict behavior unless there is a compelling medical need and the woman has made an informed choice to comply with recommended restrictions.

The *physical environment* should provide adequate space for the laboring woman and her companions and furniture to accommodate them comfortably, sitting and reclining. There should be safe and private spaces to walk, tubs and showers for hydrotherapy, and props that promote upright positioning, including balls, chairs, stools, ropes, posts, and pillows. Enabling women to control or modify aspects of the physical environment also enhances mobility. In one qualitative study women who labored in both a typical hospital room and an alternative setting that offered control of furnishings and sensory stimuli reported experiencing greater mobility in the adaptable room.[12]

As important as what should be present in the labor environment is what should be absent. Labor and birth spaces should be free of items that restrict mobility or reinforce that the woman is a patient rather than a healthy person undergoing a normal physiologic process. Kennedy (2010) studied two hospitals in the United Kingdom that were known for their excellent outcomes and high vaginal birth rates to identify factors that might have contributed.[16] She observed that electronic fetal monitors were kept in the hallway unless a woman required continuous monitoring, and labor beds were set at the highest position when

* This implies that the woman must ask for permission from a care provider or another professional who has the authority to grant it. We believe the words "freedom" and "autonomy" better describe the concept, but in the spirit of having a list of "P's," we chose "permission."

preparing the room for the next occupant, deterring the new admission from getting into them.

Caregivers should also avoid *practices* that interfere with mobility or override normal physiology, such as using intravenous lines, electronic fetal monitoring (EFM), and pharmacologic analgesia. When these become necessary or the woman elects them, effort should be made to mitigate the impact. For instance, an intravenous catheter can be set in the forearm rather than the hand or wrist, telemetry monitoring can be used, and women with regional analgesia can be encouraged to labor sitting upright or side-lying and to change positions periodically.

How the *people* attending the laboring woman behave within the birth environment also affects autonomy and mobility. In order to relax inhibitions and allow instincts to take over, women require supportive, attentive caregivers who cede them control, respecting their needs for privacy, dignity, and autonomy. Laboring women need people around them who help them find congenial positions and activities, provide hands-on comfort measures, and give reassurance, guidance, and encouragement. Women must feel free to vocalize, express both positive (e.g., ecstasy) and negative (e.g., fear, vulnerability) emotions, reach out for help, and respond to the sensations of labor in whatever way they need without fear of being judged or pressure to comply with staff preferences or expectations. Without accommodating and nonjudgmental people to care for a laboring woman, a permissive physical environment is meaningless.

Studies tell us that implementing the four preventive P's promotes the twin goals of mobility and autonomy: women free of restrictions will move around, change position, and follow spontaneous pushing urges.[15, 19, 25] There may be important neurologic effects as well. Hormones in the limbic system of the brain—the "primitive" part of the brain that humans share with other mammalian species—affect both the woman's contraction pattern and her experience of pain.[2, 4] As physician Sarah Buckley writes, "For birth to proceed optimally, this part of the brain must take precedence over the neocortex, or rational brain. This shift can be helped by an atmosphere of quiet and privacy . . . and *no expectation of rationality from the laboring woman*" (p. 1 of 7; emphasis ours).[6] Freeing women from the need to control their behavior may decrease stimulation of the neocortex and support the neuro-hormonal changes that allow labor to progress normally.

We may never know exactly how hormones affect labor progress and pain, because any attempt to measure blood hormone levels or brain activity would be intrinsically disruptive of the process, painful, or both. Regardless of explanation, anyone involved in animal husbandry will attest that successful birthing in mammals requires a dim, comfortable, undisturbed environment where the dam can behave as she pleases and nothing triggers alarm. Animal studies show as well that frightening or hurting laboring animals can not only delay or interrupt labor, but cause fetal distress.[20] Why would we think that laboring humans would be exempt?

OBSTACLES TO PRACTICING THE FOUR P'S

As we know, labor and delivery units rarely operate on the principles of the four P's. Listening to Mothers I, a survey of U.S. women giving birth between 2000 and 2002, reported that 71% of respondents remained in bed once they were admitted to the hospital and had regular contractions.[9] The most common reason for this was "being connected to things" (67%), which they were: nearly all women (93%) had EFM and an IV (86%). Of note as well, more than one in four women were told by nurses to stay in bed (28%). One woman writes: "I felt less pain while I was sitting up in a chair, and the nurse insisted that I get in the bed. I did not like that because it hurt much worse. I would also like to have had an opportunity to walk around during contractions, and not be hooked up to constant fetal monitoring." (p. 25)

Not specified in the survey but a common practice in some settings is confining women to bed after membranes have ruptured. The concern is that the umbilical cord could prolapse. Our review revealed no published trials that support this practice, and it is logically plausible that upright positioning would, in fact, be protective against prolapse, as gravity would keep the presenting part lower in the pelvis than the cord.

Listening to Mothers II, surveying women giving birth in 2005, supplies more recent information on the use of obstetric interventions to prevent or treat prolonged or arrested labor and more details on the reasons for cesarean surgery.[8] Among these women, 59% had their membranes ruptured, and 55% received IV oxytocin to augment labor, but these measures failed in a substantial percentage of cases. More than one in four primary cesareans were for slow labor progress or because the provider was concerned that the baby was too big. Seven percent of women had vacuum or forceps-assisted vaginal births. This rampant use of treatments for prolonged or arrested labor implies that we are facing an epidemic of labor progress disorders. Why, then, is there so little emphasis on prevention?

The pathology-oriented approach that is the hallmark of the medical management model clearly plays a role. Care providers persist in practices that restrict mobility, such as routine and continuous electronic monitoring and intravenous lines, because they believe their use might avert a catastrophe. No evidence supports this (see chapters 10 and 11), yet the "just-in-case" mentality provides a rationale for imposing them on healthy women, and in the face of belief about their effectiveness, the fact that these interventions impede mobility and increase stress and discomfort holds little sway.

Economics also comes into play. Small rooms allow hospitals to accommodate more patients within the same physical space. Remodeling is expensive and is generally aimed at making care delivery more efficient, thereby reducing cost. For example, centralized monitoring stations allow fewer staff members to watch over more patients, but at the sacrifice of personal contact and individualized care.

Adding private showers or tubs large enough for hydrotherapy is costly and use of a tub or shower is not currently reimbursable.

Another factor clearly influencing mobility and autonomy is the use of epidural analgesia and, to a lesser extent, narcotic pain medications. In Listening to Mothers I, 32% of respondents said they remained in bed because pain medication prevented mobility and 20% because pain medication made them groggy.[9] However, evidence suggests that some women may turn to epidurals because of the restrictions on mobility and autonomy imposed by the hospital environment. Women in studies of maternal movement and upright positioning report less pain when they are not confined to bed. (See mini-review 3.) Moreover, women who are immobilized by "being connected to things" or by staff expectations cannot access the full range of non-pharmacologic pain relief options, many of which require some mobility. We know too that where mobility and autonomy are keystones of care, use of pharmacologic pain management is rare: inadequate pain relief is infrequently cited as the reason for transferring from home or freestanding birth centers. (See chapters 20 and 21.) Thus, hospitalized women may choose pharmacologic pain relief because the restrictions imposed on them leave them no viable alternative. This creates a self-reinforcing circle in which restricted mobility leads to high rates of epidural analgesia, and high rates of epidural analgesia lead to a physical environment based on the presumption that women will not be mobile.

THE ROOT OF THE PROBLEM: A CLOSER LOOK AT RESEARCH PRINCIPLES

The research itself may be another obstacle to reform. While mobility and autonomy have impressive theoretical benefits—improved circulation and perfusion and enlarged pelvic diameters, for example[15]—observational and experimental studies provide scarce evidence that women or babies fare better when women walk or assume upright positions. In some studies, these behaviors seem to confer no significant benefits at all; in others, a few more women give birth vaginally and report improved satisfaction, but these modest benefits offer little incentive for hospitals to make the fundamental, sweeping, and expensive changes needed to fully incorporate the preventive P's. However, the body of available literature is severely compromised by medical-model biases that affect what research questions get asked, how studies are designed, and how results are reported and interpreted.

Beginning with the research question, no study has ever compared a *policy* of unrestricted mobility and support of spontaneous behavior with a *policy* of restricted and directed behavior. Instead, maternal movements and physiologically normal behaviors are framed as "interventions." Using mobility as an example, researchers then ask, "What is the effect of walking?" rather than, "What is the effect of prohibiting walking?" This has implications for both the design and interpretation of research. When researchers design a trial, they pit an intervention against either another intervention or the standard of care. To enhance trial

validity, investigators define and describe the intervention with exactness and attempt to minimize noncompliance. These requirements do not easily adapt to studying the effects of free mobility and autonomy, concepts that do not lend themselves to specific delineation. Existing trials of maternal positioning, for instance, assign some women to assume certain upright positions for a certain amount of time and restrict them from assuming others (e.g., supine) during that time. However, requiring a woman to assume any position in labor overrides natural instinct and restricts mobility. We do not know the potential harms of the standard practice of discouraging mobility without controlled trials that compare confinement to bed with complete freedom of movement.

Proper data analysis and interpretation require that researchers isolate the effect of the intervention from other elements of care. But this disregards the complex interrelationships of the labor environment, obstetric practices, maternal instinctive behavior, and labor progress. In a systematic review of maternal movement and upright positioning, researchers found a small but statistically significant decrease in first stage labor duration with walking or upright positioning.[23] But they conclude that the findings are unreliable, in part because "the adoption of an upright position or walking during labor possibly interferes on the performance of other interventions such as amniotomy, analgesia and monitoring during labor" (p. 6). Walking may speed labor *because* it interferes with the ability of care providers to perform procedures that can inhibit labor progress, a valid benefit in itself. Had reviewers been able to use the "appropriate" methods to control for these confounding effects, the benefits may have been obscured.

Finally, when trial findings are equivocal or fail to show significant benefits of the "intervention," medical-model research precepts mandate rejecting it in favor of standard care. So, for example, when researchers who conducted a large trial of ambulation in the first stage of labor failed to find statistically significant differences in length of labor, mode of birth, or maternal and newborn health outcomes, they reported their findings in an article entitled "Lack of effect of walking on labor and delivery."[5] They chose this title despite finding that ambulation was not harmful and that 99% of those who walked would choose to do so again in future labors. The fact that ambulation did no harm and women liked it was not sufficient reason for researchers to recommend permitting it.

AN OUNCE OF PREVENTION IS WORTH A POUND OF CURE

"Modern" medical model management is designed to fix what it breaks. When stressful, disruptive, and counterproductive practices lead to dysfunctional labor, oxytocin and cesarean surgery are at hand to save the day. The sole goal of "delivering" a live baby to a live mother can almost always be achieved with these measures, and the collateral damage is easily dismissed as more evidence that birth is intrinsically difficult and dangerous. Proponents of medical management,

therefore, see no need for reform. We argue, as we have before, that care that promotes the unfolding of the normal process should be the default. "No evidence of harm" and "maternal preference" are sufficient to make care that meets those criteria the standard. The known harms of medical management clinch that argument.

Implementing the preventive P's does not, of course, prevent all women from needing medical intervention for labor dystocia, but the U.S. maternity care system in its current state makes it impossible to determine which women do need it. To use an analogy, conventional obstetric management tinkers with more than half of all cars to get them to their destination faster and still ends up towing a third of them. Take the foot off the brake, give drivers a map, accept that some drivers will take the scenic route or stop off for a while with no harm done, and most of them will get there just fine. The mechanics can then work on the cars that really need it. Until we provide optimal conditions for labor progress, which conventional obstetric management does not, we will not know how many women are undergoing costly and risky procedures to treat a preventable problem. A common sense approach, and one supported by physiologic principles and empirical evidence, is to arrange the labor environment with attention to autonomy and mobility and to avoid disturbing the laboring woman in the absence of a compelling reason. This approach would reduce the need for risky interventions while providing a baseline from which to determine the safety, acceptability, and effectiveness of low-risk approaches to enhancing progress and achieving vaginal birth when labor does not proceed normally.

STRATEGIES FOR OPTIMAL CARE

To facilitate mobility,

- offer all laboring women ample space for walking and changing positions;
- inform all women of the physiological, anatomical, and clinical benefits of mobility and nonsupine positioning;
- make a variety of props available, such as birth balls, chairs, posts, cushions, and a shower and deep tub;
- provide physical assistance and verbal encouragement to change positions when the woman desires;
- train staff, including nurses, physicians, and midwives, in the use of mobility props and comfort measures and in the principles of emotional supportive care;
- encourage women to manipulate physical aspects of the environment, including position of furnishings, lighting, ambient sound, and the flow of people in and out of the room;
- welcome doulas and other non-medical labor companions of the woman's choosing (see chapter 18);

- listen to fetal heart tones through a contraction after membranes rupture (or are ruptured) to detect possible umbilical cord prolapse. If heart tones are reassuring, do not subsequently restrict maternal mobility on the basis of concern for cord prolapse.

Additional ways to remove impediments to mobility and autonomy are covered in other parts of this book. They include the following:

- refraining from practices and procedures that impede mobility unless necessary to correct a problem or requested by the woman (see chapters 10 and 11);
- providing a full range of non-pharmacologic pain relief options (see chapter 12);
- allowing oral intake of fluids and food throughout labor (see chapter 11).

MINI-REVIEWS

Notes:

- Problems with the literature include the following:
  - » Population size and characteristics. Most trials are small and underpowered to detect clinically meaningful differences. More recent trials have recruited more participants, but they remain underpowered to detect differences because they restrict their populations to healthy women in whom adverse outcomes are rare. This means we also do not know the safety or effectiveness of free mobility for women under less optimal conditions, although physiologic principles and studies on animals suggest that confinement to bed, supine positioning, and maternal fear and distress may represent more potent threats to compromised fetuses. The same likely holds true for those exposed to interventions that affect placental perfusion, such as exogenous oxytocin.
  - » Methodological problems, especially crossover. In randomized controlled trials (RCTs), crossover dampens the magnitude of observed differences, sometimes obscuring true differences. Crossover can originate from protocol violation; that is, clinicians or participants fail to comply because they prefer the other mode of treatment. For example, a woman does not wish to ambulate, or a nurse, uncomfortable with it, finds excuses to put her patients to bed.
  - » Strictures of the medical model. Conventional obstetric management limits freedom of movement. For example, in the largest trial of first stage ambulation, ambulating women were sent back to bed for routine evaluations, administration of analgesia or oxytocin, or whenever there was an indication for continuous EFM.[5] As a result, nearly all women were confined to bed for some part of their labor, and one in five did

not walk at all. In another study, epidural analgesia was given routinely at 7 cm dilation or earlier if the woman requested it.[18]

- » Inconsistent categorization of movements/positions. Variation among studies makes it impossible to pool their results in meta-analyses. In some cases it even becomes impossible to interpret individual studies. Some studies compared women who walked with others who remained in bed, but those confined to bed could assume upright positions such as sitting or kneeling. In other studies, sitting was considered the "intervention" and was compared to recumbent positions. Confusing matters further, several studies grouped together women who were supine with others who were side-lying or even on hands and knees, considering all of these "recumbent." In other studies, "supine" was compared with "non-supine" including side-lying and hands-and-knees as well as upright postures.
- » Lack of consistent and reliable standards for measuring labor duration. Without a reliable and consistent way of defining labor onset, any discussion of labor duration becomes meaningless. Yet most studies that report length of labor fail to specify how onset of labor was diagnosed. In practice, there is wide variation in how clinicians define labor onset, with some relying on the woman's recall of when contractions became regular and painful, and others deeming labor to have begun as soon as a woman reaches a threshold of cervical dilation, effacement, or both. At least one study recorded labor duration from the time of hospital admission, a method fraught with potential bias.

- Because the Cochrane Systematic Review, *Maternal positions and mobility during first stage labour,*[17] does not address any of these limitations in the analysis, we have excluded it from our review. However, the meta-analysis did show a statistically significant 1-hour reduction in the duration of active labor and found no evidence of harm from upright positions or ambulation in labor.
- These mini-reviews focus on the effects of movement and positioning in women without epidural analgesia. For a review of the effects in women with epidurals, see chapter 12. The evidence on benefits and safety of upright positioning during second stage is reviewed in chapter 13.
- Assume differences are statistically significant unless otherwise noted.

1. Labor environments that are designed to encourage mobility and autonomy may facilitate physiologic labor progress and reduce the need for pharmacologic augmentation and other interventions.

Canadian researchers conducted a pilot study gauging the effects of modifying the labor room to encourage mobility, reduce stress and anxiety, and discourage routine medical intervention.[14] Investigators randomly allocated 62 healthy women in spontaneous labor to either a modified room or the standard labor room. Women attended by midwives or doulas were excluded from participating, effectively creating a study population not predisposed to be mobile in labor.

Changes to the labor environment included removing the labor bed and replacing it with a portable double-sized mattress and pillows in the corner of the room on the floor. Rooms were also equipped with a birth ball, a chair that promoted sitting upright or leaning forward, an LCD projector with a selection of movies of calming nature images, an mp3 player with a selection of music, and a chart illustrating upright labor and birth positions. All labor rooms had a private bathroom and lacked windows. Nursing alterations included mandating intermittent auscultation, leaving the overhead light off, keeping the door closed, and putting a sign on it asking people to knock before entering.

Sixty-six percent of the women in the modified room reported spending less than half of their time in labor in bed vs. 13% of women in the standard room, and only 35% spent three-quarters or more of their time in bed vs. 87% of women in the standard room. (The bed was brought back at the woman's request—mostly for epidural analgesia—or caregiver's.) Women in the modified room were less likely to have oxytocin augmentation (40% vs. 68%), and those who had it got it later in labor (9.3 vs. 6.4 hours after randomization). Rates of cesarean surgery and instrumental vaginal delivery were similar across the two groups. The trial was too small to draw firm conclusions, but the results support conducting a larger one.

2. RCTs have failed to find clinically significant benefits for ambulation or upright positioning, but they suffer from weaknesses that handicap their ability to detect differences.

The largest RCT evaluating the effects of movement on labor progress, and the only trial to include multiparous women, randomized 1067 healthy women in active labor at 36-41 w gestation with uncomplicated pregnancies to walk as desired (n = 536) or to remain in bed (n = 531).[5] Women allocated to the walking group were encouraged to walk but were to return to their beds for routine assessments if analgesic drugs were to be administered, or if continuous EFM was required. Women were also instructed to return to bed for second stage, during which women in both arms of the study were required to assume either a supine or lateral position. Women randomized to remain in bed were permitted to assume various positions, including upright, and were also permitted to walk to the bathroom as needed. Results were almost identical across the two groups with respect to length of labor, need for pharmacologic augmentation, need for analgesia/anesthesia, mode of birth, and newborn outcomes. For example, among nulliparous women (n = 272 in each group), the average length of first stage of labor was nearly identical (7.6 h walking vs. 7.3 h bed) as was the spontaneous vaginal birth rate (about 85% of both groups). Multiparous women too had nearly identical average lengths of first stage of labor (4.6 h walking vs. 4.7 h bed), and spontaneous vaginal birth rates (97% walking vs. 95% bed). The authors concluded that walking does not shorten first stage of labor so women should have the freedom to walk or stay in bed. However, this trial is weakened by several limitations. First, as Albers (2007) points out, "Very little walking actually occurred in this study, and therefore, the two comparison groups would be expected to be similar on all outcomes of interest" (p. 211).[1] Twenty-two percent of the women randomized to walk did not walk at all. Among women who did walk, the average time spent out of bed was 56 minutes. Second, many women were exposed to interventions that slow labor or preclude walking. About 85% of both groups had analgesia, including about one-third of both groups who used epidurals.

Use of analgesia, augmentation of labor (used in 23% of the walking group), or both would nearly always restrict the woman's movement for the remainder of her labor. Thus, it can be presumed that most of the walking that did occur in the study occurred early in active labor. Finally, in both arms of the trial most women were cared for by midwives and spontaneous vaginal birth rates were high. Findings may not be applicable to women whose labors are managed by obstetricians.

A smaller RCT, conducted in Brazil among healthy nulliparous women, was intended to measure the effects of upright positioning on labor progress and other maternal and newborn outcomes.[18] The researchers assigned 54 women to the upright group and 53 women to a control group. Women in the upright group were given information about the possible benefits of upright positioning and were actively encouraged to assume upright positions. No information was given to the control group. The researchers found no significant differences in labor progress, need for pharmacologic augmentation, or mode of birth. However, several aspects of the study seriously limit its ability to detect significant differences. Although the researchers conducted a power calculation to determine the appropriate study size to detect differences in labor progress, they did not account for possible crossover. The upright group was upright for 57% of the time between enrollment (average 4 cm) and analgesia vs. 29% of the time for the control group. Analgesia (type not specified) was routine in the hospital, and all but one of the participating women received analgesics, usually by 7 cm of dilation. After analgesia was administered, women assumed the semi-seated position in bed. So, like the Bloom trial, participants in this trial spent very little time upright, and most upright positioning occurred early in the active phase of labor.

Another small RCT published in 1990 looked at the effect of maternal position in the phase of maximum slope of active labor (e.g., 4-9 cm) on labor progress.[3] All of the participants were nulliparous and had intact membranes at the beginning of the phase of maximum slope. Women were randomized to assume upright (n = 20) or recumbent (n = 20) positions. Acceptable upright positions included standing, ambulating, sitting, squatting, and kneeling. Variations for the recumbent group included supine, lateral, or hands-and-knees. Women were not prevented from using the positions from the other group for "routines of care and for rest" (p. 9). Half of the women allocated to upright positions assumed lateral positions for up to one hour after receiving analgesic drugs. The researchers did not report how frequently the women in the recumbent group assumed upright positions. The researchers detected a difference in the length of first stage labor, favoring the upright group (235 min vs. 325 min, absolute difference 90 min). Unfortunately, the researchers did not report mode of birth, and we cannot assume that a shorter first stage necessarily resulted in more vaginal births.

3. Movement and upright positioning are associated with increased maternal comfort and satisfaction.

A systematic review of non-pharmacologic pain management techniques synthesized the findings of 14 controlled trials of positioning during the first stage of labor in healthy women at term.[22] Eight of these trials (N = 311) used each woman as her own control by having her alternate between specified positions for pre-determined periods of time. In general, women were more comfortable the more upright they were. For example, women reported less pain while standing than while sitting or supine. Sitting was, in turn, more comfortable

than supine. Comparing sitting with side-lying, the women reported less pain with sitting until 6 cm and then less pain with side-lying from 7-10 cm. Some of the positions did not result in significantly improved comfort, but none of the women in these eight trials found the supine position more comfortable than other positions. The six remaining trials included in the systematic review (N = 2629) compared two groups of women: an experimental group who were encouraged to remain upright (sit up, stand, or walk) during first stage, and a control group, who remained recumbent in bed. Three of the trials found decreased pain in upright positions and two found no difference. One of the trials showing no difference was Andrews and Chrzanowski (1990), included in the previous mini-review,[3] although participants in the recumbent group were having shorter, less frequent contractions, so they would be expected to feel less pain. In fact, at each hourly assessment, comfort scores were higher in the upright group, although these differences did not achieve statistical significance. Women in the upright group also received less narcotic analgesia (21 mg vs. 39 mg), although, again, the difference was not statistically significant. The remaining trial included in the systematic review found increased pain in the upright position. However, unlike the other trials that allowed women allocated to the upright groups to assume recumbent positions as needed, this trial required those in the upright group to remain upright throughout labor. One included trial assessed satisfaction with the option of walking by asking women who had walked if they would choose to do so in a future labor. Ninety-nine percent of respondents said they would.

An RCT published after the close date for the systematic review compared satisfaction in women assigned to receive encouragement to remain upright (n = 54) and women who were assigned to receive no such encouragement (n = 53).[18] All women in both groups were upright at some point during labor with the "upright group" assuming an upright position 57% of the time prior to receiving analgesia and the control group assuming an upright position 29% of the time. When the researchers analyzed outcomes by intent-to-treat, no differences were detected. However, because most women in both groups were upright and many were supine at various points in labor, researchers evaluated women's satisfaction with each position. Within each study group, women preferred upright positioning over the supine position. Statistical significance was not reported, but the magnitude of the difference was large. In the group that received encouragement to be upright, 42 of 54 women preferred being upright. In the group that did not receive instruction or encouragement, 33 of 53 preferred being upright. The most common reasons cited for being dissatisfied with the supine position were "increased pain" or "uncomfortable." Moreover, four women in the upright group and 10 in the control group remained upright for the entire first stage until analgesia was administered. Analgesia was a routine practice in the study setting. All women except one received pharmacologic analgesia (type not specified), and the two assigned groups did not differ in average dilation at administration of analgesia (about 7 cm in both groups).

4. Maternal movement and upright positioning in labor do no harm.

The six RCTs included in Simkin and Bolding (2004) assessed the safety of ambulation and upright positioning by evaluating effects on maternal outcomes, including postpartum blood loss and episiotomy, and newborn outcomes, including Apgar scores, need for resuscitation, and neonatal mortality.[22] No trial found that a supine position was associated with

improved maternal or fetal/neonatal wellbeing. One small trial comparing ambulation with side-lying reported more late decelerations of the fetal heart rate (suggestive of decreased fetal oxygenation) in the recumbent group.[10] The remaining trials found no difference in any reported maternal or fetal/newborn outcome. An RCT published after the systematic review also found no difference in abnormal fetal heart rate tracings or low Apgar scores.[18] However, the subsequent trial and those included in the systematic review were generally small, and most included only healthy women with no obstetric complications. For both these reasons, the studies are very likely underpowered to detect clinically significant differences, but should they exist, the research suggests they would favor non-supine positions.

5. The hands-and-knees position does no harm and may be beneficial when the fetus is in an occipitoposterior position.

A small Canadian RCT evaluated the effectiveness of hands-and-knees position in labor for rotating a fetus from an occipitoposterior (OP) position, alleviating back pain, and improving perinatal outcomes.[24] Healthy, low-risk women in the first stage of labor with an OP fetus confirmed by ultrasound were randomized to either the hands-and-knees group (n = 70) or the control group (n = 77). Those in the hands-and-knees group were asked to spend as much time as possible in the hands-and-knees position over a period of 60 minutes, for a minimum of 30 total minutes. They were then encouraged to use the position according to their preference for the remainder of labor. Those in the control group were able to use any position except hands-and-knees (or similar position resulting in the suspension of the abdomen) during the 60-minute study period. Following the study period, they were not encouraged to use a hands-and-knees position but were not discouraged from doing so.

Persistent back pain scores were reduced in women who used the hands-and-knees position compared with those in the control group. While fetal rotation to the optimal occiput anterior position (confirmed by ultrasound after the study period) occurred more frequently in the hands-and-knees group (16% vs. 7%), this association failed to achieve statistical significance. Similarly, non-significant trends favoring the use of hands-and-knees positioning was found for operative delivery, head position at the time of birth, and time from randomization to birth. Hands-and-knees positioning was apparently acceptable to women, evidenced by the fact that 84% of survey respondents said they would use the position again in a future labor, with increased comfort and improved labor progress listed as the most common reasons.

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Augmentation: Forced Labor

"Management of labour is now based squarely on the simple proposition that efficient uterine action is the key to normality. A strictly pragmatic approach has shown beyond doubt that efficient uterine action can be provided with a very high degree of safety, subject to a small number of rules that are precisely stated. As a consequence of these new-found certainties, a dynamic approach to the birth process based on efficient uterine action, has replaced the old static approach."

O'Driscoll 1993, p. 16[39]

"Time is usually an ally, not an enemy. With time, many problems in labor progress are resolved. In the absence of clear medical or psychological contraindications, patience, reassurance and low or no risk interventions may constitute the most appropriate course of management."

Simkin 2005, p. 3[53]

In Neverland, the children arrived at their underground home by sliding through trees. Peter measured the children for their trees "as carefully as for a suit of clothes: the only difference being that the clothes are made to fit you, while you have to be made to fit the tree" (p. 75-76).[5] If you do not, Peter "does some things to you, and after that you fit. Once you fit, great care must be taken to go on fitting" (p. 76). It is left to the imagination what Peter might do to a child who does not continue fitting its tree.

We cannot think of a more apt metaphor for medical-model concepts of labor dystocia. The precept that the uterus should perform according to a schedule and, if it does not, that something will be done to make it conform to one has its clearest enunciation in active management of labor (AMoL), but it underlies medical-model labor management regardless of what it is called. This chapter debunks AMoL, exposes the subjectivity of current standards of dystocia, and defines normal labor progress.

AMoL: FICTION VERSUS FACT

AMoL was the brainchild of a small group of obstetricians at the Dublin National Maternity Hospital in the late 1960s.[39] As Masters (the term used for chiefs of obstetrics), the rigidly hierarchical structure at the hospital enabled them to impose

AMoL as the uniform practice of the hospital without exception, input from others, or supportive evidence. AMoL is popularly believed to consist solely of amniotomy shortly after hospital admission and administration of a high-dose, short-interval oxytocin protocol to any woman whose cervix fails to dilate at an average rate of 1 cm per hour for a period of 2 hours, i.e. a 2-hour action line on a partogram. AMoL also limits labor length to 12 hours: 10 hours to dilate and 2 hours to deliver the baby. These elements, however, are not the whole story.[39] AMoL also includes the following:

- Constant companionship of a midwife or midwifery student. Some have argued that this may be *the* effective component of the package,[7] but it is debatable. The Cochrane review of continuous support in labor found that only non-medical staff achieved a significant reduction in cesarean rate.[20]
- Childbirth preparation classes. Knowing that one's care providers believe labor will almost always end in vaginal birth and the assurance of continuous supportive care can reduce anxiety, which would promote labor progress.
- Diagnosis of labor dependent on painful regular contractions in the presence of complete effacement, bloody show, or rupture of membranes. These criteria ensured that only women who were, or were likely soon to be, in active labor were admitted to the labor ward. Unfortunately, though, women with painful contractions alone were not sent home, but kept in an antenatal ward, sometimes called the "not-in-labor" room, where they received little support.[52]
- Discouragement of pain medication, although that has changed now, apparently without much affecting cesarean rates.[22] Instrumental vaginal delivery rates are high (19%), however, nearly double the rate (10%) before epidural use became more common,[39] and instrumental delivery is far from harmless. (See chapter 14.) Still, cesarean rates with epidurals depend on management practices, including timing of epidural initiation, use of oxytocin, and patience with longer labors. (See chapter 12.) Epidurals have been a boon to advocates of active management by both increasing the need for oxytocin and removing the main impediment to its use: increased pain.
- Labor care given by experienced midwives,* not midwife or obstetrician trainees. This would ensure confident, skilled care.
- AMoL limited to nulliparous women. Multiparous women not fitting the labor progress curve were thought to have problems with fit rather than drive. Nulliparous women's uteruses were also considered to be rupture proof and therefore not at risk with a high-dose oxytocin protocol.

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* At the Dublin National Maternity Hospital, midwives act both as intrapartum nurses and birth attendants at normal births, but they do not make care decisions or set policy.

In addition to a limited understanding of AMoL's components, AMoL has accreted erroneous beliefs, which we deconstruct in this chapter.

Fiction: AMoL was developed to reduce cesarean rates for labor dystocia.
Fact: Cesarean surgery rates were under 5% when AMoL was introduced and, in fact, rose slightly thereafter.[39] AMoL's progenitors framed it as a boon to women. Citing no data, they claimed that women's morale deteriorated after 6 hours of labor and that this deterioration accelerated rapidly after 12 hours. Limiting labor to 12 hours offered the twin benefits of eliminating the need for treatment for dehydration and ketosis and reducing demand for analgesia. Dehydration and ketosis are, of course, iatrogenic problems arising from depriving women of oral intake in labor, and if women themselves had been asked whether they preferred a kinder, gentler, albeit, longer labor, they would have discovered that women find augmented labors more painful,[18, 51, 61] a factor that would tend to increase desire for analgesia. The real benefits accrued to staff: AMoL reduced the care provider's wait through the "tedious hours of the first stage of labour until the cervix reaches full dilation" (p. 13) and to the hospital: "The newfound ability to limit the duration of stay and, therefore, quantify the total number of consumer hours to be serviced, has transformed the previously haphazard approach to planning in this area" (p. 114).[39]

Other practices might explain the Dublin National Maternity Hospital's low cesarean rate. For example, AMoL's progenitors write that staff obstetricians ignore occiput posterior (OP) antenatally and in first stage labor, other than to treat slow progress generically with AMoL, because "As with cephalopelvic disproportion, experience has shown that the greater the emphasis, the more likely it is that difficulties will follow. The anxious doctor creates his own problems under both those headings" (p. 68).[39] Posterior position that persists into second stage for more than an hour is treated by manual rotation if the head is on the pelvic floor and it can be done easily, or sometimes the woman is able to birth the baby in the OP position. We wonder what the results would have been had practitioners looking to reduce cesarean rates for dystocia adopted approaches such as this one instead of AMoL.

Fiction: The AMoL oxytocin regimen has a scientific basis.
Fact: The precision of the AMoL regimen creates the illusion that it is scientifically based, but AMoL was developed before researchers had the technology to research oxytocin metabolism, research that subsequently showed the AMoL oxytocin regimen to be anything but evidence-based. The specificity and strictness of the protocol was to ensure that soft-hearted midwives did not "reduce the rate of infusion simply because the mother complains of the pain, which is, of course to be expected" (p. 55).[39] So much for the Masters' solicitude around the woman's experience of labor.

Fiction: AMoL is safe.

Fact: AMoL trials are not large enough to detect differences in occurrence of uncommon severe morbidity. However, the Dublin National Maternity Hospital conducted a large trial (13,100 women) of routine continuous electronic fetal monitoring (EFM) (cardiotocography), in which AMoLs originators damned it with their own data.[33] The neonatal seizure rate was 10 times (260 per 10,000) the rate in an even larger EFM study (14,600 women, 27 per 10,000) at a U.S. hospital that did not practice active management.[31] Seizure rate in the Dublin EFM trial was associated with longer labors and oxytocin use, i.e., the very labors for which AMoL prescribed high-dose oxytocin. Neonatal seizures may not only have resulted from fetal hypoxia consequent to uterine hyperstimulation, but also from hyponatremia (low blood sodium), a consequence of fluid overload. Pregnant women are already predisposed to retain water, and oxytocin acts as an antidiuretic at high infusion rates (> 20 mU/min).[42] AMoL permits infusion rates up to 40 mU/min.[39] (See also chapter 11.)

Excess seizure rate is not the only harm. The Dublin EFM trial also reported three neonatal deaths from forceps injuries in babies delivered for prolonged pushing phase. In another AMoL study, staff ignored a case of uterine hyperstimulation, and the baby died.[62] In addition, early rupture of membranes may cause more episodes of nonreassuring fetal heart rate (FHR), increase infection rates, and predispose to persistent OP position, and it can precipitate umbilical cord prolapse. (See mini-review 5.)

Psychological morbidity is also an issue. AMoL prescribes augmentation for labors that do not progress steadily at the *average* rate. With active management, 45% of first-time mothers had labor augmented at a time when few (15%) had epidurals, which would have slowed labor.[39] AMoL conveys to large numbers of women that their bodies are incapable of birthing a baby without help, which surely has significant adverse psychological consequences for self-image and self-confidence. What, too, is the psychological aftermath for the women relegated to the "not-in-labor" room, who are told that contrary to what they were feeling, nothing worthy of attention and support is happening to them? Furthermore, according to the Dublin Masters, women ranked as privates in a scheme of "military efficiency but with a human face" (p. 103). The purpose of antenatal classes was to "define a woman's role in labour and to teach her how to fulfil it" (p. 77), her role being to "behave with dignity" and refrain from the "degrading scenes which occasionally result from failure of a woman to fulfil her part of the compact" (p. 105).† Back when pain medication was discouraged, what about the women who could not tolerate contractions generated by a high-dose oxytocin protocol and

† The Dublin Masters were dubious about the presence of husbands, one reason being that they might foster insubordination in the ranks: "Sometimes it is difficult to avoid the impression that husbands are enlisted to protect their wives . . . from unwarranted intervention" (p. 95).[39]

who engaged in the "degrading scenes" so deplored by the Dublin obstetricians? And although this is a problem with all obstetric management models, not just AMoL, what happens when we deprive women of the exhilaration and mastery that often comes with a birth free of interventions, an experience that can change how a woman sees herself forever?

Fiction: AMoL averts poor outcomes associated with prolonged labor duration.
Fact: Over the decades, the Dublin National Maternity Hospital Masters moved back the threshold for prolonged labor from 36 hours in 1963 to 12 hours in 1972, but they offered no evidence supporting the change beyond a commitment "not to expose anyone to the stress of labour for more than 12 hours" (p.35),[39] by which they meant women, not fetuses. AMoL would not benefit fetuses in any case because their risk arises from prolonged active phase, and AMoL only affects latent phase duration.[6] (Some studies report increased cesarean rates with prolonged latent phase, but medical-model management is almost certainly at fault. [See mini-review 1.]) AMoL is useless in the phase of labor where it might theoretically prove beneficial. Not that this stopped the Dublin doctors from advocating it: undeterred by their own evidence that AMoL was ineffective, they declared slow dilation in early labor to be "inefficient" (p. 365),[6] thereby inventing a problem for which AMoL became the cure.

Fiction: AMoL reduces cesarean surgery rates for dystocia in nulliparous women.
Fact: Yes, and no. A Cochrane systematic review of seven trials of AMoL in low-risk nulliparous women reported that AMoL had a nonsignificant effect on reducing cesareans (absolute reduction 1.5%).[7] Reviewers then repeated the analysis excluding the largest trial, Frigoletto et al. (1995),[14] on grounds that the high rate of exclusions after randomization may have introduced bias.‡ In the new analysis, AMoL achieved a modest, statistically significant absolute reduction (3.3%) in cesarean rates. (See mini-review 3.) Consider, though, that clinicians knew which women were allocated to AMoL and that AMoL was supposed to reduce cesareans for poor progress, that labor dystocia is defined by rate of progress, and that high-dose, short-interval oxytocin protocols are consistently found to shorten labor duration. In other words, if more women can be forced to fit their doctors' unrealistic expectations of labor duration—fit their Neverland tree, so to speak—their doctors may operate less often.

We do not see much formal discussion of AMoL today, but its philosophy forms the basis of current medical-model labor management. Under the false veneer of benefitting women by reducing cesareans for labor dystocia, AMoL lent

‡ This trial was the only one that included the education component, which meant that, unlike the other trials, women had to be randomized early. As a result, many more women no longer qualified by time of hospital admission.

legitimacy to the principle that making women labor faster was itself a virtue.[65] Many intrapartum units today practice early amniotomy, have little tolerance for delay in progress, and use high-dose, short-interval oxytocin regimens.

THE AMoL TOOLBOX: THE PARTS ARE NO BETTER THAN THE WHOLE

Routine Early Amniotomy

According to a systematic review, routine early amniotomy reduces diagnosis of dysfunctional labor, but not oxytocin augmentation rate and, more importantly, not cesarean rate.[56] It could be argued that this is because so many women in the "conserve membranes" arms of the trials had amniotomies, but amniotomy tends to increase, not reduce, cesarean rates, so any effect on cesarean rate in the "conserve membranes" groups would be in the wrong direction. (See mini-review 4.)

An increase in cesareans has biologically plausible rationales. Simkin and Ancheta (2005) write that rupturing membranes early in women with malpositioned babies deprives them of the benefits of the forewaters, which protect the fetal head from uneven molding and provide space for the baby to maneuver into a more favorable position,[53] Research supports the association: a study found that amniotomy was an independent risk factor for persistent OP.[11] That same study, among others (see appendix "Optimal Practice for Not So Optimal Babies"), also found that persistent OP was strongly associated with cesarean delivery. (See mini-review 5.)

Amniotomy also appears to increase risk of episodes of nonreassuring FHR, which would predispose to increased cesarean deliveries as well. (See mini-review 5.) Increased nonreassuring FHR, too, has biological plausibility. So long as membranes are intact, the umbilical cord floats inside a water balloon, its circulation protected from contraction pressure because a liquid cannot be compressed. Rupture membranes, and the protection is gone. At least one study found that early membrane rupture was more problematic (see mini-review 5), which makes sense: the longer stress continues, the greater the likelihood the fetus will lose the ability to compensate. It may not be coincidental that left alone, 70% of women reach full dilation with membranes intact.[56] Indeed, a major concern with low amniotic fluid volume is that it is associated with episodes of nonreassuring FHR due to cord compression.[21] Why, then, would clinicians provoke that scenario deliberately?

Early Augmentation

A systematic review of randomized controlled trials (RCTs) in low-risk, nulliparous women found no decrease in cesarean rate with early versus late augmentation. In fact, the reviewers found no decrease in cesarean rate with oxytocin augmentation, period, causing the lead author to comment, "We need better ways of managing slow progress in labor. . . . [T]he method we've relied on for so many years doesn't actually work."[1] On the other hand, early augmentation increased

the likelihood of uterine hyperstimulation with nonreassuring FHR changes. (See mini-review 6 for details.)

Other studies corroborate that delay in augmenting labors does not increase cesareans. Frigoletto et al. (1995), by far the biggest AMoL trial and the only trial that included all the Dublin AMoL components—childbirth education, 1:1 labor support, strict criteria for diagnosis of labor—failed to find a significant difference in cesarean rates in protocol-eligible women.[14] This was despite three times more women (26% vs. 9%) receiving usual care exceeding the 12-hour AMoL limit, which, if the principles behind AMoL are correct, should have tipped the balance strongly toward AMoL. If whatever constituted usual care worked equally well, then AMoL is not essential for managing delayed progress. In addition, a prospective study of low-risk nulliparous women reported an 8% cesarean rate in 1000 women treated for delayed progress,[27] a rate within the range of the active management arms in AMoL trials (4-12%) and lower than the pooled rate in the early augmentation arm of the systematic review (12%).[9] Clinicians achieved this despite using a very different and, we may say, more evidence-based (see "Labor Dystocia as State of Mind") definition for delayed progress. First stage delay was defined as less than 0.5 cm dilation per hour over 4 hours after reaching 4 cm, compared with AMoL's less than 2 cm over 2 hours after hospital admission, and second stage delay was defined as 2 hours from full dilation to onset of strong urge to push, 3 hours if the woman had an epidural, and an additional hour after urge to push, versus AMoL's 2 hours from full dilation to delivery. If treatment according to a far more conservative definition for delayed progress worked equally well, then AMoL is not necessary.

High-Dose Oxytocin

We now have the technology to study oxytocin metabolism and uterine response, and what we know indicts high-dose, short-interval oxytocin regimens. (See also chapter 7 text box "Pitocin Label Excerpt.") It takes 40 to 60 minutes for the uterus to respond fully to initiating oxytocin infusion or increasing rate, and a protocol that begins at 1 mU/min and increases dose by 1 mU/min at 40-minute intervals can accomplish vaginal birth in almost all women at maximum doses of 6 mU/min or less.[12] The AMoL protocol *starts* with a 6 mU/min dose and may go as high as 40 mU/min.[39] We know that fetal oxygen saturation reaches its nadir about 90 seconds after a contraction peaks and takes another 90 seconds to fully recover.[34] Ongoing strong contractions too close together can cause an incremental decrease in fetal oxygenation with potentially severe consequences. Uterine hyperstimulation poses maternal risk as well. Desensitization of oxytocin receptors can result in postpartum uterine atony and hemorrhage. (See also chapter 16 mini-review 4.) We know, too, that hyperstimulating oxytocin receptors desensitizes them,[43] a feedback mechanism that protects against hypoxia by weakening contractions, but

practice is often to "'Pit' through" the resultant "irritable uterus" pattern (frequent, low-intensity contractions), when the proper response should be to discontinue oxytocin and allow the uterus to recover.[34] We know as well that forcing stronger contractions in latent labor may be counterproductive. One reason dilation is slow in this phase is that the cervix is transitioning from pregnancy mode, where it tightens to resist the pull of uterine contractions, to labor mode, when it dilates.[40] With greater effacement, it stops fighting back. Finally, contraction strength, presumably the intent of high-dose oxytocin, predicts vaginal birth poorly. It is generally believed that women must sustain contraction strengths of 200 Montevideo units or more to achieve vaginal birth, but an augmentation study of 286 women found that while 85% of women who met this criterion had vaginal births, so did 83% of the women who never reached 200 Montevideo units and 74% of the women who did not sustain contractions at this level.[50]

Nonetheless, a systematic review comparing RCTs of high- versus low-dose oxytocin reported a modest (2%) but significant absolute difference in cesarean rates favoring higher-dose regimens.[66] High-dose oxytocin did not increase episodes of abnormal FHR or fetal distress, although it did double uterine hyperstimulation (20% vs. 11%) rates. What are we to make of this?

Insofar as fetal effects go, it must be remembered that these were low-risk women participating in a trial, which presumably means tighter control and supervision. The excess hyperstimulation rate certainly creates a potential for fetal compromise and is likely to do so under less controlled conditions and in a more general population.

As for cesarean rates, a closer look reveals that among trials in low-risk nulliparous women, despite similar populations, cesarean rates in the high-dose arms of some trials were higher than cesarean rates in the low-dose arms of other trials, and absolute differences were less than 1% in two trials, including in protocol eligible women in Frigoletto et al. (1995), the only trial to implement all of the components of AMoL.[14] Also, the only trial that eliminated clinician bias by concealing oxytocin dose, this one of mixed parity, reported a 2% (statistically nonsignificant) absolute increase in cesarean rate in the *high-dose* arm. (See mini-review 8.) The results tell us that low-dose oxytocin protocols can get the job done, and other factors, including clinician bias, influence cesarean rates.

AMoL, however, has legitimized forcing women through labor at an unnaturally rapid pace in the name of efficiency. This can be seen in struggles between nurses and obstetricians over the appropriate use of oxytocin. A study of nurse-physician communication during labor found that nurses reported pressure to "push the Pit," a practice they resisted on grounds that it compromised patient safety.[54] Most obstetricians wanted nurses to "keep the labor on track" and repeatedly used "aggressive" to describe how they wanted oxytocin administered. Doctors expressed frustration with nurses for not following orders. They saw nurses as overly concerned about

abnormal FHR patterns and too quick to discontinue oxytocin. Nurses, meanwhile, felt frustrated with physicians, who seemed to them to be motivated to hurry labor so that the baby would be born at a convenient time. Disagreements sometimes escalated to what the study's authors termed "behavior . . . inconsistent with what should be expected from another team member" (p. 550), an example of which was, "He said 'Get her delivered. I've got a meeting at 5 pm so she's going to have a section at 4 pm or she better be on the perineum . . . your choice'" (p. 550).

AMoL's "head 'em up; move 'em out" approach reaches its full flower in the horrific practice of "Pit to distress," in which women are given ever-increasing doses of oxytocin until they either deliver or the baby goes into distress, in which case the woman goes off for an emergency cesarean.[25] This would be a cesarean, we might add, that a woman would likely experience as obstetrician rescue of the baby from her body's failure and that would include all the factors—threat to life, threat to bodily integrity, powerlessness, pain—conducive to developing posttraumatic stress disorder (PTSD). But this is not the worst that could occur. High-dose oxytocin combined with failure to heed ominous symptoms can also lead to uterine rupture in an unscarred uterus, hysterectomy, hypoxic brain injury, or stillbirth.[55] "Pit to distress" is the monster that lurks behind AMoL's smiling mask.

LABOR DYSTOCIA AS STATE OF MIND

Active Management of Physician Perception

An RCT of AMoL in nulliparous women illustrates the extent to which cesarean rate for dystocia depends on beliefs.[32] Overall cesarean rates differed only modestly between AMoL (11%) and usual care groups (14%). A critique of this trial points out that the cesarean rate in nulliparous women the year previous to the study was 23%,[47] so merely conducting the trial decreased cesarean rates by 40% in women receiving usual care. The decline in cesarean rates in the usual care group might be attributed to contamination—that is, obstetricians began applying AMoL to women in the control group. It seems extremely unlikely, though, that so many women would need liberal application of oxytocin to deliver vaginally, and in any case, active management only benefited patients of private physicians. The cesarean rate in clinic patients was 9% in both AMoL and standard care groups. Incredibly, the trial's authors explained the difference between private and clinic patients by saying that AMoL seemed "especially effective" in private patients, "a group recognized as being at increased risk for dystocia" (p. 452). Given that all participants were healthy, first-time mothers who began labor spontaneously, the authors are claiming that having enough money to afford private care causes dysfunctional labor.

What constitutes delayed progress depends on what most clinicians believe constitutes normal labor length and progress pattern, beliefs that have been disproven without effect on practice. The famous Friedman labor curve, which serves as the basis for the partogram and for setting AMoL criteria, does not reflect means and extremes for normal labor duration or for rate of progress. Friedman derived his curve from labor graphs of 500 women of mixed parity in the 1950s, half of whom were delivered instrumentally; some of whom had cesareans, oxytocin augmentation, or regional anesthesia; and all of whom were delivered in an era when all women birthing vaginally had episiotomies,[68] all factors that would affect labor length.

The best data we have for extremes for normal labor duration and rate of progress come from two studies, one at a single institution and the other multicenter, that achieved remarkably similar results. Combined, they encompassed 4000 healthy women with term, singleton fetuses who labored and gave birth spontaneously without epidural analgesia and were attended by midwives.[3, 4] Investigators used the same standard as Friedman: two standard deviations below the mean (the slowest 5%) to demarcate prolonged labor. In nulliparous women, who are at greatest risk for delayed progress, the mean length of first stage from 4 cm to 10 cm dilation was 7.7 hours, which calculates to a mean rate of progress of 0.8 cm/h and a rate at two standard deviations below the mean of 0.3 cm/h. Friedman reported a mean dilation rate of 3.0 cm/h between 4 cm and 9 cm, and two standard deviations below the mean fell at 1.2 cm/h—faster than the *mean* in the physiologic dataset.[38] As for labor duration, two standard deviations from the mean in the physiologic dataset fell at 18 to 19 hours for length of active first stage and 2.5 hours for second stage for a total of 20 to 22 hours. (See mini-review 2 for more details and other studies.) In the Friedman dataset, two standard deviations from the mean fell at 8.5 hours for active first stage and 1.8 for second stage or 10.3 hours for total duration.[3] Moreover, the physiologic dataset represents the extreme of normal, *not* pathology: They were not augmented, ended in spontaneous vaginal births, and did not result in excess incidence of complications. Compare this with AMoL, which deems progress of less than 1 cm/h unacceptably slow, declares 12 hours to be abnormally long, and starts the clock before 4 cm dilation.

Another group of researchers point out that the expectation that dilation should progress at a minimal linear rate of 1 cm/h, now enshrined in AMoL and partograms, misinterprets the Friedman labor curve.[38] Friedman's curve is S-shaped. Dilation rate is slower in the early phase of dilation, accelerates, and then slows slightly as full dilation approaches. The 1.2 cm/h minimum applies only to the phase of maximum slope between 4 cm and 9 cm. About half of active-phase duration is spent getting from 2.5 cm to 4 cm. If the curve is converted to a straight line running from 2.5 cm to 10 cm, the rate at two standard deviations below the mean calculates to 0.6 cm/h, not 1.2 cm/h. The same group undertook a systematic

review of 25 studies of active labor duration in low-risk nulliparous women beginning labor spontaneously and confirmed that two standard deviations below the mean fell at 0.6 cm/h and amounted to an active labor duration of 13.4 hours, not 10, AMoL's limit of first-stage labor's normal length.[37] Review authors concluded: "A revision of existing active labor expectations . . . is warranted, and efforts to do so must supersede efforts to change labor to fit existing expectations" (p. 317).

What Does "10 cm" Dilation Really Mean?

The term "10 cm" to indicate full dilation is merely a convention signifying that the cervix has opened widely enough for the presenting part to exit the uterus. The last couple of centimeters' dilation are typically evaluated by estimating the width of the cervical rim and calling the point at which it disappears "10 cm." The true diameter at which this occurs will be determined by the diameter of the presenting part. For a baby with a large head, this could be 11 cm or more, while a preterm baby would be correspondingly less. Women with large babies or OP babies, which present a larger diameter than occiput anterior babies, may therefore be thought to be taking overly long to dilate, when, in fact, they have further to go to achieve full dilation.

Moreover, in some situations besides nulliparity labor may *normally* progress more slowly and still achieve spontaneous vaginal birth and good outcomes. These include labors in heavier women,[64] VBAC labors (see chapter 6), induced labors (see chapter 7), and labors with OP babies. In a system in which labors were considered innocent until proven guilty, this would be taken into account, but it is not, except, of late, with second stage in women with epidurals.

All of this, though, is almost beside the point. Anyone with more than cursory experience with laboring women knows that dilation and descent do not necessarily proceed smoothly and linearly. Women can dilate without accelerating pace, make quantum leaps, stall for hours and then resume progress, or even go backwards.[16] Descent, too, does not necessarily occur at an even pace. Labors can take a short or long time and still end in healthy, spontaneous births. Labor graphs, regardless of basis, are the product of averaging, at a minimum, hundreds of labors. They are a gross oversimplification of reality, which means any prescriptions for action based on them are a gross oversimplification as well. As much as clinicians would wish it, there are no hard and fast rules about normal versus abnormal, and women and babies would be infinitely better off if clinicians stopped pretending that there are.

The Partogram: Friend or Foe of the Laboring Woman?

The partogram was invented in the early 1970s and intended to reduce poor outcomes from obstructed labor in low resource countries by providing a timely means of identifying women experiencing abnormal progress in active labor. An alert line flagged nulliparous women in active labor who were progressing at rates in the lowest 10%, according to Friedman's data, so that they could be moved from a low-tech peripheral unit attended by midwives to a central unit capable of treating labor dystocia.[30] An RCT of 35,484 Southeast Asian women in the 1990s verified that it could serve this purpose.[2] Use of the partogram resulted in a decline in augmentation rates in low-risk nulliparous women (32% to 14%) and a rise in spontaneous vaginal birth rates (74% to 78%), mostly because cesarean rates declined from 10% to 7%. Both intrapartum stillbirths and in-hospital neonatal deaths among all women fell from 5 to 3 per 1000. The partogram, therefore, was associated with less inappropriate medical intervention, helping to limit it to women who truly benefitted.

In contrast, a Cochrane systematic review of RCTs of partogram use did not find these happy results.[30] Partogram use increased intervention rates without improving outcomes. In particular, women were more likely to have labor augmented with oxytocin with a 2-hour than a 4-hour action line without any benefit, and when a 3-hour versus a 4-hour action line was compared, more women had cesareans with the 3-hour line, again without improvements in outcomes. The reviewers discussed the partogram's possible drawbacks in the introduction, drawbacks subsequently supported by their results:

> The partogram's status within some obstetric units is such that they may restrict clinical practice, reduce midwife autonomy and limit the flexibility to treat each woman as an individual. . . . There are worries that use of the partogram can create unnecessary interference. This is because by assuming that all women will progress in labour at the same rate, partogram use could have adverse effects such as increased rates of artificial rupture of the membranes, oxytocin augmentation and use of analgesia resulting in a more negative labour experience. (p.4)

Turning to dystocia, all terminology for delay in progress—cephalopelvic disproportion, failure to progress, labor dystocia—amount to the baby not coming out within someone's idea of a reasonable time, a judgment that is highly subjective.

Proof of subjectivity can be seen in studies finding that altering the appearance of the partogram so as to give the visual impression that labor is taking longer (by increasing the distance between marks on the time axis or by including or not including latent labor on the graph), results in more recommendations for intervention.[10, 60]

We know as well that early admission leads to more use of oxytocin and operative delivery, and this is not simply because women having more difficult labors are more likely to present at the hospital earlier in labor. Increased use is at least partly a matter of perception that labor is taking longer and of practice variation. (See mini-review 1.)

The Cochrane review of early amniotomy and early oxytocin versus usual care also tells us that AMoL has much less effect on cesarean rates than practice variation.[7] All seven trials of the AMoL approach were in healthy, nulliparous women in spontaneous labor. Despite this homogeneity, cesarean rates in the AMoL group ranged among the trials from 4% to 12% in protocol-eligible women, a much bigger variation than the differences between AMoL and usual care arms within the same trial. In five of the trials, the difference was 4% or less between arms and the sixth trial favored usual care. (In the seventh trial the difference was 7%.) As we have seen, practice variation plays a role in effectiveness of AMoL's components as well. If the populations are homogenous but the results are not, the reason is probably related to variation in institutional practices and clinician judgment.

Finally, the two-hour action line imposed by AMoL results in 46% of healthy nulliparous women receiving oxytocin for inadequate progress.[30] If this many women require augmentation for abnormal progress, something is wrong with the definition of normal.

We are not arguing that dystocia isn't a real problem requiring nuanced diagnosis and appropriate treatment, but diagnoses of abnormal should be set at thresholds associated with the appearance of, or an increase in, pathology.[59] Current medical-model definitions of delayed progress do not meet that requirement. AMoL's premise that labors dilating at less than 1 cm per hour and second stages longer than two hours will lead to increased morbidity and operative delivery is false. Nor are we saying that AMoL's "everything looks like a nail" approach does not work. Data from the Dublin hospital shows that it does, provided that the practitioners wielding the hammer believe in it strongly enough. But go beyond the true believers and all the AMoL approach reliably does is shorten labor. Shortening labor may sometimes modestly reduce cesarean rates, but this is a byproduct of managing obstetricians' unrealistic expectations, not managing women's abnormally functioning uteruses. Most importantly, AMoL is not necessary to achieve good outcomes and low cesarean rates. What we truly need is to eliminate the impediments to progress that are more or less universal in the typical hospital environment under conventional obstetric management. We need a package of care that addresses true dystocia with the goal of maximizing the number of spontaneous vaginal births

of healthy babies to physically and mentally healthy mothers with the least use of medical intervention. Active management is blatantly and explicitly about what serves obstetricians and institutions at the expense of laboring women. Put the woman at the center and you get not "active management," but "optimal care."

STRATEGIES FOR OPTIMAL CARE

Regarding diagnosis and treatment of labor dystocia:

- Healthy women in latent labor belong at home, but they often need realistic expectations, guidance, and supportive care not available under conventional obstetric management.[24] Best practice dictates that institutions develop strategies for providing this.
- Slow progress in latent labor almost always requires nothing more than supportive care.
- The labor environment and care practices should promote, not impede, labor progress. (See chapters 8 and 13.)
- The partogram is highly subject to perception bias and commonly used labor curves, and alert and action lines are not evidence-based. In particular, the labor curve has a much flatter slope in nulliparous women than in multiparous women, has no sharp inflection point delineating latent from active labor, and does not become steeper until around 6 cm dilation.[67] If they are used at all, labor curves should be drawn according to current understanding of means and extremes of normal, and action lines, if any, should be set at four or more hours beyond the mean.
- In the absence of symptoms of infection or fetal intolerance of labor, time is the woman's friend in slowly progressing or arrested labors, not her enemy.

To resolve labor delayed progress:

- Maintain prophylactic and supportive care measures.
- Non-medical interventions such as addressing fear and anxiety, encouragement, rest, oral intake, and ambulation and position changes may suffice. Best practice principles dictate that women with epidurals should be encouraged to adopt upright or side-lying positions, not to remain in one position for an extended time, and to avoid recumbency. (See also mini-review 9.)
- Breast stimulation may be the optimal first response to progress delay if acceptable to the woman. It can reduce or eliminate need for oxytocin infusion, thereby avoiding its potential harms, gives the woman control, and has the advantages of endogenous over exogenous oxytocin. IV oxytocin does not cross the blood-brain barrier, whereas oxytocin produced in the pituitary produces loving feelings and sense of well-being.[8] (See mini-review 9.)

- If exogenous oxytocin is needed, mimic physiologic levels of oxytocin by starting at an initial dose 1-2 mU/min, increase in increments of 1-2 mU/min, and wait 40 min between dose increases so that the dose reaches full effect:
- Make an adequate trial of oxytocin. The "two-hour rule" results in unnecessary cesarean surgeries. (See mini-review 7.)

Keep in mind that:

- Rupturing membranes does not reduce cesarean rates, and it may increase infection rates, especially in the presence of internal monitoring.
- Ability to sustain contraction strength of 200 Montevideo units or more predicts vaginal birth poorly. This means that internal contraction monitoring does not improve ability to determine need for cesarean, and it is associated with an increase in maternal infection rates.

MINI-REVIEWS

Notes:

- The obstetric literature on diagnosis and treatment of labor dystocia is severely compromised by medical-model biases. What appears effective—or not—depends largely on clinician judgments and beliefs, which renders the research almost useless for determining when to intervene in a slowly progressing or arrested labor or for establishing what treatment strategies are safest and most effective. We can, however, use the research to disprove common beliefs about labor dystocia and its appropriate treatment. Nevertheless, while negative information has value, we badly need research conducted within a model of physiologic care.
- Although safety is often claimed for AMoL protocols, observational studies and trials are not big enough either alone or in the aggregate to detect differences in uncommon, severe outcomes.
- We have focused on nulliparous women in studies reporting outcomes according to parity because they are much more likely to experience delayed progress.
- We do not report the effect of the AMoL package or its components (routine early amniotomy, liberal diagnosis of delay in dilation, and use of high-dose, short-interval oxytocin regimens) on instrumental vaginal delivery rates because we do not find a physiologically plausible reason why these practices would affect second stage. While second-stage dystocia may be caused by inadequate contractions, etiology and treatment differ from that of dystocia in first-stage labor.
- Assume differences are statistically significant unless otherwise noted.

1. Hospital admission in latent labor increases the likelihood of medical interventions, including cesarean surgery, and differences in labor management and practice variation are culprits.

It is difficult to distinguish whether women having more difficult labors present earlier or early admission leads to overdiagnosis and treatment of labor dystocia because clinicians perceive labor to be taking longer. Practice variation may also play a role: physiologic care practitioners may admit women later in labor, and their practices may result in fewer cesareans regardless of admission timing. Three studies attempted to control for these factors. A prospective study of 2810 nulliparous women adjusted for factors associated with slower labors (age, height, prepregnancy BMI, cervical thickness and consistency and fetal station at admission, birth weight, and epidural use) and found that admission at < 4 cm dilation was independently associated with a 30% increase in diagnosis of dystocia during active phase or second-stage labor.[28] A study of the same population reported that this diagnosis was associated with a 99% augmentation rate, more cesareans (13.4% vs. 3.3%), and more vacuum extractions (27.6% vs. 5.0%).[27] A different prospective study compared outcomes according to timing of admission in spontaneous labor (early defined as < 4 cm dilation) in 1413 women (616 nulliparous) receiving midwifery care in a birth center with 783 similar women (292 nulliparous) planning hospital birth with an obstetrician.[23] Investigators looked at the effect of cervical dilation at admission stratified according to care provider type; effect of care provider stratified according to cervical dilation at admission; and whether the two together enhanced or diminished effects. Nulliparous women admitted in latent labor were more likely to have cesareans compared with women admitted in active phase regardless of care provider (midwife: 17.1% early vs. 6.7% late; obstetrician: 20.2% early vs. 10.1% late). Nulliparous women admitted by obstetricians were more likely to have cesareans than women admitted by midwives regardless of timing of admission (early: 20.2% obstetrician vs. 17.1% midwife; late: 10.1% obstetrician vs. 6.7% midwife). Parallel differences were found in instrumental vaginal delivery rates. Analysis of the joint effect found a synergistic interaction between having an obstetrician and dilation at admission. Finally an RCT was summarized in a systematic review.§[29] The trial randomly allocated 209 low-risk nulliparous women in term, spontaneous labor to assessment or direct admission.[35] Women in the assessment group who were not in active labor (defined as > 3 cm) were either sent home or asked to walk outside. Women in the direct admission group were more likely to spend more time laboring in the hospital (mean 13.5 h vs. 8.3 h) and less time laboring at home (mean 7.0 h vs. 10.3 h) and to have oxytocin augmentation for progress delay (40.4% vs. 22.9%). Differences in cesarean (10.6% vs. 7.6%) and instrumental vaginal delivery (35.5% vs. 30.5%) rates did not achieve statistical significance; however, the study was too small to detect modest but important differences. Moreover, crossover occurred. Twenty percent of women in the assessment group were admitted within one hour of presentation at the hospital,[29] and 16% of women in the direct admission group were sent home. Suggestive as well of a real effect of early admission, 2 of the 8 cesareans in the assessment group were for labor dystocia vs. 8 of 11 in the direct admission group.

§ The systematic review included additional data not included in the published trial.

2. Partograms increase use of medical interventions, including cesarean surgery, without improving neonatal outcomes, probably because the labor curves and typical action lines represent neither mean labor progress nor the point at which intervention improves neonatal outcomes.

The "1 cm per hour" mean dilation rate in active phase labor used in partograms is based on old data from a population in which many women experienced interventions that affect labor progress. Two contemporary studies provide better means and extremes for progress rates in physiologic labor.[3,4] Both studies have the same lead author and were conducted in healthy women in spontaneous labor at term with a singleton, vertex fetus. No woman had oxytocin augmentation, epidural analgesia, or an instrumental vaginal or cesarean delivery. The first study took place in a single institution among 1473 women (556 nulliparous) cared for by midwives.[4] Active first stage was defined as cervical dilation ≥ 4 cm and the demarcation of prolonged labor as two standard deviations from the mean, which is the slowest 5%. Women admitted in advanced labor were excluded. The second study was a multicenter study of 2511 women (806 nulliparous) using the same criteria.[3] The mean length of active first stage in both studies in nulliparous women was 7.7 h, which calculates to 0.75 cm per hour to dilate from 4 to 10 cm, and the mean length of second stage was 0.9 h for a total mean length of active labor of 8.6 h. The threshold for prolonged active first stage fell at 17.5-19.4 h in the two studies, which calculates to 0.3 cm per hour, and the threshold for prolonged second stage fell at 2.4-2.5 h, for a total length of prolonged active labor of 19.9-21.9 h. Complication rates (blood loss > 500 ml, postpartum fever, 5-minute Apgar < 7, infant resuscitation) were low and were not increased in the slowest quartile.

A systematic review evaluated the effect of introducing use of a partogram and of using various action lines.[30] Included were five trials of which two evaluated introduction of a partogram (Mexico and Canada, N = 1590), two investigated different placement of action lines (both in Canada, N = 3601), and one compared partograms with an alert and an action line with one with an alert line alone (South Africa, N = 694). In the two trials of partogram introduction, the Mexican trial reported a decrease in cesarean rates in the partogram group (9.4% vs. 24.8%, RR 0.38) while the Canadian trial reported no difference (21.6% vs. 21.0%). The Mexican trial had poor concealment of allocation and little information on study methods, which may have biased outcomes. Two Canadian trials (N = 3601) compared a two-hour action line with a four-hour line. Women in the two-hour action line group were more likely to receive oxytocin augmentation (46.5% vs. 41.0%, RR 1.14), but cesarean rates were similar as were neonatal and maternal outcomes. One of the trials (N = 613) also compared a two-hour action line with a three-hour line and a three-hour line with a four-hour line. Significantly fewer women had cesareans with a four-hour action line: 11.1% 2-hour line, 14.2% 3-hour line, 8.4% 4-hour line. No differences were found for maternal or neonatal outcomes. The South African trial of an alert line vs. both alert and action lines (N = 694) reported fewer cesareans with an alert line only (16.0% vs. 23.4%) with no differences in maternal or neonatal outcomes.

3. Early intervention with amniotomy and high-dose, short-interval oxytocin regimens has minimal, if any, effect on cesarean rates.

A Cochrane systematic review pooled outcomes (7 trials, 5390 women) comparing AMoL with usual management.[7] All participants were healthy nulliparous women in spontaneous

labor at term with a vertex fetus. The AMoL package consisted in all cases of early amniotomy; delay defined as progress at < 1 cm per hour; and a high-dose, short-interval oxytocin regimen for treating delay. Four studies included one-to-one care in labor, and one study included special childbirth preparation classes as well. Usual practice, deemed "noninterventionist care" (p. 3), more accurately might have been termed "somewhat less interventionist management." Amniotomy rates with usual management in the four trials reporting this ranged from 50-63% with a fifth trial reporting that 20% had spontaneous rupture of membranes compared with 61-91% in the AMoL groups. Augmentation rates with usual management ranged from 27-66% vs. 53-71% with AMoL. One trial used the same high-dose, short-interval oxytocin regimen in both groups, and while the other six used lower-dose, longer-interval regimens with usual management, only one used an evidence-based regimen (1 mU/min increasing by 1 mU/min every 30-40 min). No trial blinded clinicians to allocation group, which could introduce bias. Results were as follows:

- The meta-analysis of cesarean rates found a decrease with AMoL that just missed statistical significance (RR 0.88, CI 0.77 – 1.01), but the absolute reduction was small (1.5%). The reviewers then repeated the analysis, removing Frigoletto et al. (1995),[14] by far the largest trial, on grounds that many women were excluded after random assignment and that this could introduce bias. Excluding this trial, AMoL achieved a modest, statistically significant decrease in cesarean rates (3.3%); however, it is not clear that excluding this trial was appropriate. This trial was, in fact, not only the largest but the strongest of the tests of AMoL because it included all its elements. The reason for the high post-randomization exclusion rate was that this trial, unlike the others, included the childbirth preparation component, which meant women had to be entered into the trial early, and sizeable percentages were not protocol eligible at hospital admission. This trial reported similar cesarean rates (10.9% AMoL vs. 11.5% usual management) in protocol-eligible women.¶[14] The pooled cesarean rate in the AMoL group was 13.3%, 9.8% when calculated using Frigoletto's protocol-eligible numbers,[14] results inferior or similar to rates (8% and 10%) achieved in studies of low-risk nulliparous women receiving physiologic care in out-of-hospital settings.[26, 46]
- Half as many women had labors exceeding 12 h with AMoL (11.0% vs. 23.4%). Given the minimal difference in cesarean rates with AMoL, this refutes the belief that labors exceeding 12 h indicate labor dystocia.
- No statistically significant differences were found for maternal or neonatal complications; however, the review is underpowered to detect differences in rare severe adverse outcomes. In addition, many women in the usual management group were exposed to the same potentially harmful interventions as women in the AMoL group, which would decrease differences between the groups.

Review data also suggest that practice variation plays a much bigger role in determining cesarean rates for dystocia than AMoL. Despite the homogenous populations, cesarean

¶ Frigoletto and colleagues reported cesarean rates both according to "intent to treat" and women eligible for AMoL at labor onset. The Cochrane reviewers cite the former while we have chosen the latter as being more comparable to the other AMoL trials.

rates in the AMoL group ranged among the trials from 4-12%, a much bigger variation than the differences between AMoL and usual care arms within the same trial: in six of the trials the difference was 4% or less between arms, and in one trial the difference favored usual care, while in the seventh trial the difference was 7%.

4. Routine early amniotomy probably increases the likelihood of cesarean surgery.
A Cochrane systematic review of routine early amniotomy vs. conserve membranes compared cesarean rates (9 trials, 4370 women) and found a trend (RR 1.3 CI 1.0 – 1.6) toward increased cesarean rates (5.7% vs. 4.7%) in the early amniotomy group.[56] Rates with routine amniotomy exceeded those of the control group among nulliparous women (5 trials, 2517 women), multiparous women (1 trial, 940 women), and mixed parity populations (4 trials, 913 women), but differences did not achieve significance. However, large percentages of women in the conserve membranes groups had amniotomies. Rates ranged from 31-59% with two trials not reporting. Because crossover diminishes differences between groups, amniotomy would likely have had a much stronger association with cesarean rates had not so many women in the conserve membranes groups had amniotomies. The likelihood of increased incidence of nonreassuring FHR and persistent posterior position with early amniotomy could explain the association. (See mini-review 5.) Regardless, amniotomy does not reduce cesarean surgery rates, which is the rationale for performing it routinely.

5. Early amniotomy has potential adverse effects, including possible increased likelihood of nonreassuring FHR, persistent OP fetus, and infection, and it can precipitate umbilical cord prolapse.
The Cochrane systematic review of routine early amniotomy vs. conserve membranes reported a trend (42.7% vs. 38.7%, RR 1.1 CI 1.0 – 1.2) toward increased likelihood of suboptimal or abnormal FHR tracing with amniotomy during first stage labor (4 trials, 1284 women).[56] However, the two bigger trials (1153 women) reported that 31% and 51% of women in the conserve membranes groups had amniotomies, which would diminish differences between groups. (The two smaller trials did not report crossover rates.) In addition, more women had oxytocin augmentation in the conserve membranes groups in the two bigger trials, amounting to an absolute difference of 4.6% in one, which did not achieve statistical significance, and 18.6% in the other, which did. Oxytocin augmentation is a potential confounder because it increases the likelihood of nonreassuring FHR. (See mini-review 8.) Also supporting an association between amniotomy and nonreassuring FHR, one of the two larger trials did not report an excess, but a reanalysis found an association when analysts took into account that amniotomy shortened labor.[17] When they calculated the number of episodes per hour, they found that early amniotomy doubled the average number of episodes of severe variable decelerations, an abnormal FHR pattern associated with umbilical cord compression, and increased the average number of late decelerations per hour. Moreover, crossover rate in this trial was 51%. It must be remembered, too, that trials were in healthy women and babies; amniotomy could cause more problems when the fetus is compromised or already stressed by oxytocin augmentation or induction. Finally, early amniotomy may be more problematic than late amniotomy. In another study, researchers randomly assigned 209 women to induction of labor with oxytocin and early amniotomy

or amniotomy performed at or after 5 centimeters dilation.[36] Four times as many early-amniotomy group members as late-amniotomy group members (12% vs. 3%) experienced recurrent moderate to severe FHR patterns emblematic of umbilical cord compression. (See essay for a biologically plausible explanation of the association.)

Amniotomy predisposes to persistent OP position. (See essay for a biologically plausible explanation of the association.) A study analyzing associations with persistent OP position in 30,839 term, cephalic, singleton births reported an association with amniotomy after adjusting for correlating factors (11.3% vs. 7.6%, OR 1.2).[11] Persistent OP was strongly associated with cesarean surgery (47.0% vs. 4.4%), instrumental vaginal delivery (25.3% vs. 15.3%), and anal sphincter lacerations (22.3% vs. 9.7%).

The Cochrane systematic review of early amniotomy reported similar maternal infection rates (2 trials, 1460 women), but other studies suggest correlations among amniotomy, invasive procedures such as vaginal examinations, internal monitoring, and time.[56] (See also mini-review 4 in chapter 7.) Investigators in a 1989 study followed 408 consecutive women to determine factors associated with intra-amniotic infection and found that duration of ruptured membranes, number of vaginal exams, and use of internal monitoring were independently associated with intra-amniotic infection.**[57] A trial of management of active-phase arrest in 118 women, half of whom were assigned to oxytocin augmentation and half to augmentation plus amniotomy and internal monitoring, likewise reported more maternal infections in the amniotomy group.[48] A case-control study of factors associated with endometritis in 124 women having cesarean surgery compared with 310 women having cesareans and no endometritis also reported an independent association with amniotomy despite only 7% of case patients not having prophylactic antibiotic therapy.[41] Internal monitoring was associated in the univariate analysis but dropped out after adjustment for duration of ruptured membranes (and other variables).

The Cochrane review reported no difference between "routine amniotomy" and "conserve membranes" groups in the sole trial (N = 925) reporting on umbilical cord prolapse,[56] but, given the rarity of umbilical cord prolapse in a term pregnancy with a vertex fetus, all the trials together would have been severely underpowered to detect a difference even if crossover rates (31-60%) in the "conserve membranes" group had not been so high. We must turn to other study designs to determine an association with cord prolapse. A case-control study compared 37 cases of umbilical cord prolapse after hospital admission in women with intact membranes with 74 randomly selected control women admitted on the same day as cases.[45] Amniotomy rates did not differ significantly (68% cases vs. 53% controls), but of the 25 women who had amniotomy, 9 (36%) experienced umbilical cord prolapse at the time of rupture. In 6 of the 9 cases, amniotomy was performed because of concern for fetal status to either initiate internal fetal monitoring or amnioinfusion, which suggests the possibility of occult prolapse. Nonetheless, amniotomy was the precipitating factor in an overt prolapse that might have resolved with a shift in fetal position, and it converted a concerning situation into an emergency. In 10 of the remaining 12 cases, prolapse occurred at spontaneous rupture, again an indicator of association between membrane rupture and prolapse, although the association with spontaneous rupture may be at least

** This study was included because it and the other studies cited here were the only ones we could find evaluating the association between amniotomy and maternal infection.

partially explained by an excess of women in preterm labor (57% vs. 27%) among cases, i.e., the smaller the fetus, the greater the potential for prolapse. In a study of 87 cases of umbilical cord prolapse, 73 occurred after hospital admission.[63] Among these 73, amniotomy was performed in 29 (40%) of cases, and prolapse occurred within 30 min of amniotomy in 9 cases (12%), which suggests amniotomy precipitated the prolapse. A table reports cord prolapse following application of a scalp electrode in 4 women (5%) and after inserting an intrauterine pressure catheter in 6 women (8%) in separate categories. These procedures necessarily involve amniotomies if membranes are intact. It is not clear whether these prolapse cases are incorporated in the 29 amniotomies overall or represent additional cases. Finally, five out of eight cases of cord prolapse occurred subsequent to amniotomy in a comparison study of 11,800 labors beginning in free-standing birth centers and 2250 low-risk women having hospital births.[15] All women would have been at term with a single, cephalic baby and therefore at minimal risk of cord prolapse.

6. Allowing more time before augmenting for progress delay does not increase cesarean rates while early augmentation increases rate of uterine hyperstimulation with accompanying nonreassuring FHR.

A systematic review (8 trials, 1338 women) in low-risk, almost all nulliparous women (39 parous) of trials of oxytocin augmentation vs. no treatment or of early vs. delayed oxytocin augmentation for slow progress in first-stage labor of spontaneous onset found that oxytocin augmentation conferred no benefit beyond shortening labor duration but increased the potential for harm.[9] Specifically, neither oxytocin vs. placebo or no treatment (3 trials, 138 women) nor early vs. delayed oxytocin administration (5 trials, 1200 women) reduced cesarean surgery rates, but early vs. delayed administration (2 trials, 472 women) increased likelihood (6.9% vs. 2.7%, RR 2.5) of uterine hyperstimulation with FHR changes necessitating intervention.

7. Limiting trial of oxytocin augmentation to two hours before proceeding to cesarean surgery increases cesarean rates without improving outcomes.

Two studies by the same group at the same institution with nonoverlapping populations investigated the effects of a treatment protocol for active-phase arrest (cervix ≥ 4 cm dilation, ≤ 1 cm progress in 2 h) in healthy women in spontaneous labor at term.[49, 50] The protocol required at least four hours with a sustained contraction strength ≥ 200 Montevideo units or at least 6 hours if this could not be achieved. The first study reported on 542 women (288 nulliparous).[49] All but 10% had epidurals. Among nulliparous women, 88% had vaginal births. Among nulliparous women with no progress after 2 hours of oxytocin augmentation, 74% had vaginal births, and even after 4 hours with no progress, 56% delivered vaginally. If cesareans had been performed after 2 hours with no progress, 59 nulliparous women would have had avoidable cesareans. The second study reported on 501 (286 nulliparous) consecutive low-risk women with spontaneous labor onset receiving oxytocin for active-phase delay or arrest.[50] As before, 90% had epidurals. Among nulliparous women, 30 women had not progressed despite two hours of contractions sustained at ≥ 200 Montevideo units. Among these women 18 eventually had vaginal births.

8. Augmentation with high-dose oxytocin appears to result in a modest decrease in cesarean surgery rates compared with low-dose oxytocin; however, low-dose protocols are capable of achieving equally low cesarean rates.

A systematic review compared augmentation with high- vs. low-dose oxytocin (10 trials, 5423 women).[66] In the high-dose arms, initial doses and increments were 4-6 mU/min, interval between dose increases was < 30 min in 6 of the 10 trials, and maximum doses were 36-42 mU/min in the 3 trials reporting a maximum. In the low-dose arms, initial doses and increments were 1-2 mU/min, interval between dose increases was < 30 min in four trials, and maximal dose was 40 and 20 mU/min in the two trials reporting a maximum. High-dose oxytocin modestly reduced cesarean rates (13.2% vs. 15.1%, absolute difference 1.9%) and would have done slightly better (13.9% vs. 16.2%, absolute difference 2.3%) had reviewers used rates in protocol eligible women in the largest trial, Frigoletto (1995),[14] instead of "intent to treat." (Because Frigoletto [1995] included the childbirth education component of AMoL, women entered the trial in the third trimester, and many women were not protocol-eligible at labor onset.) However, a closer look at five trials in low-risk nulliparous women reveals that cesarean rates in the high-dose arms ranged from 8-11% while cesarean rates in low-dose arms ranged from 10-16%.†† Absolute differences ranged from minor (0.3-0.6%), the latter being Frigoletto (1995),[14] the only trial to implement all of the components of AMoL, to more substantial (3.6%, 4.2%, and 6.9%). Therefore, despite apparently homogenous populations, rates in the high-dose arms of some trials overlapped rates in the low-dose arms of others, and in some cases differences between arms in the same trial were under 1%. In addition, the only trial (501 women) that eliminated clinician bias by concealing oxytocin dose, this one of mixed parity, reported a statistically nonsignificant (2.1%) excess of cesareans in the high-dose arm. It therefore appears that low-dose oxytocin protocols can be just as effective as high-dose protocols, which argues that, as with early vs. delayed augmentation (see mini-review 6), practice variation, not differences in treatment, explain the results. Turning to harms, high-dose oxytocin doubled the likelihood of uterine hyperstimulation (20% vs. 11%) in the five trials (1446 women) reporting this outcome, but did not increase either episodes of FHR abnormality (3 trials, 1396 women) or fetal distress (4 trials, 1848 women).

9. We have little data, and studies are flawed, but ambulation and breast stimulation show promise for reducing the need for oxytocin augmentation in cases of progress delay in active labor.

We have limited data evaluating walking as a treatment for slow progress: two small studies published before 1990, the usual cutoff for inclusion in this book, which we include because data are so sparse, and a bigger one lacking crucial information published in 2008. In one, 14 women in active labor who had not progressed for an hour plus a further 30-min observation period to evaluate contraction strength via internal monitoring were randomly allocated to either immediate oxytocin infusion or ambulation.[44] In the first hour, all eight walking women made progress in dilation and descent of the fetal head vs. three of six women having

†† We exclude one trial with an unusual regimen that began at 10 mU/min and doubled the dose every hour in the high-dose arm versus beginning at 4 mU/min and doubling the dose every half hour in the low-dose arm. We also exclude a trial of only 40 women because even one cesarean more or less makes a substantial difference in rates.

oxytocin. In the second hour, one woman in the walking group gave birth and the rest made further progress while four women in the oxytocin made progress. All six women receiving oxytocin reported more pain whereas four ambulant women said pain was lessened and three said it remained the same. In the other small study, 57 women who would have been augmented with oxytocin for slow or no progress in dilation were randomly allocated to walk (n = 30) or to receive oxytocin (n = 27).[18] Women in the ambulation group were encouraged to move around, walk, stand, or sit as they wished. Outcomes were reported according to "intent to treat," and some women did not walk or only left their bed for a short time (percentage not reported). Sixty percent of the ambulation group delivered without need for oxytocin. Cesarean rates did not differ significantly. Women in the oxytocin group were more likely to experience contractions > 250 Montevideo units and a resting tonus > 18 mmHg. Of the 44 women responding to a questionnaire, 71% of women treated with ambulation said it was "pleasant" while only 4% of women given oxytocin said the same, 19% said walking increased pain vs. 83% of women given oxytocin, and 48% said walking decreased pain vs. no women given oxytocin. Study investigators argue that walking truly treated progress delay because mean labor duration was similar in the two groups. The larger, more recent study was of 412 low-risk nulliparous women with progress delay (≤ 2 cm dilation in 4 hr) after 3 cm and before 6 cm dilation who were randomly allocated to immediate oxytocin or oxytocin delayed for 8 h with encouragement to ambulate.[19] Cesarean rates were identical in both groups (14%), and only 30 of the 204 women assigned to conservative management received oxytocin before 8 h. We do not know, however, what percentage eventually had augmentation or what percentage of women walked, although we do know that 24% had epidurals before allocation and an additional 120 (59%) had one at some point after randomization, which suggests that many women may not have ambulated or may have ambulated only briefly.

Two trials have evaluated breast stimulation vs. oxytocin to augment labor. Unfortunately, both trials have marked difference in size of the two arms, which suggests subversion of random allocation. In one study women were randomly allocated to labor augmentation either by breast stimulation via breast pump (n = 40) or oxytocin infusion (n = 52).[58] Breast stimulation failure was defined as no change in uterine activity within 30 min. Four breast stimulation women dropped out because of discomfort before 30 min, and results for one woman in the breast stimulation arm and four women in the oxytocin arm were excluded because of poor quality contraction tracings. Groups analyzed were 17 breast stimulation successes, 17 oxytocin group women matched for parity, gestational age, and entry cervical dilation, all 48 oxytocin group women, and 18 breast stimulation failures. Cesarean rates were identical in the breast stimulation success group and the matched oxytocin group (18%). This was despite substantially lower mean (68 vs. 101 Montevideo units) and maximum (127 vs. 203 Montevideo units) contraction pressures in the breast stimulation group, a theoretical advantage in that lower pressures could minimize pain and the possibility of fetal distress. In the oxytocin group overall, the cesarean rate was 27% while 44% of the breast stimulation failures had cesareans. In the other trial, women with "indications for augmentation" were randomly allocated to breast stimulation via their choice of self-massage, support person massage, or breast pump or to oxytocin augmentation.[13] The study was planned for 200 participants but slow recruitment led to stopping after 78 trial entrants (48 breast stimulation, 30 oxytocin). Women with prelabor rupture of membranes > 1 h and < 24 h were included, which means some women were actually being induced. Breast stimulation

failure was defined as no cervical dilation or active labor pattern within one hour. One-third of the breast stimulation group never needed oxytocin. No woman was switched from breast stimulation because of adverse fetal events or uterine hypertonus. Among the 48 nulliparous women, women were equally likely to have cesareans (25%).

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Electronic Fetal Monitoring (Cardiotocography): Minding the Baby

"Modern intensive monitoring [electronic fetal monitoring combined with fetal scalp-blood sampling] of the fetus during labor affords the opportunity for the greatest possible safety to the infant, whilst at the same time dispensing with unnecessary operations to terminate labor which can be dangerous for the mother and her child."

Saling 1996, p. 7[72]

"Since the advent of EFM, EFM tracings and the debate surrounding their interpretation have proved more valuable to plaintiffs' lawyers than to physicians seeking potential patterns of fetal distress."

Lent 1999, p. 834[47]

A sequence in the Monty Python movie *The Meaning of Life* shows obstetricians preparing for a birth. "More apparatus!" the doctors command. "Get the machine that goes *ping!*" They especially want this machine because it is extremely expensive and will impress the hospital administrator should he drop by. The delivery room fills with equipment. All seems in readiness until one of the doctors notices that something is missing—the patient. Amused at their oversight, they retrieve her gurney from behind the equipment and shift her onto the delivery table. "The administrator is coming," warns the nurse. Hurriedly the doctors order her to switch everything on. The administrator enters. "Ah," he says, suitably impressed, "I see you have the machine that goes *ping!* Carry on." With a great show of busy self-importance and barking out of orders, the doctors deliver the baby and clap it into an isolette. Everybody rushes out with the equipment and the baby, leaving behind the bewildered mother. This sketch perfectly captures the obstetric fascination with electronic fetal monitors. As one real obstetrician explains it, "When you look at anything that has lights and a digital readout and a paper drum turning and an instantaneous fetal heart rate recording . . . it makes you feel like you're getting a lot of information" (p. 817).[47]

It is hard to blame them, though. Electronic fetal monitoring (EFM), called cardiotocography (CTG) in the U.K. and elsewhere, seemed to make so much sense and offer so much promise.[29, 32, 47] The underpinning belief is that intrapartum

asphyxia (hypoxia) is a major cause of perinatal death and major neurologic morbidity in general and cerebral palsy (CP) in particular. Intermittent auscultation picks up abnormal patterns preceding these outcomes, but intervening rarely averts them. The problem, obstetricians reasoned, must be too little information too late. Surely a machine that continuously monitors the fetal heart rate (FHR), making a tracing for analysis, will give doctors the means to identify impending brain injury and prevent it by rescue delivery. Good thinking, but, as H. L. Mencken said, "For every complex problem, there is a solution that is simple, neat, and wrong."

EFM has never lived up to its billing, yet despite growing recognition of that fact, the use of EFM continued to rise, and now virtually all U.S. women delivering in hospitals have continuous EFM during most or all of their labors.[19] EFM is embedded in the structure of hospital intrapartum units and acts as the central organizing principle of labor management. This chapter will document that EFM is a failure and why this inevitably should be so, and it will chart EFM's rise and persistence. Let us begin by looking at the rise of EFM.

EFM, THE EARLY YEARS: SELF-INTEREST, 1; SCIENCE, 0

EFM's history is a cautionary tale of the deleterious effects of conflicts of interest on our maternity care system. The father of EFM, Edward Hon, an obstetrician who invented the internal electrode, founded Corometrics Medical Systems to produce and market his device, and he and other physician-promoters of EFM held a majority stock position in this company.[12, 32, 69] Corometrics then served as a conduit for funding Hon's research at the University of Southern California (USC), providing over $1 million in contracts between 1971 and 1975.[9] Thanks to studies extolling EFM, Corometrics income rose from $467,000 in 1969 to $5 million in 1973.[12] By 1976, most intrapartum units had monitors and were using them on most women. None of the studies that came out of USC—all of which favored EFM—acknowledged industry funding, the researchers' personal connections with Corometrics, or that EFM researchers held patents on EFM devices.[9, 32] In 1975, USC rejected a proposal to conduct a randomized controlled trial (RCT) on the grounds that the value of EFM was so well established that it would be unethical to withhold EFM from control-group women.[32]

When the first trials and reviews began appearing showing that EFM was not improving outcomes while increasing the cesarean surgery rate, the obstetric community responded by shooting the messengers.[9] In particular, obstetricians attacked the credibility and integrity of Banta and Thacker, the authors of the first thorough and complete review of the EFM research. The *New England Journal of Medicine* rejected their paper, both peer reviewers making factual errors in problems alleged with the paper and one reviewer accusing the authors of misrepresenting the data. The same report was subsequently accepted with minor changes and

published in a different journal in 1979. Publication created an uproar, including critical commentaries by EFM advocates in *Pediatrics* and *Obstetrics and Gynecology*. Their commentaries also contained factual errors and accused the report's authors of bias. In that same year, the National Institutes of Health held a consensus conference on EFM to present the data for and against it to a supposedly neutral panel of experts. Banta was told he had 10 minutes to speak but was allowed only 5 minutes by the chairman. As he spoke, he overheard one of the panelists comment to the chairman, "Why don't you get him out of there?" (p. 712).[9] Following his presentation, one of the authors of the critical commentaries in *Pediatrics* and *Obstetrics and Gynecology* was given much more time than Banta to make a detailed rebuttal of Banta and Thacker's work from the floor.* Evidence steadily piled up thereafter, though, and a series of RCTs published during the 1980s and into the mid-1990s all contradicted the rosy picture of the early uncontrolled studies.

THE FACTS ABOUT EFM

With one exception (see text box "One of These Trials Was Not Like the Others"), the RCTs all concluded that EFM was a failure. The 2006 Cochrane systematic review of EFM versus intermittent auscultation, which pooled data from 12 trials and comprised more than 37,000 women, showed that continuous EFM failed to decrease incidence of any adverse neonatal outcome while babies of low-risk women were one-third *more* likely to be admitted to intensive care in the electronically monitored group.[5] In the sole trial of very preterm infants, continuous EFM also failed to decrease adverse outcomes, and CP incidence was *increased* in the electronically monitored group. Continuous EFM had one perinatal benefit only: 1.5 per 1000 fewer babies in the EFM group overall and 1.2 fewer babies per 1000 in low-risk women had neonatal seizures. No long-term differences were seen, however, and this short-term benefit was seen only in women receiving high dosages of oxytocin and early amniotomy under Active Management of Labor. This means the excess in neonatal seizures may be iatrogenic. (See mini-reviews 1 and 2.)

On the minus side, the systematic review reported that continuous EFM increased cesarean surgeries overall and cesarean surgeries for abnormal FHR/acidosis.[5] The excess numbers of women having cesareans in the EFM group overall and among low-risk women were small because cesarean rates at the time were much lower, but the excess among high-risk women—9 more per 100—was not. (See mini-review 3.) With the current liberal approach to performing cesarean surgery in conjunction with the fear of malpractice suits, the excess might be greater were the trials repeated today. As one obstetrician puts it, "The minute you see a deceleration on the heart monitor, you say maybe it's fetal distress, better to do a cesarean. . . . A lot of that is driven by fear of liability" (p. 63).[12]

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* This will sound depressingly familiar to anyone present at the 2006 National Institutes of Health consensus conference on elective primary cesarean surgery.

One of These Trials Was Not Like the Others

Only one EFM trial, conducted in Greece, has ever found that EFM reduced perinatal mortality. It reported an astonishing 1 more death per 100 with intermittent auscultation.[87] Dr. Murray Enkin, professor emeritus of obstetrics, gynecology, clinical epidemiology, and biostatistics at McMaster University in Canada and co-author of *Guide to Effective Care in Pregnancy and Childbirth*, commented on some disturbing aspects of this trial in a personal communication (Nov 13, 1993):

> [T]he results are widely discrepant from those reported in all previous trials. This is a most unusual finding, and can only be caused by differences in the populations studied, the intervention carried out, or the methodology of the trial.
>
> The method of allocation, by a coin toss, is open to enormous bias, and it is difficult to believe that all house officers involved would always be scrupulously honest. This suspicion is heightened by the discrepancies in the numbers in different strata in the two arms. For instance, of patients in spontaneous labour, there were 238 in the EFM group, 374 in the IA group, instead of the equal split that would be expected with a fair coin toss. The probabilities of such an unequal split occurring by chance would be too small to calculate. The probabilities of finding a 117 to 48 split in the 165 induced labours is too small to accept as due to chance.
>
> Also difficult to believe is that in a hospital with a perinatal mortality of 20-22 per thousand, during the study it dropped to 2.6 per thousand in the experimental group, and [13] per thousand in the control group. The results in the EFM group could only have been obtained if the house officers in the hospitals studied were far better in interpreting the tracings and acting on the interpretation than the investigators in all the American, Irish, British, and Australian studies reported. This still would not explain the halving of mortality in the control group.

To Dr. Enkin's commentary we add that of the six deaths attributed to hypoxia in the intermittent auscultation group, one baby had severe FHR decelerations in both first and second stage and was stillborn, which suggests staff did not respond to overt distress. Another death was a vaginally born breech who had mild second-stage decelerations yet 1- and 5-minute Apgars of 0 and 1, which suggests a complication during delivery or possibly a congenital problem. A third neonate with mild second-stage decelerations had ruptured membranes, which suggests infection, not hypoxia, as cause of death. Medical care quality is substandard as

well. One newborn died of hemorrhage from trauma to the base of the tongue during intubation for meconium. We note too that monitors and financial support were provided by a monitor manufacturing company, a red flag for possible bias. Despite these problematic factors, the trial was not excluded from the Cochrane systematic review.

It has been argued that the modern, more sophisticated understanding of FHR patterns has solved this problem, but a recent study suggests that EFM continues to cause unnecessary surgeries. Investigators compared outcomes in women planning birth in a freestanding birth center with birth-center eligible women who planned hospital delivery.[40] Half the women planning birth center birth versus almost all the women planning hospital delivery had EFM. Women with FHR abnormalities were equally likely to have cesarean sections for this diagnosis, but women planning hospital deliveries were nearly twice as likely to be diagnosed (19% vs. 11%),† without improvement, we should add, in neonatal outcomes.

Continuous EFM imposes other harms as well. Cochrane review meta-analyses found that 6 more low-risk women per 100 had instrumental vaginal deliveries.[5] (See mini-review 3.) Internal EFM appears to increase the likelihood of maternal infection, especially in conjunction with cesarean surgery, and case reports can be found of neonatal infection, sometimes serious infections resulting in death or severe morbidity, arising from the internal electrode puncture wound. (See mini-review 4.)

Continuous EFM has additional disadvantages not generally recognized. For instance, it restricts mobility: only 1 in 4 women laboring in hospitals walked once contractions were regular according to Listening to Mothers II, a survey of 1600 U.S. women, undoubtedly partly, if not predominantly, because of EFM.[19] Women also may be asked to take up or avoid certain positions in order to secure a better tracing, which deprives them of positions that they may have found more comfortable or that might have enhanced labor progress. EFM deprives women of showers or immersion in deep tubs or pools as well, comfort measures Listening to Mothers II respondents reported as effective at relieving labor pain.

All studies of maternal satisfaction with the labor experience report that emotional and physical support is a key component (see chapter 18), but EFM is antithetical to supportive care. Analysis of birth videos revealed that the nurse attended to the machine even at moments of the woman's greatest distress.[42] In one 5-minute segment, the nurse glanced at the monitor 19 times. As one woman

† It is also possible that the difference was not spurious but resulted from significantly increased use of interventions that can cause fetal distress in the population planning hospital birth. A proponent of EFM cites as a reason for using it that half the admissions to neonatal intensive care come from women who were low-risk at labor admission.[75] If true, this is a stunning indictment of medical-model management.

put it, "As soon as I got hooked up to the monitor, all everyone did was stare at it. The nurses didn't even look at me anymore when they came into the room—they went straight to the monitor. I got the weirdest feeling that *it* was having the baby, not me" (p. 107).[18] Centralized monitoring systems exacerbate this problem. A major selling point is that nurses can monitor many women from a single location and rarely need even enter the room. Fascination with the electronic monitor can interfere with supportive care by the woman's labor companions as well. A father writes, "No matter what I did, the machine kept drawing me to it. I just couldn't keep from watching the beeps. My wife would get angry every time I tried to say, 'Here comes a contraction . . . .'" (p. 819).[47]

Centralized monitoring raises another concern: we do not know how much harm electronic monitors really may be doing. During the EFM trials, women were closely supervised by medical staff. Today, staff have little knowledge of laboring women's conditions beyond what is displayed on the central bank of monitor screens. The investigators in the preterm labor EFM trial proposed an explanation for why they found more CP in the EFM group: the median time to delivery after diagnosis of abnormal FHR patterns was much longer (104 min vs. 60 min).[76] Clinicians, they theorized, may have been lulled by the detailed data the machine generates, or they may have been aware of EFM's high false-positive rate and therefore reluctant to act. In other words, continuous EFM may have given clinicians a false sense of confidence on the one hand and an unwarranted mistrust on the other.

The potential for serious iatrogenic harms is underappreciated. Rupturing membranes to insert an internal electrode releases the cushion of amniotic fluid that prevents umbilical cord compression. The added stress may be enough to put a compromised baby over the edge, or amniotomy may precipitate a prolapsed cord. EFM, as we have seen, increases the use of instrumental vaginal delivery. Forceps delivery can cause serious morbidity or even mortality that likely will be attributed to intrapartum asphyxia rather than its true source. In one study, autopsies of two of seven infants who died after delivery for "ominous" FHR pattern showed bilateral tentorial tears, a forceps injury.[92] Vacuum extraction can result in subgaleal hematoma, a potentially fatal hemorrhage. As already noted, fatal infections and infections resulting in permanent brain injury can arise in the scalp wound made by the internal electrode. (See mini-review 4.) Immediate cord clamping, a certainty when concern leads to performing umbilical blood-gas analysis, adds insult to injury in cases of suspected intrapartum hypoxia. It simultaneously prevents placental resuscitation via ongoing placental circulation after birth and deprives the newborn of a substantial proportion of its blood volume. (See chapter 17.) This too could result in encephalopathy or death in a baby lacking the reserves to compensate, but poor outcome likely would be attributed to intrapartum events. Last, but far from least, the excess cesarean surgery rate that accompanies EFM introduces maternal short-term, long-term, and future reproductive risks.

WHY DOESN'T EFM WORK AS PREDICTED?

A large body of literature documents that EFM could not possibly perform as it was hoped. To begin with, EFM's success depends on tight links between abnormal FHR patterns, hypoxic symptoms such as low Apgar score or acidemia, and permanent brain injury or death, but research shows no more than weak connections in this chain. FHR patterns do not predict low Apgar scores or acidemia very well.[13, 16, 50, 57, 58, 68, 73, 80, 84, 86, 89] Low Apgar scores and acidemia do not predict brain injury very well.[6, 20, 22, 38, 48, 51, 57, 71, 92] If the link between what confidently used to be called "fetal distress" and now is called "nonreassuring fetal heart rate patterns" and acidemia or low Apgar score is weak, and the link between those symptoms and brain injury is weak, then the connection between nonreassuring FHR patterns and long-term outcome is nearly nonexistent. And so it has proved: abnormal FHR predicts extremely poorly both early (hypoxic-ischemic encephalopathy [HIE], cerebral white matter injury, intraventricular hemorrhage) and permanent (CP) brain injury.[5, 6, 63, 70, 73, 92] EFM also errs in both directions: most of the children who developed CP in the Dublin EFM trial had no clinical evidence of intrapartum asphyxia.[33] (See mini-review 2.)

Why should this be? For EFM to work, its underlying hypothesis, that slowly developing hypoxia in labor is the major cause of permanent brain injury and perinatal death, had to be valid, but it is not. Many factors having nothing to do with intrapartum hypoxia are associated with poor neurodevelopmental outcome and death.[8, 27] EFM may signal the problem, but rescue delivery will make no difference. And EFM may make no difference with acute prelabor or intrapartum events such as placental abruption, umbilical cord prolapse, uterine rupture, or maternal cardiopulmonary arrest or abate neurologic injury from acute hypoxic events such as shoulder dystocia and difficult breech delivery.

Furthermore, slowing of the fetal heart rate and the switch to anaerobic metabolism that eventually decreases blood pH are not symptoms of deteriorating status but healthy adaptive responses to suboptimal conditions that function to protect the brain and vital organs from hypoxic injury.[10, 20, 27, 50, 71] Ruth and Raivio (1988) theorize that one reason acidemia correlates so poorly with neurologic injury is that the adaptation usually succeeds.[71] Dennis and colleagues (1989) support that theory with the finding that among newborns with low Apgar scores, *non*acidotic newborns were *more* likely to be impaired at age 4 than acidotic newborns.[20] Similarly, Svirko, Mellanby, and Impey (2008) found that cord blood pH at birth correlated inversely with intelligence and literacy test scores at ages six to eight.[83] Parer et al. (2006) cite older studies reporting a window of an hour or more between onset of late decelerations and acidemia, another indication of this compensatory mechanism at work.[68] Resorting too hastily to operative delivery harms the mother without benefiting the baby, exactly what we see in the systematic review of EFM trials.

Signs and symptoms of hypoxia also have nonhypoxic causes. Dextrose and other sodium-deficient IV fluids can cause low blood pH and low blood sodium (see chapter 11), and the latter can cause neonatal seizures. An EFM RCT at an Irish institution where dextrose IVs were standard practice reported a 10-fold greater neonatal seizure rate than a similarly sized U.S. EFM study, although high-dose oxytocin protocols and early amniotomy also may have contributed (see chapter 9).[5,81] Delivery will not improve outcomes in cases where hypoxia isn't the problem.

In addition, nonreassuring tracings may be false positives. FHR patterns arising from fetal states such as sleep or active awake and behaviors such as intrauterine breathing or suckling can mimic patterns associated with hypoxia.[54,66,75] Medications such as butorphanol (Stadol), nalbuphine (Nubain), and corticosteroids can result in harmless but nonreassuring FHR patterns.[3] Opioids can decrease FHR variability and responsiveness to scalp stimulation.[14,28] External monitoring may display the heart rate of the mother instead of the fetus,[37,59] and it may halve or double a fetal heart rate.[37,60,75]

Finally, caregivers may fail to respond. As we have already seen, median response time to abnormal FHR was 40 minutes longer in the preterm labor EFM trial in the EFM group compared with the intermittent auscultation group.[76] Another study reported that response times to severely abnormal FHR did not differ from response times to moderately abnormal patterns.[58] In one case of severe neurologic handicap, a severely abnormal tracing had continued for 8 hours; in another, a case of vasa previa causing fetal hemorrhage, 90 minutes passed before staff responded.

A Guide to Effective Care in Pregnancy and Childbirth (2000) sums up the history of EFM:

> A number of lessons can be learned from the trials of intrapartum electronic fetal heart-rate monitoring. First, "more information" is not necessarily beneficial and can have harmful effects. Second, if a test result is predictive of an adverse outcome, it should not be taken as self-evident that intervention based on the results of that test will prevent or ameliorate that outcome. Third, the relationship between measures in the neonatal period and long-term outcome is not straightforward, and measures in the neonatal period may not be accurate surrogates of long-term outcome (p. 279).[26]

EFM, THE LATER YEARS: REFUSAL TO FACE FACTS

The dawning realization that EFM did not work did not lead to abandoning it. Obstetricians first argued that measuring pH in a fetal scalp-blood sample would enable identification of fetuses truly at risk, thereby reducing unnecessary operative deliveries. But a 1994 study showed that fetal-scalp pH testing could be eliminated without affecting perinatal outcomes or increasing the cesarean rate for fetal

distress,[31] and a 1999 study showed that scalp-blood pH had low positive predictive values for low 5-minute Apgar score, low umbilical artery pH, and HIE.[45] This should not be surprising given the many studies showing weak association between acidosis and neurologic outcomes. The Cochrane systematic review of EFM confirms that scalp-blood sampling has little effect on either cesarean rates or perinatal outcomes.[5] (See mini-review 6.) Testing scalp-blood lactate has also been tried, but it does no better at improving neonatal outcomes or reducing operative deliveries for nonreassuring fetal status.[24]

The recognition that many babies with neurologic symptoms after birth display nonreassuring FHR patterns at labor admission led to the admission test strip (using continuous EFM for the first 20 minutes). The intent was to identify at-risk babies for more intensive surveillance in hopes of improving outcomes, but this too has failed. (See mini-review 5.) EFM and rescue delivery cannot fix what is already broken.

Believing that the difficulty lay in insufficient information, researchers have studied the use of fetal electrocardiograms and pulse oximetry. These have proved no more useful than EFM.[23, 62] It does not matter what cardiac data are gathered if it has little predictive value.

EFM proponents argued that EFM RCTs had failed to show benefits because definitions were ambiguous and clinicians lacked sufficient understanding at the time of what variations in FHR patterns portended. To address that problem, in 1997 the National Institute of Child Health and Human Development (NICHD) assembled a panel of EFM experts and tasked them with developing a standardized set of definitions and clinical recommendations.[2] This has not helped either. Two studies of interobserver agreement in analyzing and interpreting FHR tracings in women found poor agreement for accelerations and decelerations despite using the NICHD guidelines.[13, 21]

Refining definitions, though, does not address the real issue: assigning meaning. While the NICHD panel had no trouble agreeing on what was reassuring and what was severely abnormal and required intervention, they could not agree on what to do with tracings falling between the two extremes—these, of course, constituting the majority of cases. The panel decided that "giving strict recommendations for management of this group is premature" (p. 1389),[2] which left clinicians right where they were before the meeting. For this same reason, using computer analysis to standardize data was predestined for failure.[32] In equivocal cases, whether the obstetrician reviews a tracing directly or a computer analysis of a tracing, the obstetrician still has to make the call.

Standardized definitions have done no better at predicting outcomes. Althaus and colleagues (2005) looked at the relationship between nonreassuring FHR tracings in labor and cerebral white matter injury in infants born between 23 and 34 weeks' gestation.[6] They chose this outcome because it is a hypoxic injury that can

be identified in the neonatal period, and 60% to 100% of survivors will develop CP. Three maternal-fetal medicine experts blinded to neonatal outcome independently evaluated monitor tracings according to NICHD guidelines and definitions. No differences were found for any heart-rate patterns between infants with white matter injury and infants without white matter injury in either vaginal birth or cesarean delivery groups. One of the studies of interobserver agreement also looked at clinician ability to predict outcome with nonreassuring tracing.[13] Results were so poor that investigators concluded:

> Intrapartum FHR tracing is not a useful diagnostic test (likelihood ratio 1-2) for the identification of parturients who need emergent cesarean delivery [for persistent nonreassuring tracing] or those who deliver a newborn infant with a low Apgar score or abnormal umbilical acid-base" (p. e5).

This was predictable. Fortune tellers may hold workshops to teach tealeaf reading; they may come to consensus on what they believe certain patterns portend; they may even develop programs to perform computerized analyses of tea-leaf patterns, but they are still reading tea leaves.

EFM AND CONFLICTS OF INTEREST

Some advocates justify EFM's use for reasons unrelated to health. They claim that hospitals lack sufficient staff to auscultate and that increasing staff numbers would be too expensive.[3, 67, 75] At least one big, busy hospital did not find auscultation impractical.[74] Insufficient staffing forced the switch from intermittent auscultation in low-risk women only 3% of the time. Neither do we have data establishing that one-on-one nursing costs more than purchasing and maintaining monitoring equipment. Indeed, a 1988 government report estimated that EFM cost $1 billion annually.[12] Even if EFM were cheaper, the argument that it substitutes for nursing care amounts to saying that hospitals do not have enough nurses to care for laboring women properly.

The primary driver for EFM, however, is defensive medicine, but obstetricians have only to look in the mirror to see who created the litigation crisis. Suits claiming negligent injury to the fetus exploded only after obstetricians began making extravagant claims for EFM, beginning with Edward Hon, who was quoted in a 1969 *Life Magazine* article as saying that EFM could save as many as 20,000 babies per year and reduce brain-injured babies by half.[32] Julian Parer (1979), an obstetrician who went on to build his academic career as an expert in EFM interpretation, wrote this in 1979 in rebuttal to a review showing increased risk and uncertain benefit for EFM: "There is now compelling evidence that [intrapartum stillbirth] will decrease by 1-2 per 1000 and neonatal deaths will be halved if monitoring is widely used" (p. 633).[65] Barry Schifrin wrote as late as 1995 that "several meta-analyses have shown that

electronic monitoring does indeed reduce the risk of perinatal death and seizures" (p. 842), but provided no citation for this statement.[75]

Obstetricians never would have had a problem had they not extolled EFM and introduced it into every maternity unit in the country, making it, at least for a time, the standard of care. Even today, most obstetricians have no idea of EFM's limitations. A 2001 survey by the American College of Obstetricians and Gynecologists (ACOG) revealed that half of respondents either overestimated or did not know what percentage of CP is due to intrapartum asphyxia.[36] In a hypothetical case of a woman with no medical problems whose baby develops persistent late decelerations in labor, only one in six obstetricians surveyed would correctly advise her that the odds were 99% that her baby would not have CP.

Obstetricians also would not have a problem had their colleagues not been willing to profit from promulgating the idea that EFM, correctly interpreted, saves babies. Hon and Schifrin, for example, both have acted as expert witnesses for the plaintiffs in cases of damaged babies.[9, 32] Parer has built his academic career on his expertise with EFM.[68] Commenting on the malpractice debacle, a *Lancet* editorialist (1989) wrote trenchantly, "In light of the evidence . . . , the continued willingness of doctors to reinforce the fable that intrapartum care is an important determinant of CP can only be regarded as shooting the specialty of obstetrics in the foot" (p. 1252).[1]

While obstetricians maintain that risk management demands that they use EFM to protect themselves in malpractice cases, it may, in fact, have the opposite effect. Sandmire (1990) points out that a tracing "leaves a permanent record for hindsight interpretation by expert witnesses" (p. 1131),[74] which, as we have just seen, some obstetricians are all too ready to supply. Sandmire writes that he personally has seen mild variable decelerations interpreted as fetal distress in jury trials. Lent (1999) observes that more malpractice claims involve cesarean surgeries than vaginal births.[47] EFM therefore increases the risk of suit by increasing the use of cesarean surgery. Lent also notes that alienation and poor doctor-patient communication, which central monitoring systems promote, increase the likelihood of filing a malpractice claim.

The contention that EFM is the standard of care to which obstetricians will be held in malpractice litigation is untrue. Any number of credible bodies, including ACOG (2009),[3] the Agency for Healthcare Research and Quality (AHRQ) (1996),[4] the Royal College of Obstetricians and Gynaecologists (RCOG) (2007),[61] the Society of Obstetricians and Gynaecologists of Canada (SOGC) (2007),[49] and the World Health Organization (WHO) (1996),[91] state that intermittent auscultation is equivalent to (in the case of ACOG‡) or preferable (in the case of the others)

‡ ACOG buries this in the text of their guidelines. The list of "Recommendations and Conclusions" only states that continuous EFM is recommended for women with high-risk conditions, a recommendation based on expert opinion, not evidence.

to continuous EFM in low-risk women. According to Lent (1999) intermittent auscultation is, at the very least, acceptable under the "respectable minority" rule, which holds that physicians may choose between methods where there is reasonable doubt over which is preferable.[47] But she goes further, arguing that the claim of adherence to the community's customary practice may not insulate doctors from liability. In some jurisdictions, physicians have an obligation to keep abreast of progress and to use their best judgment. If EFM leads to cesarean surgery that results in complications, this opens the door to law suits for negligence.

Currently, U.S. obstetricians have positioned themselves to have plausible deniability while conducting business as usual. Schifrin's (1995) commentary on EFM's medicolegal ramifications schizophrenically maintains that EFM will prevent deaths and is "the most sensitive available clinical index of changes in fetal oxygenation and neurologic responsiveness" (p. 837) while elaborating on the reasons why it fails to prevent neurologic injury.[75] He assures clinicians that "provided the physician or nurse exhibits certain minimal knowledge of heart-rate patterns and the mechanics of fetal monitoring devices, offers a reasonable interpretation and a plan of action, the individual cannot reasonably be held liable . . . ." (p. 847) and concludes that all that is necessary is that "[the medical record] should convince anyone who is reading that he or she is a thoughtful caring compassionate provider who did what was reasonable under the circumstances" (p. 852). Nowhere in this standard is any obligation to practice according to what best practice dictates as safe and effective care. Clark and Hankins's (2003) (Hankins is an ACOG spokesperson) evaluation of the relationship of EFM and CP begins, "Although it is clear that the use of [EFM] has virtually eliminated unexpected intrapartum fetal death . . ." (p. 628), but cites no source.[15] The rest of the review, with abundant citations, explains why EFM cannot be expected to prevent CP. ACOG's 2009 Practice Bulletin frames the choice between EFM and intermittent auscultation purely as one of practitioner preference, immediately after acknowledging that EFM increases the risk of cesarean surgery and instrumental vaginal delivery without reducing perinatal mortality or CP,§ EFM's *raisons d'être*.[3]

ACOG's stance, however, does not represent international or even unopposed domestic professional opinion. RCOG 2007 guidelines for intrapartum care state: "Intermittent auscultation of the FHR is recommended for low-risk women in established labor in any birth setting" (p. 155).[61] The SOGC Guideline (2007) states that in healthy, term women in spontaneous labor "Intermittent auscultation following an established protocol of surveillance and response is the preferred method of fetal surveillance," (p. S6) including in women having epidural analgesia.[49]

§ ACOG's Practice Bulletin notes that EFM reduces incidence of neonatal seizure, but we argue this has to do with increased risk of seizure with use of high-dose oxytocin regimens, a modifiable practice. (See mini-review 1.)

(The SOGC guideline, while acknowledging that "little scientific evidence" [p. S33] supports EFM in high-risk pregnancies, recommends it in women at risk for adverse outcomes. It also recommends EFM in women receiving oxytocin because it reduces neonatal seizures. Even so, it softens this by adding that with a normal tracing in high-risk women and a normal tracing and stable rate of oxytocin infusion, 30-minute respite periods for ambulation, bathing, or position change are "appropriate" [p. S6].) Similarly, AHRQ (1996) states: "Routine electronic fetal monitoring for low-risk women in labor is not recommended. There is insufficient evidence to recommend for or against intrapartum electronic fetal monitoring for high-risk pregnant women" (p. 433).¶[4] The World Health Organization lists intermittent auscultation under "Practices which are Demonstrably Useful and Should be Encouraged."[91]

Lent (1999) says this about the defensive medicine argument:

> The law generally grants great deference to physicians' professional expertise and invests in them the autonomy to determine the standard of care according to what is best for their patients. The obstetrical profession should not perpetuate abuse of this authority by encouraging the continued employment of an ineffective, unsafe fetal monitoring method, and it should not permit obstetricians to duck behind the shield of "defensive medicine" to support an inferior technique (p. 837).[47]

WHY DOES USE OF CONTINUOUS EFM PERSIST?

Wriggling on the hook of malpractice litigation, obstetricians in recent years have been happy to backpedal from the idea that EFM, or EFM plus fetal scalp-blood sampling, could prevent neurodevelopmental disorders. ACOG spokespeople and others have written any number of commentaries pointing out the disconnect.[15, 36, 50, 67] What obstetricians have not done is back away from EFM. Instead, they have shifted to trying to establish a tight connection between abnormal FHR patterns and low blood pH,[52, 53, 66, 68, 89] an exercise in futility because, as we have seen, research has long since established that there isn't one. In pursuit of a rationale for routine EFM, some contemporary research groups also have called acidemia "asphyxia," a misnomer that fosters the illusion that low blood pH (1) always indicates intrapartum hypoxia, and (2) is a clinically significant outcome. Even if the connection were there, acidemia is a surrogate outcome that has been shown to be only weakly associated with clinically important outcomes, and, as we discussed above, it appears to be a healthy, adaptive response to reduced oxygen, not a symptom of failing compensation. The authors of *Evidence-Based Medicine* repudiate using surrogate measures as a diagnostic endpoint. They write that diagnostic

¶ The last of the trials of EFM versus intermittent auscultation was published in 1994.

thresholds should not be arbitrary lines defining some percentage of the population as abnormal but rather the demarcation beyond which "target disorders become highly probable" and "treatment does more good than harm" (p. 69).**[82] Setting an arbitrary threshold for acidemia without consideration of EFM's harmful effects violates both these precepts.

This stubborn persistence in the face of logic, common sense, science, the best interests of women and babies, and even self-interest raises the question: Why have obstetricians spent nearly two decades rearranging deck chairs on the Titanic instead of abandoning ship? One answer is medical-model thinking, a mindset rooted in the belief that labor is a pathological process from which babies frequently need rescue. The theory behind EFM fits perfectly with this mindset, and where this is the case, discrepancies with the facts will be rationalized away or denied outright. For example, Parer (2000) observes that obstetricians often think that in their hands EFM is efficacious whatever the trials may conclude,[67] and one study's investigators found "strong justification" (p. 74) for continuous EFM despite 95% of babies thought to be in distress according to the monitor tracing being fine at delivery.[86] They attributed this to "management that prevents acidosis and clinical depression" (p. 74). An objective researcher would simply conclude that EFM has an extremely high false-positive rate. For believers, though, whether the baby is delivered in good or poor condition, the outcome will reinforce continuous EFM. Either the baby was rescued before harm was done or before worse harm was done.

Industry pressures also contribute. Marsden Wagner writes of attending a meeting to make recommendations for the use of electronic monitors held by the International Federation of Obstetricians and Gynecologists (FIGO).[88] Travel expenses and the cost of the conference were borne by monitor manufacturers and attendees passed through a large commercial display to gain entrance to the conference hall. And, as we saw, the one RCT finding extraordinary benefits for EFM not found in any other trial was funded by an EFM manufacturer.

At this point, EFM is structurally and functionally embedded in obstetric labor management. Beyond a few old timers, doctors and nurses today have no experience working without it. An industry has grown up around it involving manufacture, sales, service, training, and more. Countless individuals' livelihoods and careers depend on it. EFM technology has enhanced the professional status of obstetrics, is intertwined with the evolution of the perinatal specialist, and provides the basis for obstetric intensive care.[69] To dislodge it would mean rebuilding maternity care from the ground up, a daunting proposition with powerful forces arrayed against it. J. B. McKinley put it this way:

** This same problem applies to other medical-model parameters for normality, notably labor duration. (See chapter 9.)

> The success of an innovation. . . is dependent upon the power of the interests that sponsor and maintain it. . . . The power of such interests is also evident in their ability to impede the development of alternative practices . . . that could conceivably threaten an activity in which there is already considerable investment. The "need" for universal EFM legitimates so many other contentious decisions on the place, style and management of labor that it will not be discarded in favor of [auscultation] but only displaced when another new, equally unevaluated procedure arrives on the obstetric scene (p. 151).[55]

IS THE ROUTINE USE OF CONTINUOUS EFM ETHICAL?

A 2007 online article in *Contemporary OB/GYN* begins: "While there's little evidence that EFM during labor improves outcomes when compared with intermittent auscultation, . . [a]s a labor-saving device for nursing care and as a way to generate a permanent record of FHR patterns, it would appear EFM is here to stay."[60] The article goes on to recommend strategies to ensure a complete tracing in order to minimize vulnerability to accusations of negligence, including placement of an internal electrode despite its risks. No mention is made of the other adverse consequences of EFM. A 2007 *American Journal of Obstetrics and Gynecology* clinical opinion recommends using a green-to-red color-coded scheme to rate FHR patterns and key them to clinical action.[66] The authors acknowledge that their guidelines have not been validated, meaning they have not been tested, which contravenes an important principle of evidence-based medicine. The authors justify operative delivery of 100% of babies with certain nonreassuring patterns in order to prevent an estimated 1% of them having acidemia—acidemia being a laboratory, not a clinical, outcome—on the basis that obstetricians are similarly enforcing cesarean surgery for breech babies and in women with prior cesareans on similar grounds. The appearance of these two articles in mainstream publications with no hint that their content might be controversial indicates that the obstetric community does not find anything ethically dubious about them. We beg to differ.

Turning first to legal obligations, as far back as 1984 Myra Gilfix reviewed the law pertaining to EFM and informed consent and concluded that clinicians had a duty to inform women that EFM had not been shown to improve outcomes but increased operative delivery rates.[30] Gilfix also pointed out that "too few nurses to auscultate" as a rationale for EFM really meant too few nurses to provide optimum care. Gilfix thought doctors might be obliged to inform women of this too. Oberman (2000) explains that both law and medicine define doctors and patients as being in a fiduciary relationship.[64] Unlike a contractual relationship, where both parties are presumed to be motivated by self-interest, the entrustor (pregnant woman) relies on the fiduciary (doctor) she has chosen to provide her with services that meet her needs. For example, informed consent, meaning the duty to disclose

relevant information and abide by the patient's decision, is the best known of the physician's fiduciary obligations, although not the only one. Acting contrary to the interests of the entrustor breaches that relationship. In financial relationships, the law regulates and penalizes fiduciaries who abuse their power, but not in medical fiduciary relationships. Clearly, providers who employ EFM in their own interest and against the best interests of women under their care and who tacitly assume that they, not women, make treatment decisions violate their fiduciary obligations.

As for ethical considerations, Wood (2003) explores the ethical ramifications of EFM for nurses according to the ethical principles of autonomy (people determine their own course of action), beneficence (doing good), nonmaleficence (avoiding harm), justice (treating individuals equally and fairly and distributing societal benefits and burdens equitably),†† and veracity (telling the truth).[90] Under one ethical model for decision making, her analysis determined that while informed consent is supported by principles of autonomy, intermittent auscultation in low-risk women is supported by principles of nonmaleficence for baby and mother and beneficence and justice for the mother, making intermittent auscultation the superior option. Under a second ethical model that evaluates the positive and negative consequences of each option for everyone involved, analysis also failed to support routine use of EFM. In a reminder that applies equally well to physicians and midwives, Wood writes, "Women rely on the judgment, integrity, trustworthiness, and compassion of nurses to do what is in their best interests" (p. 298). The routine imposition of continuous EFM betrays that trust.

STRATEGIES FOR OPTIMAL CARE

Note: Starred recommendations come from SOGC guidelines.

- Refrain from admission test strips.
- *Auscultate intermittently in low-risk women.[49]
- *Provide "near-continuous presence of nurses or midwives" (p. S28).[49]
- *With epidural analgesia, limit continuous EFM to the initiation period and after top-ups.[49]
- *When inducing or augmenting labor with oxytocin, auscultate intermittently when the tracing is normal and the oxytocin dosage stable. At a minimum, under these conditions, incorporate 30-minute respite periods for ambulation, showering or bathing, and position changes.[49]

†† We confine concepts of justice to the ethical principles governing the relationship between care provider and woman, but the huge ongoing expenditure of time and money on this failed technology that should have been put to better use also transgresses this principle.

- Judge individually whether continuous EFM is warranted in women at risk for adverse outcomes.
- *If using EFM in women at risk for adverse outcomes, with normal tracing, incorporate 30-minute respite periods, as above.[49]
- Cross-check external EFM with auscultation to rule out halving or doubling of the FHR or picking up the maternal heart rate.
- Use telemetry monitoring to permit mobility.
- Refrain from immediate operative delivery with nonreassuring FHR patterns in nonacute situations. In a labor with normal patterns that have devolved into abnormal ones, an hour or more will elapse before acidosis occurs when the cause of the change is not acute.[68] And while low blood pH is of concern, it is not itself a clinical adverse outcome but a compensation mechanism.
- With nonreassuring patterns in nonacute situations:
  - » *Try to alleviate the problem: remedies include change maternal position to lateral, decrease or stop oxytocin, hydrate, modify pushing technique, reduce anxiety and modify breathing techniques, give oxygen by mask, administer amnioinfusion for variable decelerations.[49]
  - » Implement internal monitoring only when external monitoring does not produce an adequate tracing, but do not rupture membranes for this purpose. This will minimize exposure to the potential harms of internal monitoring while preventing potentially doing further harm to an already compromised baby by removing the protective cushion of amniotic fluid. (See chapter 9.)
  - » Use gentle digital stimulation of the fetal scalp as a follow-up test. (Vigorous stimulation may elicit a vagal reflex, causing a bradycardia.[77]) We may not have evidence that fetal stimulation tests reduce cesarean rates for false positives, but gentle digital stimulation does not require rupturing membranes, is not invasive, does not require equipment, and heart rate accelerations reassure that blood pH is highly likely to be normal. (See mini-review 7.)
- *If sampling umbilical cord blood for testing, delay cord clamping until the cord stops pulsing.[49]

MINI-REVIEWS

Notes:

- Where RCTs or systematic reviews of RCTs are available, observational studies are excluded.
- Assume differences are statistically significant unless otherwise noted.

1. Continuous EFM fails to improve short- and long-term perinatal outcomes in high- and low-risk women with the exception of reducing neonatal seizures, a difference that may be explained by modifiable management factors.

> **Note:** We do not normally report surrogate outcomes (outcomes believed to be on the pathway to clinically significant outcomes but which are not themselves of clinical significance) such as low Apgar scores, cord blood acidemia, or admission to neonatal intensive care, but we make an exception here because 1) claims for EFM's benefits include these outcomes, and 2) while finding statistically significant differences in surrogate outcomes does not rule in clinically significant differences in larger populations, failing to find a difference almost certainly rules them out.

According to the Cochrane systematic review of continuous EFM vs. intermittent auscultation, continuous EFM failed to decrease adverse perinatal outcomes in both low- and high-risk women.[5] Outcomes overall included Apgar scores < 4 at 5 min (4 trials, 1919 women), cord blood acidosis (2 trials, 2494 women), admission to neonatal intensive care unit (NICU) (10 trials, 33,067 women), HIE (1 trial, 1428 women), perinatal death (12 trials, 33,513 women), neurodevelopmental disability at ≥ 12 months of age (1 trial, 173 women), and CP (2 trials, 13,252 women). Among low-risk women (not defined), continuous EFM had no effect on perinatal death rate (2 trials, 15,545 women), and babies were *more* likely (1.1% vs. 0.8%) to be admitted to intensive care (2 trials, 15,545 women) in the monitored group. Among high-risk women (not defined) continuous EFM failed to reduce Apgar scores < 4 at 5 min (3 trials, 941 women), NICU admissions (4 trials, 1528 women), neonatal seizures (6 trials, 4805 women), or perinatal death (6 trials, 1974 women). In the sole trial of 246 very preterm (28-32 w gestation) infants, continuous EFM had no effect on Apgar score < 4 at 5 min, neonatal seizures, perinatal death, or neurodevelopmental disability at ≥ 12 months of age, and incidence of CP was *increased* (20% vs. 8%) in the electronically monitored group.[76] That increase may have been due to chance, but the trial's investigators offered a possible explanation: the median time from diagnosis of abnormal FHR patterns to delivery was 104 min with EFM vs. 60 min with intermittent auscultation. "Clinicians," they write, may have been reassured by "certain inherent aspects of electronic fetal monitoring such as the paper record itself" (p. 392) or by aspects of the tracing such as baseline variability that cannot be picked up by auscultation. They may also have been aware of EFM's high false-positive rate and therefore reluctant to act.

The review reported that continuous EFM had one perinatal benefit only: it reduced (1.5 per 1000 vs. 3.0 per 1000, RR 0.5, absolute difference 1.5 per 1000) the incidence of neonatal seizures overall (10 trials, 32,386 women) and reduced it (0.6 per 1000 vs. 1.8 per 1000, RR 0.4, absolute difference 1.2 per 1000) in low-risk women (2 trials, 24,671 women). (As noted, neonatal seizure rates were similar in high-risk women.) Labor management, however, may be a confounding factor. Of the 10 trials reporting neonatal seizure rates in all women, 8 have at most 1600 participants. Dwarfing them are two trials, one at the Dublin National Maternity Hospital (13,100 women) and one in the U.S. (14,600 women).

The neonatal seizure rate overall in the Dublin trial was 4 per 1000, whereas in Dallas it was 4 per *10,000*, an order of magnitude less. Among low-risk women, only these two trials reported neonatal seizure rates, and seizure rates differed by an order of magnitude as well: 2.6 per 1000 in the Dublin trial vs. 2.7 per *10,000* in the Dallas trial. The Dublin National Maternity Hospital is the home of Active Management of Labor (AMoL), a protocol mandating routine rupture of membranes and high-dose oxytocin for any woman not progressing at the average dilation rate, both practices that can increase fetal stress. (See chapter 9.) Furthermore, the Dublin trial reported that oxytocin was independently associated with seizure and that continuous EFM was protective.[56] The meta-analysis weights the Dublin trial at 53% of the total result while the Dallas trial accounts for only 6%. It seems probable that differences in neonatal seizure rates would become clinically insignificant, if not statistically insignificant, with conservation of membranes and more physiologic use of oxytocin regimens.

Another, unrecognized iatrogenic factor may also predispose to seizures in the Dublin trial and possibly in other trials as well. A study of hyponatremia, which can cause neonatal seizures, was subsequently conducted at the Dublin National Maternity Hospital.[81] Its introduction stated that 5% dextrose was the standard medium for administering oxytocin. The study found that newborns were much more likely to experience hyponatremia when their mothers were infused with IV dextrose than with an electrolyte-containing solution (OR 0.04, 9 babies in the dextrose group vs. 0 in the normal saline group). No newborn experienced a seizure, but the study comprised only 100 women.

Also worthy of note is that reducing neonatal seizure rates appears to be a short-term benefit only. A follow-up study to the Dublin trial that evaluated all children with abnormal neurologic symptoms in the neonatal period failed to find a difference in rates of CP at age 4.[33]

2. Continuous EFM fails to reduce the incidence of CP.

The Cochrane systematic review of continuous EFM vs. intermittent auscultation concluded that continuous EFM does not decrease incidence of CP,[5] but RCTs and systematic reviews of RCTs are underpowered for detecting differences in occurrence of rare events, especially those remote from the time of the trial. Three other studies, though, confirm the review's conclusion.

Using a California database of 156,000 children, a 1996 case-control study identified 95 children weighing ≥ 2500 g who survived to age 3 and had moderate to severe CP and matched them with 378 randomly selected similar children who did not have CP.[63] Neither use of EFM, internal EFM, nor cesarean surgery was associated with lower rates of CP. Multiple late decelerations, decreased variability, or both were associated with CP, but when investigators extrapolated results to the entire population, 0.19% (n = 21) of the estimated 10,800 children who weighed ≥ 2500 g and displayed nonreassuring fetal heart-rate patterns had CP, a false-positive rate of 99.8%. Among children lacking risk factors (bleeding during pregnancy, breech presentation, gestational age < 37 w, meconium, maternal infection), the false-positive rate was 99.9%, and among children with one or more of these risk factors, it was 99.6%. Investigators also compared results from Level 1 hospitals with higher level hospitals to ascertain whether care provider expertise in interpreting tracings improved results, and found that it did not.

A more recent study evaluating the associations among EFM tracings, acidemia (pH < 7.1), and CP in low-risk pregnancies (singleton, term, normally formed fetus, no medical or obstetric complications) confirms that continuous EFM will not prevent CP.[73] Nine cases of CP occurred in 5546 women with low-risk pregnancies (prevalence: 1.6 per 1000). Six of the nine occurred in infants who had nonreassuring FHR tracings at hospital admission, and all were cases of placental abruption. The three that occurred in the 5522 women who had normal FHR tracings at admission in labor (prevalence: 0.5 per 1000) resulted from two cases of intrauterine cytomegalovirus infection and one of amniotic fluid embolism.

A third study looked at the relationship between nonreassuring FHR tracings in labor and white matter injury in the brains of 150 infants born between 23 and 34 w gestation.[6] Investigators chose this outcome because it is a hypoxic injury that can be identified in the neonatal period, and 60-100% of survivors will develop CP. Three maternal-fetal medicine experts blinded to neonatal outcome independently evaluated monitor tracings according to National Institutes of Health guidelines and definitions in these 150 infants and in 150 similar infants who did not have white matter injury. No differences were found for baseline heart rate, tachycardia, bradycardia, short-term variability, accelerations, reactivity, number or types of decelerations, or bradycardic episodes between cases and controls in either vaginal birth or cesarean surgery groups.

3. Continuous EFM increases the likelihood of cesarean surgery and instrumental vaginal delivery.

The Cochrane systematic review of continuous EFM vs. intermittent auscultation reported that continuous EFM results in more cesarean surgeries (5.2% vs. 3.5%, RR 1.7, absolute difference 1.7%) overall (11 trials, 18,761 women) and more cesarean surgeries (1.4% vs. 0.6%, RR 2.4, absolute difference 0.8%) for abnormal FHR/acidosis (12 trials, 33,379 women).[5] In trials of high-risk women (not defined), continuous EFM increased (18.2% vs. 9.6%, RR 2.0, absolute difference 8.6%) cesarean deliveries overall (6 trials, 1969 women), and increased (9.8% vs. 5.1%, RR 2.5, absolute difference 4.3%) cesarean delivery for abnormal FHR/acidosis (6 trials, 1969 women). In low-risk women (1 trial, 927 women), the increase (4.0% vs. 2.1%, RR 2.0, absolute difference 1.9%) did not achieve statistical significance, possibly because the overall cesarean rate in that trial was a mere 3%, making the trial underpowered to detect differences.

Absolute differences might be much higher were the trials carried out today. The cesarean rate among trials reporting this outcome was 4.4%, and, in fact, women were at greater risk for cesarean surgery with continuous EFM in trials with cesarean rates > 10% compared with trials with rates ≤ 10%. In low cesarean-rate trials, having continuous EFM increased the cesarean rate by one-third (RR 1.3, absolute difference 0.7%), but it more than doubled the risk of cesarean in high cesarean-rate trials (RR 2.2, absolute difference 8.6%), an excess amounting to 9 more women per 100 having continuous EFM having a cesarean with virtually no benefit to their babies. (See mini-review 1.) The overall cesarean rate in the high-cesarean-rate trials was 14.4%, almost certainly substantially lower than typical intrapartum cesarean rates in conventionally managed U.S. women today—or, for that matter, women in most countries—which suggests a considerable effect of routine EFM on the U.S. intrapartum cesarean surgery rate. It is possible that modern awareness of the limitations of EFM might mitigate against that trend, but considering the low threshold for performing cesarean surgery today, the odds are against it.

Turning to instrumental vaginal delivery, continuous EFM increased (12.7% vs. 10.3%, RR 1.2, absolute difference 2.4%) the instrumental vaginal delivery rate overall (10 trials, 18,515 women) and increased (2.9% vs. 1.7%, RR 2.5, absolute difference 1.7%) it for abnormal FHR/acidosis (1 trial, 12,964 women). In low-risk women, EFM increased (27.0% vs. 21.0%, RR 1.3, absolute difference 6.0%) the instrumental vaginal delivery rate (1 trial, 927 women), but it had no effect in high-risk women. The total instrumental vaginal delivery was strikingly high among low-risk women (23.8%) compared with U.S. rates today, although less so in the population overall (11.5%), which makes it likely that differences between groups would be smaller today. Unfortunately, though, this would not increase spontaneous vaginal births in low-risk women because cesarean surgery has largely replaced instrumental vaginal delivery.

4. internal monitoring may increase the likelihood of maternal and neonatal complications.

The Cochrane systematic review of continuous EFM vs. intermittent auscultation does not report on maternal infection.[5] However, internal monitoring appears to increase risk, especially in labors ending in cesarean surgery. A secondary analysis of data from one of the early EFM trials reported on 690 high-risk women, of whom 610 had vaginal birth and 80 cesarean surgery.[44] Despite 95% of women having cesareans receiving prophylactic antibiotics, 14% had endometritis (fever after the first 24 h postpartum associated with uterine tenderness, malodorous lochia, or both) vs. 4% of women having vaginal birth. All women assigned to the EFM group were monitored internally, and while internal monitoring had little or no effect on infection rates in women having vaginal birth (4% vs. 3%), it nearly doubled the endometritis rate in women delivered by cesarean (8% vs. 15%). This difference did not achieve statistical significance probably because too few women had cesareans to detect a difference. Only one study (5399 women) published after 1990 (this book's cut-off date for inclusion) could be found reporting on the relationship between internal EFM and maternal infection.[78] In it, internal monitoring remained an independent risk factor after accounting for correlating factors, including cesarean section, and investigators found that it doubled the risk (OR 2.0) (raw data not reported) of intraamniotic infection (ruptured membranes and fever plus one or more: maternal or fetal tachycardia, maternal high white blood cell count, foul-smelling amniotic fluid) in full-term women. Three-quarters of the women with infection had internal EFM compared with a little more than half the women who did not have an infection. However, the study antedates routine testing for Group B strep and antibiotic prophylaxis in women testing positive, which could affect results, and epidural analgesia was a possible confounding factor because it is associated with maternal fever (see chapter 12). Maternal fever is accompanied by symptoms such as fetal tachycardia that might provoke use of internal monitoring. Thirteen percent of women with intraamniotic infection had epidurals vs. 2% of women who did not, a highly significant difference. Still, epidural analgesia may have contributed to an increased incidence of actual infection by increasing labor duration, the number of vaginal exams, and the use of invasive monitoring techniques.

As for the baby, the Cochrane systematic review reports no statistical difference between groups for scalp damage or infection (0.6% EFM vs. 0 auscultation); however, the meta-analysis was underpowered to detect one.[5] Only two trials reported on scalp damage

or infection, one of which (n = 200) did not use internal EFM while the other (n = 465) used external monitoring until internal monitoring was feasible. Reviewers combined damage/infection from scalp electrodes and scalp sampling, which further clouds the issue. We have, however, case reports of infections arising in the scalp electrode site. Most cases would be described as minor morbidity requiring only low-level treatment (topical cleansing, oral antibiotics, lancing and drainage, 10 days of IV antiviral infusion), although the mothers and babies involved might not think it minor,[7, 35, 46] but some resulted in severe morbidity (necrotizing fasciitis, Escherichia coli meningitis);[17, 39, 41] permanent injury (brain abscess ending in hemiparesis),[43] or death.[28] A case report on cerebrospinal fluid leak was also found.[79] The authors report that a literature search revealed three other cases of leakage; none, including theirs, resulted in infection.

5. The admission test strip (routine use of continuous EFM at hospital admission for a limited time) increases use of intervention without improving neonatal outcomes.

A systematic review of three RCTs (11,259 low-risk women) of the labor admission test (EFM for 20-30 min duration at admission) vs. auscultation at admission reported increases (56.6% vs. 41.9%, RR 1.3, absolute difference 14.7%) in use of continuous EFM (3 trials) and an increase (9.9% vs. 7.8%, RR 1.3, absolute difference 2.1%) in fetal scalp-blood sampling (3 trials) compared with admission auscultation.‡‡[11] Meta-analyses also found trends toward an increase (17.9% vs. 16.2%, RR 1.1 CI 1.0 – 1.3) in operative delivery (combined cesarean surgery and instrumental vaginal delivery) (3 trials), an increase (7.2% vs. 6.4%, RR 1.1 CI 1.0 – 1.3) in operative delivery for fetal distress (1 trial, 8580 women), and an increase (4.8% vs. 3.7%, RR 1.2 CI 1.0 – 1.4) in cesarean surgery (3 trials). No differences were found for any adverse neonatal outcome, including perinatal mortality, need for resuscitation, neonatal seizure, Apgar < 7 at 5 min, or admission to neonatal special care unit, although meta-analyses were underpowered to detect differences. Reviewers state that because neonatal morbidity rates were so low (0.3 per 1000 perinatal mortality, 0.2% resuscitation, 0.6% 5-min Apgar < 7) in these low-risk women, 16,000 women would have been needed to detect a difference in low Apgar scores, the most common adverse event.

6. Fetal scalp-blood sampling shows no evidence of benefit.

Fetal scalp-blood sampling has neither improved perinatal outcomes nor reduced excess cesarean rates associated with EFM. According to the Cochrane systematic review of continuous EFM vs. intermittent auscultation, women were 25% more likely to have fetal scalp-blood sampling in the continuous EFM group, but this did not reduce cesarean rates compared with trials where scalp-blood testing was not available, nor did it affect neonatal outcomes, including seizure.[5] A retrospective analysis in a high-risk referral center of 1709 babies having fetal scalp-blood sampling for ominous FHR patterns in labor reported extremely low positive predictive values of scalp-blood pH for acidemia at birth, low 5-min Apgar scores, and HIE.[45] In only one of the six cases of HIE was the umbilical artery pH < 7.21. Additionally, a study found that eliminating fetal scalp-blood sampling at a large

‡‡ Reviewers also analyzed observational studies, but we have chosen not to summarize them because random allocation minimizes bias.

hospital (16,300 births annually) did not increase cesarean rates for fetal distress and had no effect on neonatal outcomes.[31]

Fetal scalp-blood sampling, of necessity, introduces potential harms. Like any wound, it creates the possibility for scalp injury and neonatal infection. There is also the potential for hemorrhage in fetuses with coagulation abnormalities. Scalp-blood sampling causes discomfort to the mother and pain for the child. It is often done serially, which increases these risks and harms.

7. FHR acceleration (reactivity) in response to scalp stimulation appears to give reasonable, although not complete, confidence that a fetus with nonreassuring FHR patterns is not acidotic.

What Is a Likelihood Ratio?

Likelihood ratios enable clinicians to tailor counseling to each individual case. Rather than simply having a test result of "normal" or "abnormal," likelihood ratios permit calculation of the chances of a person having the target disorder depending on individual test values. A likelihood ratio less than 1 adjusts the probability of having the disorder downward, and a ratio greater than 1 adjusts the probability upward. The greater the difference from 1, the greater the effect on the probability.[34]

A systematic review and meta-analysis evaluated studies of four types of scalp stimulation: digital, vibroacoustic, Allis clamp, and scalp puncture (as part of a fetal scalp-blood sampling procedure) to determine their accuracy in identifying acidotic fetuses in the presence of nonreassuring FHR patterns.[77] The gold standard to which they were compared was fetal scalp-blood results done within minutes of the stimulation test. Reviewers calculated likelihood ratios for positive (nonreactive) test and negative (reactive, heart rate acceleration) tests. Pooled likelihood ratios for a negative stimulation test (FHR acceleration or reactive test) predicting a nonacidotic fetus were digital 0.06, vibroacoustic 0.20, Allis clamp 0.10, and scalp puncture 0.12. That is, FHR accelerations in response to any type of fetal stimulation test greatly reduces the likelihood that nonreassuring FHR patterns indicate an acidotic fetus. (See text box "What Is a Likelihood Ratio?") The authors recommend digital stimulation as being the simplest because no device is required and membranes need not be ruptured but warn that overly aggressive technique may cause false positives in that too much pressure can trigger the vagal reflex, slowing the FHR. A study of digital stimulation published after the systematic review reports a much higher negative (no acidosis) likelihood ratio (0.87)—i.e., digital stimulation is less useful—than that found in the two studies of digital stimulation included in the review meta-analysis;[85] however, if one adds the findings of this study to the total in the meta-analysis, the new raw (i.e., unweighted, as would be statistically correct when pooling data from multiple studies) negative likelihood is 0.18.

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IVs Versus Oral Intake in Labor: "Water, Water Everywhere, Nor Any Drop to Drink"

"You are caving in to consumerism and courting disaster with a liberal eating and drinking policy."

quoted in McKay 1988, p. 222[30]

"The evidence identified no benefits . . . associated with restricting women's access to fluids and foods during labour for women at low risk of potentially requiring a general anesthetic. . . . Hence . . . women should be able to consume what they desire. . . . There were no studies identified that looked at restricting fluids and food during labour for women at increased risk of requiring general anaesthesia, so restricting fluid and food intake for these women remains an unproven intervention."

Singata 2010, p. 16[50]

The policy of forbidding food before surgery began in the 1940s with growing awareness that aspiration of vomitus under general anesthesia was a grave and sometimes fatal complication of surgery. The policy was extended to laboring women, many of whom were heavily drugged during labor and had general anesthesia even for vaginal birth, and NPO (*non per os,* or nothing by mouth) became standard.[28] This may have made sense back then, but not today. Few laboring women these days undergo general anesthesia: it is not used during vaginal birth, and the vast majority of cesareans are performed under regional anesthesia.[20] Furthermore, general anesthesia techniques and training have improved so as to minimize the incidence of aspiration.

Practices may have changed, but policies largely have not. The American Society of Anesthesiologists (ASA) has come around to some degree; in 1999 it grudgingly acknowledged that "oral intake of clear liquids during labor improves maternal comfort and satisfaction" and issued new guidelines that permit "modest" amounts of these in laboring women at low risk of aspiration or operative delivery (p. 602),[3] a recommendation repeated in its 2007 update.[2] The 1999 recommendation had little effect, however. Listening to Mothers II, a national survey of women giving birth in

hospitals in 2005, reported that only 40% of laboring women drank anything during labor, and a mere 15% had something to eat.[12] The ASA continues to maintain that the percentage of women having solids in labor should be "0," although neither the 1999 policy nor the 2007 update provides any evidence to support this. It took the American Congress of Obstetricians and Gynecologists (ACOG) a decade to catch up with the 1999 ASA policy change and agree that "oral intake of modest amounts of clear liquids may be allowed for patients with uncomplicated labor" (p. 714).[1] It remains to be seen what effect this will have, but we doubt that it will be much.

Other countries and professional bodies have not been so behindhand.[31, 45] For example, in 2003 half of U.K. hospitals gave women access to food and drink in labor,[50] and as of 2007, U.K. guidelines state:[35] "Women may drink during established labour. . . . Women may eat a light diet in established labour unless they have received opioids or they develop risk factors that make a general anaesthetic more likely" (p. 86), and in Scandinavia, "Many would consider it ethically questionable to perform randomised studies involving fasting during labour" (p. 248).[25]

Is there a rationale for NPO in labor? This chapter will examine its underlying assumptions, namely, that aspiration of vomitus into the lungs is a considerable risk, that an NPO policy prevents aspiration, and that intravenous fluids harmlessly replace oral intake.

HOW RISKY IS ORAL INTAKE IN LABOR?

The concern with oral intake in labor is that it risks death from aspiration should general anesthesia be required. We quantified that risk using cesarean data from U.S. studies. The primary (first) cesarean rate in 2006, the latest year for which we had this statistic, was 24%, of which all but a few percent would have been during labor.[29] In the Netherlands, where women are freely permitted oral intake,[45] the mortality rate from aspiration during cesarean surgery is 0.9 per 100,000.[46] Using 24% as a proxy rate for intrapartum cesareans, multiplying it by the percentage of cesareans done under general anesthesia in the U.S. (15%),[20] and multiplying that result by 0.9 per 100,000, the likelihood that a fed woman having an intrapartum cesarean under general anesthesia will die of pulmonary aspiration is 3.2 per 10 million. To put this number into perspective, in 2003 she would have been twice as likely to die of aspiration during cesarean surgery than to be killed by a lightning strike (1.6 per 10 million), but she would have been 8 times more likely to die in a plane crash (26 per 10 million) and nearly 200 times more likely (543 per 10 million) to die in a car crash.[36] She would also be nearly 900 times more likely to die of an elective repeat cesarean (2800 per 10 million).[51] Moreover, condition at time of surgery affects risk of death. A study of 13,400 emergency surgeries—which means people would likely have had food in their stomachs—under general anesthesia in people in reasonably good health (ASA physical status rankings of I or II) reported an aspiration death rate of zero.[54]

Large studies also confirm the safety of oral intake in labor. In three U.S. studies totaling 78,000 women who ate and drank freely in labor, not one case of aspiration occurred.[18, 19, 43] The anesthesia-related maternal mortality rate in England and Wales, where oral intake in labor is usual, is identical to the rate in the U.S., where it is not.[32] Nor is aspiration a significant problem in other countries where eating and drinking in labor is usual, such as Japan and the Netherlands.[31]

In any case, an NPO policy will not prevent the harms of aspiration. The main factors that make aspiration dangerous are stomach content volume of 25 mL or more and pH of 2.5 or less.[28] Quantities below and pH above these levels are not generally considered to cause severe problems. An NPO policy accomplishes neither of these goals. Write Enkin and colleagues (2000), "No time interval between the last meal and the onset of labour guarantees a stomach volume of less than 100 mL" (p. 261) (see mini-review 1),[14] and the residue in a fasting stomach is highly acidic. Crawford (1984) observes, "It is only since we began to starve our labouring patients . . . that we have experienced the epidemic of acid-aspiration syndrome [Mendelson's syndrome]" (p. 926).[10] To be sure, women are routinely given antacids prior to surgery, but Mendelson's syndrome has occurred nonetheless.[14] NPO policies are, therefore, exercises in futility.

IS THERE ANY VALUE TO ORAL INTAKE?

In addition to safety, proponents of NPO have argued that because labor slows digestion, caloric intake will not be absorbed, and because laboring women are prone to nausea, oral intake will provoke excess vomiting; however, studies show that ingesting calories raises maternal blood sugar levels, and a systematic review reported no effect on the likelihood of nausea or vomiting. (See mini-reviews 2 and 3.) On the other hand, the same review found that caloric intake does not improve spontaneous vaginal birth rates, but use of epidural analgesia and oxytocin were so high and spontaneous vaginal birth rates so low that any benefits would have been overwhelmed by these other factors. (See mini-review 3.)

While the benefits of oral intake may be uncertain, withholding it introduces harms. More than half of a self-selected cohort of U.S. survey respondents rated restriction of oral fluids in labor as "moderately" or "most" stressful, and more than 1 in 4 said the same of restriction of food.[49]

Studies have also uncovered a modifiable potential harm of oral intake: hyponatremia (low blood sodium) can occur with excessive intake of hypotonic fluids, resulting in fluid retention in maternal and fetal tissues. Effects can be severe. Two case series reported that hyponatremia in women with no predisposing factors caused seizures and breathing difficulties in the newborns and seizure in one laboring woman. The women in these cases reported that they were following advice to keep well hydrated in labor, therefore simply advising women to drink to thirst would eliminate this risk. (See mini-review 4.)

In short, NPO has no rational basis and causes suffering, and when self-regulated by thirst, oral intake does no harm. Given this, we agree with the investigators who concluded: "With the lack of reliable evidence to support any type of diet for women in labour, . . . best practice may be to leave the decision about oral intake to the instincts of the women who are in labour" (p. 137).[41]

ARE IVs AN ADEQUATE REPLACEMENT FOR ORAL INTAKE?

Doctors may be complacent about an NPO policy in labor because they mistakenly believe IV fluids to be a risk-free replacement for oral intake. Leaving aside the enormous physiologic and psychological difference between IV drips and normal eating and drinking, this is not true. Adverse effects can arise from excessive amounts of IV fluids, especially when administered rapidly (bolus). (See mini-review 5.) Fewer red blood cells per unit volume means less oxygen being carried to the fetus and uterine muscle.[5] Postpartum anemia is also a possibility. Decreased concentration of platelets and other clotting factors may mean increased risk of postpartum hemorrhage. Bolus IV administration can reduce, at least temporarily, uterine contractility, probably by diluting circulating oxytocin. Excess IV fluids decrease the normal osmotic pressure that keeps fluid within blood vessels and out of the mother's (pulmonary edema) and the baby's (transient tachypnea of the newborn or wet lung syndrome) lungs. Indeed, some experts think that the large amounts of fluid typically given before and during cesarean surgery may be one reason why babies delivered by cesarean are more likely to have breathing difficulties,[5] a concern that applies equally well to laboring women given bolus IV fluids in conjunction with epidurals. The extra fluid can inflate the baby's birth weight and subsequent weight loss after birth,[7] which has implications for breastfeeding because adequacy is often gauged by how fast the baby regains birth weight. Maternal fluid retention and consequent swollen breasts may also cause difficulties with latching, a problem reported anecdotally by lactation specialists in women who had epidurals. Attention to IV fluid volumes will avert these harms, but as Moen et al. (2009) point out, thirst protects against dehydration, but "no physiologic warning system protects the body against over-hydration" (p. 559).[33]

What About Prophylactic IV Bolus and Epidurals?

The rationale for preloading a bolus of IV fluid before an epidural is prevention of maternal hypotension, a common and potentially dangerous epidural side-effect; however, a systematic review failed to find a significant difference in hypotension rates with a low-dose epidural.[22] The two included trials were underpowered even when combined, which means a statistically significant difference cannot be ruled out. Still, the absolute difference was small—only 3%—which implies that clinically significant

benefits are unlikely. The reviewers also found a trend toward fewer abnormal (abnormality not defined) fetal heart rate (FHR) tracings with a pre-epidural bolus of IV fluid, but the clinical significance of this is unclear. (See mini-review 6.) Against these, at best, limited benefits we must weigh the potential harms of bolus IV fluids, harms made more likely by administering epidurals with oxytocin, an antidiuretic at higher doses.[39]

The type of IV fluid can have adverse effects as well. Electrolyte-free (salt-free) IV solutions can cause hyponatremia which can give rise to transient tachypnea of the newborn and in extreme cases newborn seizures, along with water intoxication, seizures, or coma in the mother. And while infusing salt-free solutions is rare,[44] even sodium-deficient IV fluids can be problematic. A study found that 8% of women receiving routine IV Ringer's acetate (described by the authors as hypotonic for sodium) developed hyponatremia.[33] Declining maternal sodium levels and likelihood of hyponatremia correlated with total fluids received (higher infusion rates over longer duration), a problem exacerbated by oral fluid intake, which increased the hypotonic fluid load. Higher intake resulted in higher birth weights and greater likelihood of weight loss greater than 10%, which, as we discussed, could lead caregivers to an erroneous diagnosis of breastfeeding inadequacy. Furthermore, increasing total fluid intake correlated with increasing likelihood of neonatal respiratory problems, although this missed achieving statistical significance, possibly because the study was underpowered to detect it. (See mini-review 7.) IV fluids containing glucose or lactate can cause diabetic glucose levels in the mother and fetus and rebound hypoglycemia in the newborn.[37] (See mini-review 8.) Neonatal hypoglycemia often leads to one or more painful heel pricks to monitor blood sugar, to nursery admission, which interferes with bonding and breastfeeding, and to feeding with glucose water or formula, which interferes with establishing breastfeeding.

An IV also increases maternal distress. As with deprivation of oral fluids, more than half the women responding to the survey cited above reported having an IV as "moderately" or "most" stressful,[49] and a study of IV policy at one hospital reported that 3 of 53 women surveyed said they were anxious or afraid to have an IV, and 8 said they liked not having one.*[53] Reasons for disliking an IV may have to do with fear of needles or interference with mobility, but one reason could be discomfort. A study of surgical patients reported that within 8 hours of inserting an IV, 14% had pain at the IV site, and by 16 hours the percentage exceeded 40% (Jones 1984).[24] We have no reason to think that this would not also apply to laboring women. IVs also reinforce the medical-model concepts of childbirth as an illness.

* Of 219 women in the study, 162 had an IV and 57 women did not.

Despite the potential for doing serious harm, studies of IV fluids usually report few clinically significant symptoms and even those are relatively mild; however, the women and babies in these studies are almost always healthy and the babies mature. We do not know what results might be when that is not the case. Nor do we know how much of the true morbidity of IVs is rendered invisible because they are ubiquitous.

WHY DOESN'T EVIDENCE CHANGE PRACTICE?

The authors of *A Guide to Effective Care in Pregnancy and Childbirth* sum up the research on both NPO and routine IVs by placing these policies under "Forms of care unlikely to be beneficial."[14] As we have seen, this is hardly breaking news, but, as we have also seen, it has had little effect on practice. It isn't as if researchers have not noticed the harms of NPO and routine IVs. Investigators in one decades-old study found blood-chemistry disturbances emblematic of fluid overload in laboring women with IVs but not in women allowed to drink clear liquids. Disturbances were severe enough to be, as they put it, "associated with significant morbidity in the nonobstetric patient" (p. 99),[17] although the laboring women were not harmed. Nonetheless, they write: "The data presented here do not negate the routine use of intravenous fluids in the laboring patient. Conversely, they point out the resilience of the pregnant woman's cardiovascular and renal systems when confronted with iatrogenic stresses" (p. 99).

Two others conclude that a glucose IV should be given despite the hazards,[15, 55] and the authors of two more concede that IVs are problematic and recommend dispensing with them in favor of fasting, which they assert will do no harm.[13, 34] Meanwhile, some modern researchers stubbornly persist in trying to make a case for routine IV fluids.[9, 16, 48] Why don't clinicians abandon routine IVs and let laboring women drink and eat as thirst and hunger dictate?

One reason is that NPO and routine IV fluids fit the medical-model of childbirth, which holds that labor and birth are pathological events in which something is likely to go wrong at any moment. What therefore feels right, safe, and proper—in this case, treating women undergoing a physiologic process as surgical patients—will supersede science and logic, blinding practitioners both to the harms of their policies and the benefits of treating labor and birth as normal events.

Another has to do with the nature of research. In order to alter care, new treatments must prove themselves superior to current care, the presumed "gold standard." Eating and drinking at will have not been shown to produce what medical-model thinkers would consider clinical benefits, ergo practice need not be changed. But, of course, eating and drinking are not treatments but normal, spontaneous behaviors during a normal physiologic process, and withholding oral intake and IV infusions were never established as safe or effective before they became standard management.

Finally, as Robbie Davis-Floyd (1992) writes, NPO and routine IVs serve the symbolic ritual purposes of inculcating beliefs about the nature of society and the proper role of childbearing women within it:

> To deny a laboring woman access to her own choice of food and drink in the hospital is to confirm her initiatory status and consequent loss of autonomy, to increase the chances that she will require interventions, and to tell her that only the institution can provide the nourishment she needs—a message that is most forcefully conveyed through the "IV" (p.92).[11]

The IV, she says, serves as an umbilical cord linking the woman to the hospital in the same way that her baby is linked to her within the womb. In this way, she receives the message that we are all dependent on society's institutions for our lives and that the institution, not she, is the giver of life.

A more appropriate model for childbirth than the presurgical analogy is a prolonged, demanding athletic event that poses a small risk of serious injury. A sports medicine physician would be horrified at the thought of depriving an athlete of food and fluids in such a case. And as for risk, until such time as we require "nothing by mouth" and "just in case" IVs for downhill skiers, football players, and, for that matter, drivers entering the freeway, we should not require them of laboring women.

STRATEGIES FOR OPTIMAL CARE

To minimize the risk of aspiration:

- Reduce the number of cesareans.
- Maximize the number of cesareans done under regional anesthesia.
- Ensure that all anesthesiologists are properly trained and use up-to-date equipment.

To minimize morbidity associated with IVs:

- Reserve them for medical indication.
- Avoid high-doses of oxytocin when inducing or augmenting labor: oxytocin acts as an antidiuretic at dose rates more than 20 mU/min.[39]
- Use electrolyte-containing IVs.
- Infuse physiologic volumes of fluid.
- Refrain from bolus administration, including in preparation for epidural analgesia.
- Infuse physiologic quantities of glucose or lactose if infusing fluids that include them.

To minimize risk of fluid overload from oral intake:

- Advise women to drink to thirst and not to push fluids. *Note:* "isotonic" sports drinks may use carbohydrates, not salt, to achieve osmolality with plasma, leaving them hypotonic for electrolytes.[33]

While research establishes that we should not routinely withhold food or drink from laboring women, we have little more than speculation to guide us on what advice to give them. O'Sullivan (1994) writes that gastric emptying rate depends on volume, pH, temperature, osmolality, and fat content. Based on that information, would dictate that optimal oral intake consists of food and drink that are

- low in acid,
- not overly sugary,
- low in fat,
- contains some, but not too much, salt, and
- (if liquid) not icy.

Quantity and timing of oral intake should be left up to the individual woman.

In cases of vomiting:

- Common sense dictates that women who are vomiting should cut back to sips of clear, nonacidic liquids.
- An IV might be required to treat dehydration.
- A low-dose infusion (5% glucose, 125-180 mL/h) might prove helpful in women who develop ketonuria.

MINI-REVIEWS

Note: Assume differences are statistically significant unless otherwise noted.

1. Fasting does not guarantee an empty stomach.

Ultrasound examination of the stomach contents of 39 women in active labor revealed that 16 of them (41%) had solid food detectible despite 8-24 h of fasting prior to the sonogram.[4]

2. Oral intake in labor has little or no effect on vomiting.

A systematic review reported no effect on nausea (1 trial, 255 women) or vomiting (3 trials, 2829 women);[50] however, results may be confounded in studies conducted where compounds containing ergot are administered prophylactically at time of delivery because ergot compounds have these side effects. (See chapter 16.) Investigators in one U.K. trial (N = 94) observed that some women vomited in third stage after routine postpartum administration of an ergot compound,[47] and another trial (N = 60) at the same institution reported postpartum vomiting within one hour after delivery.[27] By contrast, an observational study in a

U.S. birth center (N = 106), where, if anything, oxytocin would have been used, reported that no woman vomited after birth.[38]

3. Women digest food ingested in labor, but this does not appear to decrease use of oxytocin or increase spontaneous vaginal birth rates, although medical-model management is a confounding factor.

Both RCTs in which women had caloric intake vs. a control group having water only reported significantly higher maternal blood glucose levels and lower ketone levels in women with caloric intake.[27, 47] A systematic review, however, reported similar cesarean and instrumental vaginal delivery rates (5 trials, 3103 women) in meta-analyses of trials comparing women with no oral caloric intake with women with some form of oral caloric intake.[50] Still, any beneficial effect of oral caloric intake would have been overwhelmed by medical management practices. One trial dominated the findings (n = 2426), but all trials save one (n = 201) reported high epidural (67-93%) and augmentation (53-84%) rates in both arms, and operative delivery rates were extraordinarily high, considering that all trials were limited to low-risk women. Instrumental vaginal delivery rates ranged from 20-36% except for one trial (n = 60) reporting a rate of 13% in the restricted intake arm, and cesarean surgery rates ranged from 19-30% except for one trial (n = 201) reporting a rate of 7%, also in the restricted intake arm.

4. Excessive oral fluid intake can cause serious complications.

Two studies report on a total of five cases of severe hyponatremia in women and their newborns caused by excessive intake of oral fluid.[23, 56] Oral fluid intake was recorded as 3000 mL of water over a 2-h period, 8-10,000 mL of water and other fluids over 13.5 hr, 4000 mL of water over 12 h, "several litres of water and fruit juice" over 9 h, and "at least 8 litres of water" with no time period specified. Hyponatremia was diagnosed from blood workups following neonatal seizures. In one case, the laboring woman had a seizure and an emergent cesarean was performed. In that case and two others the infant required assisted ventilation. In all cases, women were healthy, had term pregnancies, and no other explanation was found for the complications experienced by mothers or babies. Women in both studies reported that they had been following advice to keep well hydrated during labor.[23, 56] It is likely that many other babies and mothers experience less severe complications resulting from lesser degrees of oral fluid overload that were never attributed to their source.

5. IVs can cause symptomatic fluid overload.

By diluting blood, IV fluids can cause anemia, especially with bolus administration. In one study, 21 women had 1.5-2 L of Ringer's lactate before elective cesarean delivery.[26] Pre-infusion hematocrits ranged from 31-44%, mean 38%. Post-infusion hematocrits ranged from 28-36%, mean 31%. Seventy-five percent of women were anemic (< 34%), and 30% "markedly anemic" (< 28-29%), although only one woman had been anemic before surgery. Another study measured hemoglobin after administration of preset amounts of crystalloid IV fluid in 10 women having elective cesareans.[6] Measurements were taken before infusion and after 5, 10, 15, and 20 mL/kg was administered. Mean hemoglobin concentration was 11.7 g/dL before infusion. At each successive time point, mean hemoglobin level fell significantly below the previous time period. Mean hemoglobin at endpoint was 9.9 g/dL.

No woman had hemoglobin concentrations below 10 g/dL after having 5 mL/kg of IV fluid infused, rising to 1 woman after 10 mL/kg, 4 women after 15 mL/kg, and 5 women after 20 mL/kg. (Assuming a 70 kg woman, respective infusion amounts would be 350 mL, 700 mL, 1050 mL, and 1400 mL.)

Excessive amounts of IV fluid decrease colloid osmotic pressure (COP). This is of concern because lowered COP allows fluid to leak into interstitial tissues (edema) and into the lungs in both mother and baby (pulmonary edema). Fifty-five women undergoing elective cesarean were randomly allocated to receive 10, 20, or 30 mL/kg of Ringer's lactate before surgery over a 20-min period.[40] Assuming a 70 kg maternal weight, this is a bolus of 700, 1400, or 2100 mL. Total mean fluids infused by time of delivery were 1787, 2411, and 2970 mL, respectively. Maternal COP declined significantly in all three groups compared with baseline. Maternal COP was significantly lower in the 20 and 30 mL/kg groups compared with the 10 mL/kg group. Neonatal COP as measured in the umbilical artery and vein was not affected. However, the lack of fetal differences between groups is not reassuring. The lowest volume group still received 1800 mL of IV fluids over at most an hour or two. Also, the baby would have been delivered after a relatively short exposure. Salts and water cross the placenta freely and would surely equilibrate between mother and unborn baby over time, such as would be the case when a laboring woman is given a preload IV bolus and continuing IV fluids with an epidural. Decreased COP is also a likely scenario where insufficient attention is paid to IV fluid volume.

Excess IV fluid may even affect uterine contractility, at least temporarily. Among 30 women allotted to either no IV fluid preload before epidural analgesia, 500 mL normal saline, or 1000 mL normal saline, uterine activity decreased in the group given 500 mL, and decreased even more markedly in the group given 1000 mL.[8] Activity returned to baseline over the next 20 min. No change was seen in the group not given a bolus. The dose-dependent relationship argues strongly that the effect is real. A likely cause is dilution of circulating oxytocin.

6. Research data offer little support for giving bolus IV fluid before inducing epidural analgesia.

A systematic review of IV preload vs. no preload before regional analgesia reported that meta-analysis of two trials of low-dose epidural analgesia (260 women) reported similar hypotension (fall of > 20%) rates.[22] This may have been because the trials were underpowered even in the aggregate to detect a difference, but even so, the absolute difference was clinically insignificant—only 3.4%. A third trial of 30 women that was not included because the reviewers were awaiting more information reported that no woman in either group experienced > 20% fall in blood pressure. Combining data from this trial with the two included trials decreases the absolute difference to 3.0%. Still another included trial assigned 34 women to no preload, a 500 mL preload, or a 1000 mL preload and reported no differences in incidence or severity of hypotension. (It was not included in the hypotension meta-analysis because it did not report specific numbers.) Meta-analysis did find a trend toward decreased incidence of abnormal FHR (RR 0.64, CI 0.39 – 1.05) with preload, which is puzzling because a common cause of abnormal FHR is thought to be maternal hypotension, which was not decreased. Even more puzzling, rates of FHR abnormality occurred at double the rates of maternal hypotension in both groups, raising the question of possible

cause. The trial of 34 women also reported no FHR abnormalities in any group. Neither the included trials nor the additional trial collected data on potential harms of bolus IV fluid.

7. Electrolyte-free and sodium-deficient IV infusions can cause hyponatremia.

Two RCTs reported that infusing salt-free IV solutions can cause hyponatremia. Both assigned women to receive oxytocin in either electrolyte (salt-containing) IV solution or 5% dextrose (glucose),[21, 52] and both found increased incidence of neonatal and maternal hyponatremia (serum sodium levels < 135 mmol/L) in the group given IV glucose. In one trial, 8 of 52 (16%) women were hyponatremic in the glucose infusion group vs. 0 of 51 women in the Hartmanns group as were 7 (14%) newborns in the glucose group vs. 2 (4%) in the Hartmanns group.[21] The other trial reported 9 of 48 (19%) women in the glucose group experienced hyponatremia vs. 0 of 45 women in the normal saline group, as did 16 (33%) of newborns in the glucose group vs. 6 (13%) in the normal saline group.[52] No women or babies developed clinical symptoms, but the trials were small and the women and babies healthy.

IV fluids lacking sufficient salt can cause hyponatremia as well, especially when combined with oral fluid intake. A prospective observational study evaluated postpartum hyponatremia (defined as < 130 mmol/L) in women receiving "moderate" (p. 555) hourly volumes of Ringers acetate, which the authors described as hypotonic for sodium, in addition to free access to oral fluids.[33] Investigators analyzed outcomes according to total fluid intake: group 1 < 1000 mL (n = 113), group 2 1000-2500 mL (n = 87), group 3 > 2500 mL (n = 61). Median rate of oral fluid intake per hour was similar among groups (185-196 mL), but median rate of IV fluids per hour increased by group (0 to 52 mL/h to 94 mL/h), resulting in a rise in median total fluid intake from 400 mL to 1680 mL to 3570 mL. Maternal sodium level decreased and hyponatremia rates increased (1% group 1; 5% group 2; 26% group 3) according to increasing fluid intake. Birth weight increased as did percentage losing > 10% (2% vs. 3% vs. 8%) of birth weight. Percentage of newborns experiencing respiratory problems trended upward according to maternal fluid intake (4% vs. 8% vs. 13%), but this did not achieve statistical significance.

8. IVs containing glucose (dextrose) or lactate can cause neonatal morbidity, but administration at low infusion rates appears to be harmless.

> **Note:** Only two trials of acceptable quality could be found published in 1990 or later. We therefore included studies published as early as 1985.

Glucose IVs and IV solutions containing lactate (Ringer's lactate, Hartmann's) can cause hyperglycemia in the laboring woman and fetus and rebound hypoglycemia in the newborn. Neonatal hypoglycemia occurs because fetal insulin levels rise in response to maternal glucose levels. Once removed from the hyperglycemic environment, this excess insulin causes newborn glucose levels to fall. In one trial, investigators randomly allocated 32 women undergoing elective cesarean to receive 1000 mL of 5% glucose, Ringer's lactate, or normal saline.[42] Blood glucose levels in the women receiving 5% glucose rapidly rose to a mean of 225 mg/dL (200 mg/dL is the diagnostic threshold for diabetes in a non-pregnant

population). Four of 12 newborns developed hypoglycemia (blood glucose < 25 mg/dL) in the glucose group. Ringer's lactate did not cause a maternal glucose elevation, although lactate levels were elevated compared with saline. Nonetheless, 2 of 11 newborns in the Ringer's lactate group also developed hypoglycemia. While no baby in the saline group experienced this complication, one baby in the glucose group, whose blood glucose level was 18 mg/dL, developed transient tachypnea, although this probably had to do with hyponatremia. (See mini-review 7.) In another trial, investigators randomly allocated 40 women with ketonuria to 5% glucose, 10% glucose, Hartmanns, or normal saline.[34] They reported extreme maternal hyperglycemia in the 10% glucose group (mean maximum 24 mmol/L at 1 h), hyperglycemia in the 5% glucose group (mean maximum 16 mmol/L at 1 h), and no hyperglycemia in the Hartmanns or saline groups. Both glucose and Hartmanns infusions elevated maternal lactate compared with normal saline. Mean lactate levels were highest in the 10% glucose group, followed by the 5% glucose group, followed by the Hartmanns group. (Fetal and newborn glucose and lactate levels were not measured.)

In contrast to these findings, two trials allocating women to low glucose-infusion rates in normal saline reported no excess neonatal hypoglycemia rates compared with infusing normal saline alone. One trial randomly allocated 23 women to normal saline or a low infusion rate (180 mL/h) of 5% glucose.[37] Maternal and fetal glucose levels (measured in fetal scalp blood) were higher with glucose infusion, as were levels in arterial umbilical cord blood but below levels associated with adverse metabolic effects. Too few newborns (1 glucose vs. 2 saline) developed hypoglycemia (< 1.4 mmol/L) to make comparison meaningful. Study authors suggest that infusing glucose at low rates might be helpful in laboring women who develop ketonuria. The second trial randomly allocated women to normal saline (n = 97) or to an infusion of either 5% (n = 94) or 10% (n = 98) glucose in normal saline infused at a rate of 125 mL/h.[48] As with the other trial, arterial cord glucose rates were higher in the 5% glucose infusion group compared with saline alone and higher still with 10% glucose infusion, but neonatal hypoglycemia rates (defined as 40 mg/dL) were similar.

Maternal excess of blood lactate and consequent elevation of fetal lactate may also be problematic. Because lactate is acidic, it can decrease blood pH, potentially leading to an erroneous diagnosis of fetal distress or exacerbating actual distress. Some data support this theory. One of the glucose infusion trials also measured maternal blood lactate levels and lactate levels in the umbilical vein and artery at birth.[42] Lactate levels were higher with 5% glucose than with Ringer's lactate, but both means were higher compared with normal saline. Correlating with this finding, umbilical cord artery pH was significantly depressed in the glucose group compared with the other two groups (7.21 5% glucose vs. 7.27 in both Ringer's and saline groups).

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Epidurals and Combined Spinal-Epidurals: The "Cadillacs of Analgesia"*

"There is no other circumstance in which it is considered acceptable for a person to experience untreated severe pain, amenable to safe intervention, while under a physician's care."

ACOG 2006[1]

"Epidural anaesthesia remains one of childbirth's best exemplars of iatrogenesis. It is a wonderful intervention for managing labour complications, especially as an alternative to general anaesthetic for caesarean sections, but has significant side effects that constantly need weighing alongside benefits. Though its rising popularity almost grants it the status of normative practice on some [U.K.] maternity units, it remains incompatible with physiological labour."

Walsh 2007, p. 64[102]

Unlike the U.K., epidurals for labor pain have already achieved normative status throughout the United States. According to Listening to Mothers II, a national survey of women giving birth in 2005, 76% of respondents received epidural analgesia,[28] and many no doubt see this as a positive development. Implicit, too, in pro-epidural beliefs is that all women—or at least all sensible women—would agree with them. This chapter challenges those beliefs, detailing the potential harms of epidurals, exposing other, less altruistic motives for promoting them, and showing that "epidurals for all" does not, in fact, align with women's wishes.

LOOKING UNDER THE HOOD

Epidurals deserve their sobriquet, the "Cadillac of Anesthesia,"—at least when they work (see sidebar). They allow women to be awake and aware, yet pain free, permit an exhausted woman to rest or sleep, and sometimes appear to put a stalled labor back on track. Those benefits, however, come at a cost. The exact cost is difficult to determine

* We have chosen not to delve into systemic narcotic analgesia because it is not controversial. Most agree on its drawbacks, which are inadequate pain relief, nausea, sedation, which can make it more difficult to cope with contractions, neonatal respiratory depression, and adverse neonatal behavioral effects, including difficulties suckling.

for reasons listed in the notes introducing the mini-reviews, but studies agree on many adverse outcomes and provide some sense of how frequently they occur:

How Often Do Epidurals Fail?

Listening to Mothers II reports that 9% found epidural analgesia "not very helpful" or "not helpful at all,"[28] and studies have reported similar failure rates (6-7%) or rates even greater (17-18%).[4, 29, 107] Studies also report failure rates of epidural extension for cesarean surgery ranging from 1% to 20%.[18, 61, 77, 78] We also know that discovery is not always prior to beginning surgery, and women are not always believed when they complain of pain.[61, 75, 89] Expecting pain relief and not getting it in labor will likely distress women; undergoing surgery without adequate anesthesia will almost certainly traumatize them.

- Epidural analgesia causes potentially life-threatening maternal complications at rates of 1 in 1400 to 1 in 4400. These sometimes prove fatal. (See mini-review 5.)
- Five more women per 100 will have an instrumental vaginal delivery. This is almost certainly an undercount because of crossover between trial arms (participants assigned to one group receive the allocated treatment of the other group) in epidural randomized controlled trials (RCTs). (See mini-review 1.)
- Because of greater use of instrumental vaginal delivery and episiotomy, more women will have anal sphincter lacerations. This will be moderated by choice of instrument, type of episiotomy, and frequency of their use. (See mini-review 3.)
- From 10 to 30 more multiparous women per 100 and 12 to 16 more nulliparous women per 100 will experience persistent fetal malposition. Persistent fetal malposition greatly increases instrumental vaginal and cesarean delivery rates. Studies suggest a link between early epidural and persistent occiput posterior (OP) and support the claim that epidurals lead to persistent OP, not vice versa. (See mini-review 4.)
- Seventeen more women per 100 will experience hypotension. This is almost certainly an undercount because of crossover between trial arms in epidural RCTs. By diminishing placental perfusion, hypotension poses a risk to the fetus. (See mini-review 5.)
- Fifteen more women per 100 will run fevers in labor. The likelihood relates to epidural duration. Eighteen more nulliparous women per 100 with intrapartum fevers will have cesareans, 16 more will have instrumental

vaginal delivery, and 14 more will have antibiotic treatment. Nine more infants per 100 women with intrapartum fevers will require resuscitation, 7 more will require oxygen therapy, 9 more will have sepsis evaluations, and 8 more will have antibiotic treatment. With increased awareness of epidural-related fever, fewer babies may have sepsis evaluation or antibiotic treatment, but a more relaxed approach risks missing an infection. Intrapartum fever may be the cause of some cases of unexplained neonatal seizure. (See mini-review 6.)

- Epidural and intrathecal narcotics greatly increase the likelihood of itching, nausea, and vomiting. Neuraxial epinephrine appears to increase nausea as well. (See mini-review 7.)
- Women are more likely to have oxytocin augmentation and urinary retention.[9] This exposes them to the adverse effects of oxytocin and catheterization.
- Six more women per 100 with postpartum hemorrhage of more than 1000 mL or requiring transfusion have had an epidural. This is probably an indirect result of the increased use of oxytocin and instrumental vaginal delivery. (See mini-review 5.)
- Epidurals adversely affect establishing breastfeeding and breastfeeding duration. Fentanyl appears to be a culprit. Co-interventions such as instrumental vaginal delivery may also affect early suckling ability. Early difficulties may contribute to maternal belief that breastfeeding is inherently problematic.[96] The adverse effect may be overcome by Baby-Friendly breastfeeding practices. (See mini-review 8.)
- Epidurals have been absolved of causing long-term backache.[9] Nevertheless, numbed women may injure their backs, hips, or legs because they do not feel discomfort, especially during pushing, when staff may hold women's legs in an exaggerated McRoberts position.

Combined spinal epidurals (CSEs) offer no advantages over epidurals but increase the likelihood of adverse effects (see mini-review 17):

- One more woman per 100 may experience a postdural puncture headache or be treated with a blood patch.
- Nineteen more women per 100 will experience itching.
- One more fetus per 100 or more will experience prolonged heart rate deceleration or severe bradycardia with intrathecal narcotic. The difference may be greater than appears because epidurals, too, may increase the incidence of decelerations or bradycardia. The difference does not appear to lead to more cesareans, although case reports† and studies document

† H.G. was present as a doula at one such case. The woman was told afterward that it was just one of those things that can occur without warning during labor.

it doing so;[35, 37, 60, 74] however, almost all studies are of healthy, full-term infants, who would best be able to withstand the insult. These episodes have been linked with uterine hypertonus.

- Six women per 1000 will develop maternal respiratory depression and 2 women per 100 will develop difficulty swallowing (dysphagia) severe enough to require drug treatment to reverse narcotic effects. In some cases, respiratory depression may devolve into respiratory arrest.

Epidural complications may provoke negative psychological effects as well. Itching or nausea could make the labor experience unpleasant despite freedom from pain. Fetal heart rate disturbances, falls in blood pressure, maternal respiratory depression, or problems swallowing would likely alarm a woman, and slow progress could discourage her. The tendency to focus on the equipment instead of the woman once an epidural is in place could leave her feeling ignored and unsupported. Operative delivery would convey that her body is incompetent, which could lower self-esteem. Penny Simkin has rightly observed that one can be free of pain and still suffer.

Some epidural harms arise from disrupting the normal interplay of hormones. Epidurals reduce oxytocin levels and inhibit the rise as labor progresses. Epidurals also reduce F2alpha levels, a uterotonic prostaglandin. Epidurals inhibit the catecholamine surge at the end of labor that gives women extra energy to push out their babies. Epidurals affect norepinephrine less than epinephrine, and this imbalance may explain why epidurals are associated with hypotension and uterine hyperstimulation. Hypotension and uterine hyperstimulation may cause fetal bradycardia. Epidurals relax pelvic floor muscles, which are believed to help guide the fetal head into a favorable position for birth. Epidurals also decrease oxytocin secretion during breastfeeding for at least two days postpartum.[49] Nor are the harms only physical.[16] The catecholamine surge also ensures that new mothers are excited and alert to greet their infants. Oxytocin is the hormone of love,‡ not just contractions. At the birth, unmedicated women have the highest oxytocin levels of any time in their lives, preparing them to bond with their babies. Also inhibited by epidurals, beta-endorphin levels rise in response to pain, producing the endorphin "high" that enables women to transcend labor pain and experience euphoria after the birth.

Furthermore, epidurals convert women into spectators, making the birth something "done to" them instead of their being the "doers": "As one mother, . . . unable to feel the birth because of an epidural block said, 'It's like seeing a rabbit pulled out of a hat.' Being the hat is a far cry from being the magician" (p. 116).[53] Relegation to a passive role is far from trivial. Childbirth is the primordial rite of

‡ IV oxytocin does not have the neurobehavioral effects of naturally produced oxytocin, which is secreted into cerebral spinal fluid as well as the bloodstream, because exogenous oxytocin does not cross the blood-brain barrier.

passage and serves as the template for the elements of all rites of passage rituals. Labor involves transformation to a new status after a period in which one belongs to neither the new status nor the old and during which one undergoes physical and mental challenges.[26] During functional rites of passage, under the guidance of mentors, initiates grow and gain self-confidence by overcoming challenges, emerging prepared for the greater responsibilities of their new status. Conventional obstetric management inverts that process. Women emerge from childbirth having internalized that they are incompetent mentally and physically to accomplish the birth of their child and that medical staff, not they, have produced it—witness the all too familiar "Thank you, doctor, for delivering my baby." Epidurals play a pivotal role in conveying this: "To numb a woman . . . is to intensify the message that her body is a machine by adding to it the message that this machine can function without *her*" (p. 115).[26] Women need to start off motherhood feeling strong and capable. Epidurals inculcate the reverse and, moreover, may deal a second blow by predisposing to breastfeeding failure.

Finally, anesthesiologists have had no success and obstetricians minimal success with efforts to reduce adverse effects of regional analgesia, including the following:

- Administering bolus IV fluids before initiating an epidural is intended to reduce the incidence of hypotension, but it is a common complication nevertheless, and excess intravenous fluids introduce potential harms of their own. (See chapter 11.)
- Reducing the anesthetic dose and replacing it with narcotic does not affect cesarean rates and has a modest effect at best in reducing instrumental vaginal delivery rates. The narcotic increases side-effects. (See mini-reviews 7 and 10.)
- CSEs fail to increase spontaneous births while increasing adverse effects.
- Evidence conflicts on whether delaying an epidural until active labor decreases cesarean rates. Differing results may be explained by differences in propensity to perform or avoid cesarean surgery. (See mini-review 11.)
- Ambulation and upright positioning in first stage have no effect on mode of delivery. (See mini-review 13.)
- Some have argued that aggressive use of oxytocin prevents excess cesareans for dystocia, but some evidence contradicts that theory. (See mini-review 12.)
- Discontinuing epidural analgesia late in first stage may result in a modest reduction in instrumental delivery rates but has no effect on cesarean or persistent malposition rates and increases experience of severe pain. (See mini-review 14.)
- Delaying pushing decreases instrumental vaginal delivery rates, but rates remain high. Delaying pushing has no effect on episiotomy or cesarean rates. (See mini-review 15.)

- Pushing in an upright position may reduce instrumental and cesarean delivery rates, but an adequately powered trial is needed to confirm this benefit. (See mini-review 16.)

THE GREAT DEBATES: DO EPIDURALS AFFECT CESAREAN DELIVERY? DO THEY AFFECT NEWBORN BEHAVIOR?

The cesarean debate began when observational studies in the late 1980s began consistently reporting an association with epidural analgesia.[65] Epidural proponents dismissed these studies, saying that any excess must be because women having more difficult labors would be more likely to want an epidural. According to the American Society of Anesthesiologists (ASA), "Many [women] are pleasantly surprised to learn that after the epidural medications have made them more comfortable and relaxed, their labor may actually progress faster."[7] No evidence supported this claim. The controversy could only be settled by an RCT, which would eliminate bias introduced by self-selection, but no one thought women would agree to random assignment to a nonepidural group. Then, however, study investigators who had published observational studies published an RCT in 93 healthy nulliparous women,[98] and it, too, reported a marked difference in both total cesarean rates (25% vs. 2%) and in cesarean rates for dystocia (17% vs. 2%). Indeed, the "2%" was the sole woman in the nonepidural group who had an epidural. A firestorm followed in which anesthesiologists and obstetricians attacked the paper and even the investigators:[63]

> One wonders how "available" epidural analgesia was made to these patients. Certainly there is evidence in the literature that obstetric departments may dissuade patients from receiving epidural analgesia, in spite of the availability of a full-time obstetric anesthesia service.
>
> The first is an ethical concern. Intravenous opioids do not provide comparable analgesia to that produced by epidural analgesia . . . . We are surprised that only one of the 45 patients randomized to the narcotic group requested epidural analgesia. We wonder how informed these patients were regarding the study and their treatment options (p. 1399-1400).

The investigators defended their paper, lobbed a few grenades of their own at papers cited by their opponents, and repulsed the aspersions cast on their integrity: "The opposite point may also be considered, that is, it was unethical to continue providing epidural analgesia without informing a patient that it increased her risk for cesarean birth" (p. 1406). Investigators also rushed to conduct additional trials and systematic reviews of trials. Almost all of them came to the more comfortable conclusion that epidurals do not increase the cesarean rate, including the Cochrane systematic review.[9]

Logically, one would expect to find a link. Meta-analyses of those same trials find that epidurals are associated with longer labors, more augmentation, and increased malposition (see mini-review 1), all of which are associated with cesareans. Likewise, a recent prospective study in nulliparous women that excluded women with epidurals initiated after a diagnosis of dystocia reports a strong independent association with epidural analgesia,[55] and a prospective study analyzing cesarean rates according to propensity to receive an epidural reports excess cesareans in both nulliparous and parous women (no prior cesareans) in every propensity quintile and overall after adjustment for propensity score.[73] Could a difference exist and the meta-analysis fail to detect it? We argue that it could.

To begin with, substantial percentages of women in most trials received the treatment of the other group, which would diminish differences between trial arms. Trials also included multiparous women, who would be less affected by interference with labor progress. In addition, commentators have pointed out that several trials have atypically low cesarean rates, a difference they attribute to management practices not in standard use such as delaying epidurals or administering oxytocin aggressively.[56, 58] Low rates require larger populations to show significant differences.

The critique of epidural management hints at an overarching confounding factor: practice variation. The care provider's threshold for performing cesareans will influence how he or she manages labor in general and epidurals in particular, and it is this that determines cesarean rates, not epidural use per se. (See mini-review 2.) Where cesarean rates are low, having an epidural may not make much difference. Where they are high, *not* having an epidural may make little difference. If clinicians are not committed to maximizing spontaneous vaginal births, strategies intended to minimize the epidural's adverse impact on delivery mode will likely fail because they require belief that they will work, patience, making judgment calls that favor spontaneous birth, and quelling undue anxiety in the face of nonreassuring symptoms. Committed clinicians, on the other hand, will have these characteristics. In other words, epidurals can, but do not necessarily, increase the cesarean surgery rate.

Debate also rages over whether epidural and intrathecal drugs affect neonatal behavior. We know they cross into fetal circulation, so the possibility exists.[30, 66, 82] However, neurologic assessment studies, which almost always use the Neurologic and Adaptive Capacity Score (NACS), a test assigning a single composite score after testing twenty criteria in five domains (adaptive capacity, passive tone, active tone, primary reflexes, and general neurologic status),[21] generally conclude that they do not. But can we trust the NACS? A prominent anesthesiologist and T. Berry Brazelton, the developer of the Brazleton Neurobehavioral Assessment Score, jointly point out that the NACS "normal" score was chosen arbitrarily and has never been validated, i.e. had a study establish that the score correlates with clinically important outcomes. They add that an overall score obscures possible

effects of interventions or labor events on particular domains.[17] Moreover, the test is neither reliable (similar test results when conducted by different testers) nor repeatable (similar test results when repeated on the same person).[44] Even if the NACS were sound, comparison groups have been exposed to drugs (nearly always including systemic narcotics) and interventions that would diminish differences between groups.

Furthermore, the domains scores are surrogate outcomes. The clinically significant issue is whether epidural and intrathecal drugs affect important newborn behaviors. Breastfeeding studies, particularly those implicating fentanyl in early breastfeeding difficulties, suggest that they do. And while we have not included the breastfeeding self-attachment studies in the breastfeeding mini-review because infants were exposed to other medications and procedures, their results, too, suggest the inhibition of feeding behaviors.

Unfortunately, we are unlikely to resolve either controversy here. In the case of epidurals leading to cesareans, we have a hung jury. As regards neurobehavioral effects, we have yet to have a definitive trial, but the precautionary principle dictates that we assume epidural and intrathecal drugs to be guilty until proven innocent.

QUI BONO (WHO BENEFITS)?

Pro-epiduralists make it seem as if it is all about the woman, but in reality epidurals benefit everyone else involved, and unlike the case for the woman, epidurals have no drawbacks. Obstetric anesthesiologists benefit economically. Marmor and Krol (2002) write that the median salary for an anesthesiologist in 1999 was $244,091 and explain that it is economically advantageous for anesthesiologists to participate in a dedicated obstetric anesthesia service, as it benefits both anesthesiologists and the hospital to spread out the costs of a dedicated service over many procedures.[70] They add that while epidurals require more resources and more labor, these can be recouped from insurance companies, whereas narcotic analgesia may be reimbursed at lower rates and nonpharmacologic modalities not at all. In other words, it makes poor business sense to spend money installing deep tubs and encourage their use when you can't bill for it and the anesthesiologist may end up standing idly by. Epidurals are also part of a bigger economic picture; according to an anesthesiologist quoted in an online commentary:

> While there may be problems with high epidural usage, in the presence of our nursing shortages and economic or business considerations, having a woman in bed, attached to an intravenous line and continuous electronic fetal monitor and in receipt of an epidural may be the only realistic way to go.[62]

Nurses often see providing pain relief medication as meeting a nursing care responsibility.[36] In addition, an unmedicated laboring woman's behavior and

vocalizations may distress bedside caregivers: "I am concerned that firstly I will not learn to recognize the normal manifestation and parameters of physiologic labour pain and secondly that it will traumatize me to witness it," (p. 51) worries a British student midwife.[102] Epidurals ensure that a patient is calm, quiet, undemanding, and does not require individualized care.[19]

For obstetricians, regional analgesia maps medical model ideology onto reality.[26] A woman with an epidural catheter, anesthetic pump, IV drip, oxytocin pump, electronic fetal and contraction monitoring, automated blood pressure cuff, and bladder catheter becomes literally a machine producing a product under supervision and control by medical staff. Moreover, an epidural reinforces that she is a defective machine, prone (as our list of epidural complications makes clear) to malfunction, and that she must be put right by the intervention of her management team.

By reducing paternal stress, epidurals are even a boon to fathers.[12, 22] Spousal anxiety, an American Society of Anesthesiologists press release warns, can have a negative impact on the birth experience and "that's when epidural anesthesia[§] comes to the rescue."[12]

WHAT DO WOMEN WANT?

According to surveys, one thing women want is information on the risks of regional analgesia.[28, 47] This, however, they do not get. The ASA's (2008) consumer pamphlet, which should set the standard for informed consent, mentions only hypotension, which can sometimes cause slowing of the fetal heart, post-dural puncture headache, dizziness or seizure if the drug enters a vein, and difficulty breathing if the drug enters the spinal fluid.[8] Women may also be given misinformation as well as insufficient information. For example, A 2006 Boston Globe article assured women that the medications do not cross the placenta, that epidurals slow labor only slightly on average and may speed it up, that epidurals do not increase the risk of instrumental delivery or cause fevers, and that they have no effect on breastfeeding.[87] The real problem, says the author, citing the Lamaze website as an example, is childbirth educators who frighten women away from epidurals and set them up for failure by leading them to think they can cope with labor without one. Thus he compounds misinforming women by warning them away from more accurate sources. The internet has worsened matters by dispersing disinformation further and faster.[3]

Some anesthesiologists seem almost opposed to informed consent. When studies began emerging about epidural fever and its consequences, this appeared in an Ob.Gyn. News article:[13]

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§ The language shifted from epidural "anesthesia" to the more benign sounding "analgesia" in the 1990s.

> Controversy surrounding the safety of epidural analgesia threatens to *scare pregnant women away* from pain relief during labor, speakers said at the annual meeting of the Society for Obstetric Anesthesia and Perinatology. . . . They blamed what they consider to be biased articles for misleading patients [referring to a study establishing the association of epidurals and neonatal sepsis evaluations]. . . . "This is some of the information that our patients are receiving from prenatal educators," *cautioned* Dr. David Campbell, who defended epidural analgesia during a presentation at the meeting." (Emphasis ours.)¶

We can safely assume women would like to choose from a range of pain coping options. Not every woman wants regional analgesia or wants it right away, but women do not get this either. Despite a range of 70% to 91% of women surveyed in Listening to Mothers II finding immersion in warm water, a shower, a birth ball, and application of heat or cold to be very or somewhat helpful, 7% or fewer used these modalities.[28] Women in the typical U.S. hospital are like Henry Ford's Model T customers: You can get it in any color you like as long as it's black. Women planning to have an epidural will almost all get their wish—91% in one study of the preferences of nulliparous women for epidurals—but women intending not to have one will not:[40] nearly half—43%—ended up with an epidural.

Epidural advocates might respond that women who have regional analgesia are almost always satisfied with their pain management, but Marmor and Kroll (2002) point out that satisfaction does not necessarily mean that women got what they originally wanted and note that the institution and medical staff largely control what options are available and what information women are given about them.[70] It turns out, too, that pain has little to do with satisfaction. Studies find that fulfilled expectations, the amount of support from caregivers, the quality of relationship with caregivers, and their involvement in decision making override pain in determining satisfaction. (See mini-review 1 in chapter 18.) This finding is robust: socioeconomic status, ethnicity, and national culture do not affect it. Regional analgesia interferes with these superseding factors. Once a woman has an epidural, caregivers tend the machinery, not her, and even that may be done at a distance via a central monitoring station. Epidurals merely serve as the anodyne that prevents women from noticing what is lacking in their care. Furthermore, we have a group that is not satisfied: women who planned to avoid an epidural and ended up having one.[51] Epidural advocates attribute failure to achieve their goal to unrealistic expectations, but the expectation of coping with labor pain without analgesia is not unrealistic. The rate of transfer for inadequate pain relief among the 11,814 women who began labor in a freestanding birth center was a mere 2.5%.[86]

¶ After reading this, H.G. began asking educators in audiences at her epidural talks whether they had been forbidden to discuss epidurals. Invariably, some had. Anesthesiologists, they were told, would take care of telling women all that they needed to know.

No, the failure lies with conventional labor management, which increases pain and limits options for relieving it, and even more with caregivers who discourage women and pressure them subtly—and not so subtly—to accept an epidural.

We are not opposed to regional analgesia. We believe that every woman has the right to determine her own "enough" point when it comes to labor pain. All we want is for women to make informed decisions about its use based on complete and unbiased information and to have access to, and be encouraged to use, a wide variety of no-risk pain-relieving measures that can increase comfort and contribute to a sense of mastery. For those women choosing epidurals, we want them managed in the way least likely to cause complications and unpleasant side-effects and most likely to promote spontaneous vaginal birth. Is that asking too much?

STRATEGIES FOR OPTIMAL CARE

It remains unclear to what degree women with epidurals require more than physiologic care. Is active management of labor necessary to avert cesareans for dystocia, or would patience and the judicious use of lower-dose regimens work equally well? If the latter, we could avoid the adverse effects of high-dose oxytocin. Would delayed pushing and pushing in an upright position be more effective if studied in a setting providing physiologic care? We do not know. We do, however, get some tantalizing glimpses of the possibilities. Anal sphincter injury rates depend on avoiding episiotomy and instrumental delivery. Baby-Friendly breastfeeding policies appear to eliminate disparities in breastfeeding success. When women are cared for by midwives who practice physiologic care in second stage, only 3% having epidurals had an OP fetus at delivery, a percentage that did not differ from women not having an epidural,[5] and another study in women conventionally managed reports the identical 3% rate in women without an epidural but a 13% rate in women who had one.[64] Physiologic care should at least form the basis for care and clinicians should:

- discuss the benefits and harms prior to labor of a wide variety of pain-coping strategies, both pharmacologic and nonpharmacologic. Advise women to find out whether an epidural will cost them out-of-pocket, and if so, how much? Costs may vary from $100 to $1000 or more, which may affect their plans.[2, 71]
- Provide a wide variety of pain coping options and comfort measures and train nurses in their use.
- Ascertain each woman's preferences regarding pain coping techniques and individualize care to help her meet her goal.
- Encourage the use of nonpharmacologic pain coping strategies and comfort measures.
- Encourage women desiring an epidural to delay until active labor. This will reduce the likelihood of epidural fever and persistent OP baby. Until that time, assist her with comfort measures and pain-coping strategies.

Avoid systemic narcotics as they may have a cumulative effect when succeeded by neuraxial narcotic.[6]

- When women who wanted to avoid an epidural change their minds, review and praise their efforts and sympathize over not reaching their goal.
- Administer a low-dose, anesthetic-only epidural.
- Recommend side-lying and upright postures to women laboring with an epidural.
- Provide physically and emotionally supportive care regardless of whether a woman has an epidural.
- Implement Baby-Friendly breastfeeding policies.

MINI-REVIEWS

Notes:

- Where feasible, studies have been confined to RCTs and systematic reviews.
- It is difficult to extract and synthesize information from epidural studies and systematic reviews of epidural trials and studies because:
  - » Epidurals vary in anesthetic agent; whether narcotics are used, and if so, which one; concentration of anesthetic and narcotic; timing of administration; and whether the epidural is administered via initial dose followed by top-ups, continuously, or by patient self-administration. CSEs likewise vary in agent and dosage injected into the intrathecal space. The evidence suggests that these variations affect results, but few are taken into account in systematic reviews.
  - » Co-management varies in the use of oxytocin, oxytocin dosing regimens, time limits set for progress, and whether passive descent is used in second stage. Co-management is rarely documented unless it is the subject of the study.
  - » Practice variation confounds attempts to determine the benefits of various epidural management strategies. In institutions with low background cesarean and instrumental vaginal delivery rates or both, large numbers would be needed to detect the small differences that might result, while where operative delivery rates are high, strategies designed to reduce them will likely have little effect.
  - » RCTs of epidural vs. nonepidural analgesia almost all suffer from substantial percentages of crossover to epidural analgesia among women allocated to the nonepidural group and sometimes from the epidural group to the nonepidural group, which diminishes differences between groups. On the other hand, when statistically significant differences are found despite such crossover, the true difference is likely to be greater than it appears.

  - » The most carefully designed observational studies may still be subject to confounding factors, chief among them that women having more difficult labors might be more likely to want an epidural.
  - » Trials have no unmedicated comparison group, which confounds the determination of the adverse effects of epidurals.
  - » Many studies are of mixed-parity populations, which confounds the determination of epidural adverse effects on mode of birth.
- Assume differences are statistically significant unless otherwise noted.

1. Epidural analgesia decreases the likelihood of spontaneous vaginal birth. Trials consistently find increased rates of instrumental vaginal delivery. The meta-analysis in the Cochrane systematic review of epidural vs. nonepidural analgesia included 17 trials (N = 6162) and found a 40% increase (19% vs. 14%, RR 1.4).[9] However, this may be substantially less than the true difference. Two trials in nulliparous women taken together make up half the weight of the analysis. Both have exceedingly high rates of women allocated to the nonepidural group having epidurals (62% and 56%) and substantial proportions of women in the epidural group not receiving epidurals (27% and 14%). A further three studies, together making up an additional 18% of the weight, were of women of mixed parity, and multiparous women are much less likely to be delivered with instruments.

The meta-analysis of cesarean rates included 20 trials (N = 6534) and reports similar cesarean rates (11% vs. 10%).[9] A subanalysis of the 14 trials (N = 4355) in which 70% or more women received their allocated treatment still found no difference in cesarean rates (10% vs. 9%). This seems counterintuitive given that other meta-analyses found that epidurals were associated with factors significantly or nearly significantly associated with increased likelihood of cesarean: longer labors, more augmentation, increased malposition. Moreover, those meta-analyses include trials that had large percentages of crossover and trials that included multiparous women, factors that would diminish differences between groups. Turning to the individual trials in the cesarean meta-analysis, we can see why the meta-analysis may have failed to find a difference. If we look at the meta-analysis of cesarean rates in trials with moderate or low crossover (30% or less) and sort them into categories according to confounding factors, 70% of the weight of the results comes from data from four trials conducted at a U.S. institution with extraordinarily low background cesarean rates (probably because midwives provided the bedside care), 69% from six trials that included multiparous women, and 41% from three trials in women with pregnancy-induced hypertension. This raises the question of whether results can be generalized to healthy, nulliparous women undergoing conventional management. What is more, crossover is still a confounding factor. Lieberman and O'Donoghue (2002) calculate that in a trial in which epidural analgesia truly doubled the cesarean rate from 10% to 20%, a trial with 400 participants will have 80% power to detect the difference if there is no crossover, i.e., four out of five studies will find the difference to be statistically significant; but if 30% of women do not receive their allocated treatment, 2500 participants will be needed to achieve the same power.[65] Smaller differences between groups would

still be clinically important and require even more participants, as would larger degrees of crossover.

2. Individual variation in practice style accounts for the relationship between epidurals and cesarean section.

Five studies looked at correlations among epidural rates, cesarean rates, and practice variation. One compared cesarean rates between a large tertiary-care teaching hospital and a nearby community hospital in 857 low-risk nulliparous women.[48] Women were much more likely to have cesareans (21% vs. 7%) and epidurals (67% vs. 15%) at the teaching hospital. Epidural usage was an independent predictor of cesarean at both hospitals, and differences in epidural use was the principle factor explaining differences in cesarean rate between hospitals. A small observational study of 26 laboring women at the tertiary center and 24 at the community hospital conducted as part of the larger study suggested that differences in epidural use related to differences in practice style. Women were less likely to be ambulant and more likely to be offered epidurals at the tertiary center.

The other four studies focused on differences among providers. The first compared practices of two obstetricians with high cesarean rates for dystocia (13-15%) with those of three physicians with low cesarean rates (6-6.5%) in a population of 546 nulliparous women in spontaneous labor at term, finding similar rates of epidural use (77% low vs. 82% high).[42] The second study examined the relationship between epidural use and cesarean for dystocia in 110 individual obstetricians caring for 18,333 laboring women with a singleton, vertex fetus and no prior cesarean.[91] Epidural analgesia was strongly associated with cesarean rate for dystocia, as were nulliparity, induction, maternal age, public insurance, and extremes of birth weight and gestational age; but after adjustment for these factors within their populations, epidural use was not associated with individual obstetrician cesarean rates. A model attempting to predict cesarean rates for dystocia could explain only 30% of the variation, which indicated that cesarean rates for dystocia were essentially idiosyncratic to the individual practitioner. Similarly, the third study looked at 14 obstetrician groups caring for 1228 nulliparous women laboring at term with a vertex fetus.[11] It too found that, while having an epidural increased the cesarean rate for dystocia (15% vs. 8%), it was not an independent factor in determining group cesarean rates. (It was, however, for forceps delivery and instrumental vaginal delivery overall.) The fourth study looked at epidural use as a marker for practice style.[57] Investigators stratified 96 family physicians into 3 groups according to epidural rates that were low (0-30%), medium (31-50%), and high (51-100%), comparing intervention use and outcomes in 1992 nulliparous women. To highlight differences, statistical analysis compared low to high use, although a graph showed that intervention use increased in stair-step fashion from low to medium to high. After adjustment for race and maternal age, high epidural users had higher cesarean rates (24% vs. 14%), as well as earlier admission (3 cm dilation vs. 4 cm), more electronic fetal monitoring (87% vs. 76%), more use of oxytocin augmentation (30% vs. 12%), more malpositions (34% vs. 23%), and more neonatal special care admissions (13% vs. 7%). A random chart audit found that low users spent more time with laboring women and initiated epidurals later.

3. Women having epidurals are more likely to experience anal sphincter laceration because they are more likely to have instrumental vaginal delivery, episiotomy, or both.

> **Note:** The relationship between epidural and anal sphincter injury will be modified by type of instrument (forceps vs. vacuum extraction) and type of episiotomy (median vs. mediolateral). The relationship will also be moderated by the frequency of their use in the study population.

A systematic review reports on seven observational studies examining the relationship between epidural and anal sphincter laceration, one of which was confined to women having instrumental vaginal deliveries.[65] Five of the six studies not limited to instrumental delivery report an increase in anal sphincter laceration rates with the use of epidurals that achieved statistical significance in all but the smallest of the studies. Reviewers state that there was insufficient information to explain why the sixth study was the exception to the rule. Moreover, it seems likely that the relationship is stronger than appears since three of the five studies were in mixed parity populations and one included all women planning vaginal birth, some of whom would have had intrapartum cesareans, thus reducing the proportion exposed to risk factors for sphincter laceration. One of the six studies reported that the relationship remained significant after controlling for confounding factors. Investigators in that study explored the association between epidurals and anal sphincter injury by classifying women into four categories by mode of birth (spontaneous vs. instrumental) and use of (probably median because this was a U.S. study) episiotomy (yes vs. no) and then comparing rates of anal sphincter laceration with and without epidural. Both instrumental delivery and episiotomy were more common in women having epidurals, and once this was taken into account, the association between epidural and anal sphincter laceration disappeared. In other words, instrumental delivery and episiotomy were the pathways by which epidurals increased sphincter lacerations. The link between epidurals and instrumental delivery explains why no association with sphincter laceration was found in the seventh study, in which all women had instrumental vaginal deliveries.

Since the review's publication, four studies have looked at the relationship between epidurals and anal injury while adjusting for correlating factors, three carried out in the U.S., which means median episiotomy was probably the norm.[20, 24, 31] All three found that while epidural analgesia was associated with anal sphincter injury, the association disappeared after adjustment for mode of vaginal delivery. The fourth study, from Finland (mediolateral episiotomy), analyzed 514,741 vaginal births to determine factors associated with anal sphincter injury.[81] After accounting for numerous factors, including OP position, BMI, birth weight, and instrumental delivery, a positive association with epidural analgesia disappeared in primiparous women but remained in multiparous women.

4. Early epidural administration appears to increase the risk of persistent malposition, which could increase cesarean and instrumental vaginal delivery rates. Four studies examined the associations between OP presentation at term delivery (persistent OP), epidural analgesia, and mode of delivery, three in mixed-parity populations (Ns = 30,839; 13,789; 6434)[23, 32, 79] and one in nulliparous women (N = 16,781).[94] Two of the studies adjust for correlating factors.[23, 94] All found associations between OP and epidural analgesia. Absolute differences compared with occiput anterior (OA) presentation at birth ranged from 10% to 27% in mixed-parity populations,[23, 32, 79] 10% to 30% in multiparous women,[32, 79] and 12% to 16% in nulliparous women.[32, 79] The study confined to nulliparous women reports instead the percentage of women having epidurals who had persistent OP (7.3%) vs. the percentage of women not having epidurals (2.8%), likewise finding an association (absolute difference 4.5%, OR 2.2).[94] All found major decreases in spontaneous vaginal birth in women with posterior babies. Absolute differences ranged from 44% to 53% in mixed-parity populations,[23, 32, 79] 35% to 38% in multiparous women,[32, 79] and 44% to 48% in nulliparous women.[32, 79, 94] The specific effects on cesarean and instrumental vaginal delivery rates varied more widely because they depend on practice variation in mode of operative delivery for dystocia. Nevertheless, all found major increases in cesarean rates with absolute differences ranging from 16% to 43% in mixed-parity populations,[23, 32, 79] 13% to 22% in multiparous women,[32, 79] and 15% to 35% in nulliparous women,[32, 79, 94] and absolute differences in instrumental vaginal delivery rates ranging from 10% to 28% in mixed-parity populations,[23, 32, 79] 13% to 25% in multiparous women,[32, 79] and 13% to 27% in nulliparous women.[32, 79, 94]

Two other studies suggest a link between epidural timing and persistent posterior. One, of 320 women of mixed parity at term, reports that, after controlling for age, induction of labor, and birth weight, initiating an epidural at fetal station < 0 tripled the relative risk of OP or occiput transverse (OT) babies at delivery compared with initiation at ≥ 0 station (absolute difference 16%).[85] Among nulliparous women, the absolute difference was 20%. High fetal station at initiation also increased the cesarean rate: absolute difference 15% overall and 17% among nulliparous women; absolute differences in spontaneous vaginal birth rates were 12% and 19%, respectively. The other study, of 500 nulliparous women at term, divided the women into six groups according to rapidity of early dilation (≥ 1 cm/h vs. < 1 cm/h), early or late epidural administration (≤ 5 cm dilation vs. > 5 cm dilation), and, for those who did not have an epidural, slow vs. rapid dilation.[97] Women in the early epidural group were more likely to have a persistent OP or OT fetus compared with women in the late-epidural (absolute difference 17%) and no-epidural groups (absolute difference 12%), but women in the late and no epidural groups had similar persistent malposition rates.

The question remains whether having an OP baby at admission increases the likelihood of having an epidural or if having an epidural increases the likelihood of having a persistent OP. Investigators in one study argued that, at their institution, an increase in epidural use from 3% in 1975 to 47% in 1998 with, if anything, a decrease in rate of persistent posterior presentations (3.8% vs. 2.4%) disproves the latter theory.[32] Moreover, the mean dilation at epidural initiation was 2 cm, which also refutes the theory that early epidurals are the problem. However, the Cochrane systematic review of RCTs of epidural vs. other analgesia finds a trend toward an increased incidence of "malposition" in the epidural arms in the four trials (N = 673) reporting this outcome (18% vs. 13%, RR 1.4, CI 0.98 – 1.99).[9] Moreover, in the largest trial, weighted at 74% of the meta-analysis, 28% of the women

allocated to the no-epidural group had epidurals, which would reduce the ability of the meta-analysis to detect differences.

Finally, an ingenious study also supports a role for epidural analgesia while refuting conventional wisdom about the persistence of OP and excessive pain with OP fetuses.[64] Investigators performed serial sonograms on 1562 laboring nulliparous women at term: the first at admission; the second within one hour after epidural initiation or, if there had been no epidural, four hours after the initial sonogram; and the third after 8 cm dilation. Almost all women had epidurals (92%). At initial sonogram, 49% of fetuses were OT and 24% OP, while at delivery 8% were OT and 12% OP. Similar percentages were delivered OA regardless of initial position. Of fetuses that were OP at delivery, only 31% were OP at the initial sonogram. Even among those who were OP at ≥ 8 cm dilation, only 21% were OP at delivery, and some (5%) who were OA this late in labor had converted to posterior by delivery. Conversely, half the women who delivered a posterior fetus never had a posterior fetus during labor. Epidural analgesia was associated with a four-fold (13% vs. 3%) increased risk of OP delivery compared with women not having epidural analgesia after controlling for correlating factors, including body mass index, birth weight, induction of labor, and fetal position on initial sonogram. The association remained after excluding women delivered by cesarean before full dilation. OT, however, was not associated with epidural analgesia. As one would predict, compared with OA, spontaneous vaginal delivery rates were decreased (17% vs. 76%) with OP delivery, and cesarean rates were increased (65% vs. 6%), but instrumental vaginal delivery rates were identical (18%) in both positions. Evaluation of labor pain in women laboring spontaneously did not find that women with OP fetuses reported more pain and almost identical percentages reported "back labor" (28% vs. 29%) with OP fetuses as with OA or OT fetuses.

5. Epidural analgesia can cause severe, life-threatening, or fatal complications. The incidence of rare complications related to epidural analgesia cannot be determined from trials or observational studies; however, two analyses of prospectively collected large datasets provide a source. The smaller of these was of 10,995 epidurals for labor or cesarean delivery performed between 1989 and 1994 at a single institution.[78] The investigators report statistics together with more detailed reports on selected cases. Eight women experienced a high blockade (1 in 1400), and two of them required intubation and ventilation (1 in 5500). One woman experienced a severe neuropathy (1 in 11,000) that had not resolved at discharge nine days after delivery. The larger surveyed 79 obstetric units from 1990 to 1991 covering 122,989 regional anesthesias for labor or cesarean surgery.[90] Twenty-six women experienced a high blockade, and two additional women experienced acute toxicity (1 in 4400), although neither experienced grand mal seizure. One case of high blockade resulted in cardiac arrest and another in respiratory arrest. Both women survived. Eight women experienced urinary retention lasting three to six months (1 in 15,400), and 46 women experienced a neuropathy (1 in 2700). Among the 44 women available for follow-up, at least one had not fully recovered seven months later. Epidural complications sometimes prove fatal.[45]

Epidurals greatly increase likelihood of hypotension. The Cochrane systematic review of epidural vs. nonepidural analgesia's meta-analysis of hypotension rates includes seven trials (N = 2759 women) and reports a 16.5% rate in the epidural group vs. 0.1% in the control group (RR 20.1).[9] The difference might have been even greater had analysis been

according to whether women actually received epidurals because many women assigned to the nonepidural group had epidurals. By diminishing placental perfusion, hypotension would pose a risk to the fetus as well as the woman. We do not know if any cases resulted in urgent delivery, but it is suggestive that the meta-analysis of the 10 trials (N = 4421) reporting rates of cesarean for fetal distress found a near-significant increase in the epidural arm (3.1% vs. 2.2%, RR 1.4, CI 0.99 - 2.03).

An analysis of 13,868 women delivered vaginally reports that epidurals were associated with a trend toward postpartum hemorrhage (> 1000 mL as measured by collecting blood and weighing of all sheets, drapes, and sponges or requiring transfusion because of anemia or hemodynamic instability).[68] Entering all factors significantly associated with postpartum hemorrhage into a logistic regression analysis, women experiencing postpartum hemorrhage were more likely to have had epidural analgesia (30% vs. 24%, OR 1.3, CI 1 - 1.6).

6. Epidural analgesia increases the likelihood of maternal fever, which has indirect and possibly direct adverse consequences.

Three trials (N = 1912) in the Cochrane systematic review of epidural vs. nonepidural analgesia report fever (pyrexia) rates > 38 degrees C.[9] All three report more women running fevers in the epidural group (RR 3.7, absolute difference 15%). Few women allocated to the nonepidural groups had epidurals (range 1-6%), so crossover was not a confounding factor.

An earlier systematic review included observational studies of the association between fever and epidurals and studies of adverse outcomes associated with epidural fever.[65] Among women actually receiving epidural analgesia in four RCTs (no overlap with the Cochrane review) and six observational studies, all studies report excess risk of fever, with relative risks ranging from 5.0 to 70.8. This wide range in relative risk was due to the variation in the percentage of women in the nonepidural groups who ran fevers (0.2% to 5%). The range in absolute differences was much smaller (11% to 19% in nulliparous women). Long labors per se are not the cause. A study evaluating fever prevalence over time in nulliparous women reports no relationship with labor duration in women with no epidural but a linear increase beginning at six hours' duration in women with epidurals.

Reviewers found adverse maternal outcomes associated with epidural fever.[65] A study correlated fever with operative delivery in low-risk nulliparous women in term, spontaneous labor. After controlling for confounding factors, women with temperatures > 99.5 degrees F were three times more likely to have had cesareans (25% vs. 7%) or instrumental vaginal delivery (25% vs. 9%). Ninety percent of women who ran fevers had had epidurals. A study in nulliparous women reports that those having epidurals were much more likely to have antibiotic treatment (20% vs. 6%).

Two studies published after the review refined the relationship between epidural fever and maternal antibiotic treatment. In one, investigators looked at indications for antibiotics in a population of 1235 nulliparous women during a time when screening for group B strep and antibiotic prophylaxis was rare, eliminating it as a confounding factor.[38] Sixty percent of women had epidurals. Women given epidurals were more likely to have had antibiotics (28% vs. 11%, OR 2.6). They were more likely to be given antibiotics for presumed chorioamnionitis (primarily diagnosed by fever, especially in women with epidurals because they would not feel uterine tenderness) (9.0% vs. 0.4%, OR 22.4) and for surgical prophylaxis (cesarean surgery, anal sphincter laceration, or manual placental removal) (12.8% vs.

5.4%, OR 2.9), but they were not more likely to be prescribed antibiotics postpartum or for medical reasons such as prolapsed mitral valve. Factors associated with epidurals that led to antibiotic treatment were fever > 100.4 degrees F (16.7% vs. 0.6%), cesarean (15.9% vs. 5.6%), and anal sphincter laceration in women with vaginal delivery (18.9% vs. 14.0%). Study authors theorize that epidural fever may primarily be a noninfectious inflammatory process, citing as evidence a study finding that histological placental inflammation was far more common with epidurals and greatly exceeds any expected rate of infection, but they add that we have no way to distinguish epidural-related fever from true infection. The second study prospectively evaluated tympanic temperature hourly in 99 afebrile nulliparous women from the time of epidural initiation.[39] Characteristics associated with infection-related fever were similar in the 22 women developing fever (temperature ≥ 101.4 degrees F). Mean temperature in the group overall rose over time, becoming significantly different from baseline at 4 hours. However, compared with women who remained afebrile, women destined to develop fever experienced an immediate rise in temperature that accounted for the rise in the group overall. Study authors observe that the temperature increase occurred early, before intrapartum risk factors for chorioamnionitis could accumulate, which argues strongly for a noninfectious origin of epidural fever.

Neonatal adverse outcomes correlate with epidural fever as well.[65] A study found that while newborns of women having epidurals were more likely to have sepsis evaluations (25% vs. 16%), the excess was confined to febrile women (≥ 38.0 degrees C or 100.4 degrees F). The same babies were also more likely to have had antibiotic treatment (19% vs. 11%). An association between epidurals and fever-related uncommon adverse effects would be difficult to detect in epidural studies because relatively few women would run fevers, but two studies investigated the direct effect of fever. One found that, after controlling for confounding factors, babies of women whose fevers exceeded 101 degrees F were more likely to require resuscitation (11.5% vs. 3%) and to be given oxygen therapy in the nursery (8.2% vs. 1.3%). All but 2% of women who ran temperatures > 100.4 degrees F had had epidurals. Infants were also more likely to have seizures, but numbers were small. The same investigators subsequently did a case-control study of unexplained seizure in term newborns and found that 32% of cases but only 9% of controls were exposed to intrapartum fever. After controlling for labor events associated with seizure, the odds ratio for fever was 3.4.

7. Narcotic administration, whether intrathecal or epidural, causes itching and probably increases the likelihood of nausea and vomiting, although the strength of the association is less clear and may vary according to agent.

A systematic review of epidural side effects and co-interventions reports on the incidence of itching (pruritis) in 17 trials that compared various combinations of epidural and intrathecal agents.[72] The incidence ranged from 8% to 100% with a mean of 62% in women administered epidurals or intrathecal sufentanil or fentanyl, compared with 0% to 4% in women not receiving an intrathecal or epidural narcotic agent. The likelihood of itching correlated with epidural dose. Most cases were not treated, but no information is given on whether treatment depended on maternal request or women were offered treatment and declined, nor is information given on treatment effectiveness. A systematic review of fetal bradycardia with intrathecal narcotics also reports on itching.[69] Among 20 trials, 58% (757/1311) of women with intrathecal narcotic reported itching, vs. 30% (158/536) with epidural narcotic and

0.6% (2/316) with no narcotic exposure. The authors note that some women find itching to be "extremely uncomfortable" and, citing a systematic review, that "the efficacy of treatments of opioid-related pruritis is poor" (p. 279).

Data on nausea are difficult to interpret. The systematic review of side effects includes 10 studies reporting on this outcome, 8 studies of 39 to 50 women, 1 of 90 women, and 1 of 761 women.[72] Some studies report on nausea, others on nausea and vomiting together, and still others report separately on these two outcomes. Looking at the small studies, sufentanil appears to be more problematic: rates ranged from 4% to 18% with intrathecal or epidural sufentanil vs. 0% to 3% with fentanyl, with the exception of one study in which an extraordinarily high epidural dose of fentanyl alone (100 micrograms compared with about 2 micrograms in combination with an anesthetic) was given. This resulted in a 17% nausea and 8% vomiting rate. The study of 761 women, however, reports nausea rates both much lower than the small trials and nearly identical (2% vs. 1%) in women given intrathecal sufentanil and women given epidural fentanyl. The larger percentages in the small trials may be an artifact of their small numbers and chance: where numbers are low, every case substantially increases percentage rate. Further confusing the issue, the addition of epinephrine also increases risk. Two of the trials hint at this: one trial comparing intrathecal sufentanil with the same dose of sufentanil plus epinephrine reports more nausea and vomiting in the epinephrine group, and the sole trial reporting on an epidural with epinephrine but no narcotic agent reports a 14% nausea rate. An RCT that was not part of the review confirms the association.[41] Investigators randomly allocated 76 nulliparous women to one of four intrathecal fentanyl-containing solutions: saline, bupivacaine, bupivacaine and epinephrine, or epinephrine. Severe nausea rates (self-reported as a score of "3" on a scale of 1 to 3) were 0% and 6% in the no-epinephrine solutions vs. 28% in the fentanyl-epinephrine group and 40% in the fentanyl-bupivacaine-epinephrine group. In the Cochrane review of epidural vs. nonepidural analgesia, a different picture emerges:[9] the nausea and vomiting rate in the epidural arm of the seven trials (N = 1181) reporting on this outcome was much higher (17%), a difference all the more puzzling because, in three trials, no narcotic agent was given, fentanyl was the intrathecal or epidural agent in the other four, and no trial used epinephrine. Unfortunately, we have no baseline rate in women not exposed to narcotics via some route, be it intrathecal, epidural, intravenous, or intramuscular.

8. Epidural analgesia appears to make a small but clinically significant contribution to problems establishing breastfeeding and shortened duration of breastfeeding; fentanyl appears to be a culprit.

Note: Research into the relationship between epidurals and breastfeeding is fraught with problems. These include:

- A long list of correlating and confounding factors. Studies attempt to account for some of them, but none is free from them. They include variations in analgesic agents, dosage, and regimen both within and among studies; self-selection among women choosing whether to have epidurals or who forgo pharmacologic analgesia altogether; lack of an unmedicated comparison group; parity; birth mode; routine or frequently used

neonatal practices such as suctioning; institutional policies or practices that promote or interfere with establishing breastfeeding; and access to quality breastfeeding advice and assistance before and after discharge. Moreover, adjusting for co-interventions associated with epidurals, such as instrumental vaginal delivery, discounts the possibility that epidurals lead to their use, thus diminishing differences between groups.

- Variation in wider cultural attitudes toward breastfeeding and, if duration is being measured, the presence or absence of societal policies such as paid maternity leave that support breastfeeding. This limits the ability to generalize beyond the same socioeconomic group, ethnic identity, region, or country.
- Variation in breastfeeding evaluation strategy, which makes cross-comparisons difficult. In addition, the need to arrange an observed feeding means that some poor quality feeds were related to factors other than innate ability, e.g., a sleeping baby or the woman's other children distracting her.[10, 80]
- Use of the Neurologic and Adaptive Capacity Score (NACS) to assess effects on newborn behavior. The NACS assigns a composite score based on twenty criteria in five domains: adaptive capacity, passive tone, active tone, primary reflexes, and general neurologic status.[21] It has never been validated (test score correlates with clinical outcomes),[17] it is not reliable (different testers and repeated testing find similar scores),[44] and the composite score may miss deficits in specific domains,[17] which means that finding similar scores does not rule out adverse neurologic effects that affect breastfeeding.

Reviewers conducting a systematic review of unintended effects of epidurals could find only two studies specifically addressing breastfeeding.[65] One reports fewer women who had received epidurals still breastfeeding at six months, while the other reports no difference in the numbers of women breastfeeding at six weeks. Both studies, however, suffered from serious weaknesses, making them "difficult to interpret" (p. S59-S60). Moreover, the study reporting no difference was carried out at a hospital with Baby-Friendly practices and policies,[43] so results may not be generalizable to other populations.

Among studies published after the review, one evaluated effects of epidurals on early breastfeeding.[80] Observers blinded to group assessed breastfeeding at initial feed after vaginal birth and at one day in 56 multiparous women, most of whom had breastfed before. Half the group received a continuous epidural of bupivacaine plus fentanyl in labor, while the other half had no pain medication. As in the study above, hospital policies were supportive of breastfeeding (babies kept skin-to-skin for one hour after birth, 24 hour rooming-in, breastfeeding on demand), which might overcome any difficulties imposed by epidural analgesia. No differences were found between groups. The six babies with low scores, three in the medicated and three in the unmedicated group, had influencing factors unrelated to pain medication. In three cases, the woman had not breastfed before, in two the woman

was exhausted and slept through the initial recovery period, and in the sixth, the woman complained of extreme fatigue during the initial breastfeeding session and was distracted by her other children during the later session.

Two studies evaluated the effect of epidurals on early breastfeeding and correlated it with duration. Both report an association with duration after adjusting for correlating factors, but they disagreed on its effect on early feeds. One study was a secondary analysis of an RCT of epidural analgesia vs. continuous midwifery support in which breastfeeding was followed for six months.[46] Among 992 nulliparous women at term, 690 had epidural analgesia (patient-controlled CSE using bupivacaine and fentanyl). Almost all women initiated breastfeeding (95%) and only eight women were lost to follow-up. At two months, 78% with no analgesia, 68% with narcotic analgesia (meperidine), 62% with only epidural analgesia, and 60% with both were still breastfeeding. At six months, the numbers respectively were 52%, 44%, 38%, and 38%. To eliminate confounding factors, a subset of women (n = 484) with spontaneous labor onset and vaginal birth were analyzed. After adjusting for narcotic analgesia, maternal age, education, and smoking during pregnancy, having an epidural in labor increased the likelihood of breastfeeding cessation at any time (hazard ratio 1.44), but women having narcotic analgesia alone were not more likely to cease breastfeeding. Intrapartum analgesia had little effect on quality of first breastfeed (infant well attached and sucking rhythmically), although babies whose mothers received both meperidine and epidural did nonsignificantly worse (56% good quality vs. 62-66%).

The second study was a multicenter prospective study of 1280 women and babies followed to 24 weeks, of whom only 8% were lost to follow-up.[100] In the first week, 93% were fully or partially breastfeeding, declining to 60% at 24 weeks. Women were classified into five mutually exclusive categories: nonpharmacologic pain relief, NO2, meperidine with or without NO2, epidural (bupivacaine and fentanyl) with or without other analgesia (among women having epidurals, all women having vaginal births also used meperidine), or general anesthesia with or without other analgesia. The only factor associated with no breastfeeding was less education, and half of non-breastfeeding women indicated that they never intended to breastfeed. By contrast, partial breastfeeding in the first week was associated with parity, intrapartum factors (analgesia, type of birth, and onset of labor), and cessation by 24 weeks (OR 1.9). Investigators first explored the relationship between analgesia and breastfeeding in the first week. After adjustment for parity in the group overall, partial breastfeeding was associated with epidural use (OR 3.6) when compared with no analgesic agents, while NO2 and meperidine were not; however, when analysis was restricted to vaginal births only and adjusted for parity, the association between partial breastfeeding and epidural use was no longer significant (OR 2.3, CI 0.9 – 5.9). On the other hand, after adjustment for parity in the group overall, women who had an epidural were more likely to report problems breastfeeding in the first week (OR 2.0), an association little changed when restricted to vaginal births and adjusted for parity (OR 1.8). Investigators then conducted a hazards analysis to identify independent predictors of breastfeeding cessation. While type of birth and parity strongly predicted partial breastfeeding in the first week, they were not associated with breastfeeding cessation before 24 weeks. Only intrapartum analgesia was associated with both partial breastfeeding in the first week and cessation before 24 weeks after adjustment for the other predictors in the model (maternal age and education). Compared with no analgesic agent, epidural use increased the likelihood (hazard ratio 2.0), as

did meperidine (hazard ratio 1.7), while NO2 did not. The relationship was robust. Survival curves and hazard ratios were not affected when the analysis was restricted to vaginal births and then primiparous and multiparous women or when epidural use was stratified according to epidural alone (all women with epidural alone had cesareans) or in addition to meperidine. Nor was it affected when the analysis was restricted to women having epidurals who fully breastfed during the first week.

A trial of early (1-4 cm dilation) vs. late (≥ 4 cm dilation) epidural analgesia (ropivacaine and sufentanil, like fentanyl, a lipophilic agent)[27] in 12,793 nulliparous women reports that breastfeeding was less likely (70% vs. 78%) at six weeks in the early arm.[103] This occurred despite identical cesarean rates (23%) in both arms and use of meperidine in early labor in the late arm. Median epidural duration was 12.6 h in the early arm vs. 4.8 h in the late arm, which suggests a dose-dependent effect.

Finally, two studies looked at the effect of fentanyl, a narcotic commonly used in narcotic epidurals and as an intrathecal agent in spinal-epidurals, and found an association with breastfeeding difficulties and failure. Two other studies did not find an association, but as we shall see, their results are still compatible with fentanyl predisposing to breastfeeding failure.

In the first study finding an association, investigators collected a random sample of 424 primiparous women who had given birth to healthy term infants, of whom 190 (45%) were exclusively bottle feeding at hospital discharge and 225 exclusively or partially breastfeeding.[50] Percentages of bottle feeding rose according to the potency of the analgesic agent used: 32% for NO2, 41% intramuscular narcotic (almost all meperidine), 44% epidural anesthetic only, 52% neuraxial morphine (used at cesarean section), 54% epidural with fentanyl or neuraxial diamorphine (both lipophilic opioids, diamorphine used at cesarean section). The only analgesic dose-related to bottle feeding was fentanyl. After adjustment for drugs administered (antiemetics, oxytocin, analgesic agents), mode of delivery, maternal occupation, and feeding intention, fentanyl dose remained statistically significant. Among women least likely to bottle feed (factors: older, non-manual occupation, planning to breastfeed, vaginal birth), receiving the mean dose of fentanyl (129 micrograms) increased the probability of bottle feeding from 4% to 6%. In a younger woman with a manual occupation planning to breastfeed and having vaginal birth, receiving the mean dose of fentanyl increased bottle feeding from 11% to 18%. Study authors note that lipophilic opioids transfer more easily and rapidly via the placenta and colostrum than opioids generally.

In the second study, a double-blinded RCT, investigators allocated 177 parous women who had breastfed previously for at least six weeks to either an epidural with bupivacaine only (n = 60), one with fentanyl dose ≤ 150 micrograms (n = 59), or one with fentanyl dose > 150 micrograms (n = 58).[10] Women receiving intravenous narcotics or who had cesareans were excluded. Five women in the no-fentanyl group received some fentanyl, one woman in the intermediate-dose fentanyl group received more than 150 micrograms, and nine women (16%) in the high-dose group received less. On postpartum day 1, both the woman and a lactation consultant assessed breastfeeding. Women assigned to the high dose group were more likely to report problems (21%) than women in the others (10% in each group), but the difference did not achieve statistical significance. Significance was achieved when investigators reanalyzed according to actual dose received (20% high dose, 14% intermediate, 7% no fentanyl). At six weeks postpartum, of 157 women, 14 (9%) had

ceased breastfeeding, 1 in the no-fentanyl, 3 in the intermediate-dose, and 10 in the high-dose group. In all cases women reported problems with breastfeeding as why they stopped. Women reporting problems on day 1 (29%) were more likely to stop than women who did not (6%). In the high-dose group, the likelihood of stopping was dose-related to the level of fentanyl in umbilical cord blood.

The first of the two studies that did not find an association evaluated the effect of epidural or intrathecal fentanyl in 105 women similar to those in the above RCT via telephone surveys at one and six weeks postpartum.[104] Eighteen women were lost to follow-up or excluded. If women with problems were less likely to respond, their loss to follow-up could affect results. The median total fentanyl dose was 151 micrograms (range 30-570). All women were breastfeeding at one week, but at six weeks, four women (5%) had discontinued breastfeeding because of problems with breastfeeding or supply. Only one of these women received > 150 micrograms of fentanyl, although 47 in all had received a dose this large, which the study authors take as evidence of a lack of effect. Nonetheless, 26 women (30%) at one week reported difficulties with breastfeeding as a reason for supplementing, and we are not told what proportion of these women received > 150 micrograms of fentanyl. The authors theorize that their results may have differed from the fentanyl dose trial because policies supportive of breastfeeding overcame any problematic effects, specifically access to free breastfeeding information and support antenatally, postpartum, and after discharge; hospital staff that promoted breastfeeding; and up to 12 months paid maternity leave.

The second study is a secondary analysis of nulliparous women participating in an RCT of standard bupivacaine epidurals (n = 353) vs. continuous infusion low-dose fentanyl-bupivacaine (n = 350) vs. fentanyl-bupivacaine CSE (n = 351), with comparison to a nonepidural group (n = 151 meperidine, 200 no narcotic).[105] Women in the trial groups were excluded if they received systemic narcotic. Women were equally likely to initiate breastfeeding in all epidural groups and in the nonepidural group not receiving meperidine (63-66%) but less likely to do so in the nonepidural systemic narcotic group (56%). Logistic regression incorporating ethnicity, study group, delivery mode, and age failed to find a statistically significant relationship between initiation rates and fentanyl dose compared with no fentanyl. It is, however, unclear how breastfeeding initiation rates relate to fentanyl use, as opposed to early breastfeeding difficulties, early supplementation, or early weaning. Furthermore, odds ratios vs. no fentanyl were 0.77 for total doses of 1-100 micrograms compared with 0.52 to 0.56 for incremental amounts > 100 micrograms (with one exception: 301-400 micrograms, a category containing only 31 women). None was statistically significant, although it is possible that a difference exists and that it is dose-dependent but the sample is too small to detect it, especially since the reference population included women in the no-epidural group, some of whom received meperidine. Mean breastfeeding duration did not differ among epidural groups (13-15 w), but this still does not tell us what role fentanyl may have played in early weaning.

9. Intravenous preloading before epidural or CSE analgesia may not reduce the incidence of hypotension. (See text box "What About Prophylactic IV Bolus and Epidurals?" and mini-review 6 in chapter 11.)

10. Reducing the anesthetic dose has no effect on cesarean deliveries but may reduce instrumental vaginal deliveries somewhat.

A systematic review of four RCTs of standard (0.125% bupivacaine) vs. light (0.0625% plus narcotic) epidural analgesia reports that none of the trials found a significant difference in instrumental vaginal delivery or cesarean rates.[65] A fifth trial, which may have been published after the review's close date, reports an increase in spontaneous vaginal births in nulliparous women with low-dose vs. standard epidural dose (43% vs. 35%, OR 1.6), all of which was attributable to the difference in instrumental vaginal delivery rates (28% vs. 37%), as cesarean rates were virtually identical (29% vs. 28%).[25] This trial was substantially larger (703 vs. 276 nulliparous women in the next biggest trial) than any of the other trials, which strengthens its conclusions.

11. Data conflict, but delaying epidural administration does not appear to decrease cesarean rates, probably because provider propensity for initiating cesareans overrides any effect of epidural timing.

> **Note:** We have excluded trials and systematic reviews comparing early vs. late epidural administration that included neuraxial analgesia (another term for CSE) in the early group. In those trials, women mostly received intrathecal narcotic early and received epidural anesthetic at about the same cervical dilation as women in the late epidural group. No evidence suggests that intrathecal narcotic has any adverse effect on labor progress. We also excluded trials in which timing of administration overlapped substantially between early and late groups or in which it could not be determined whether this was the case.

Some evidence suggests that early epidurals increase the probability of cesarean. A 1993 RCT of epidural vs. nonepidural analgesia in 93 nulliparous women, in which all but one woman in each arm received her allocated treatment, reports a strong association between the timing of epidural initiation and the likelihood of cesarean but no correlation with the timing of systemic narcotic analgesia.[98] Fifty percent (3/6) of women having an epidural at 2 cm dilation had a cesarean, falling to 33% (3/9) at 3 cm, 26% (5/19) at 4 cm, and 0% (0/13) at ≥ 5 cm. The difference in rates between < 5 cm and ≥ 5 cm achieved statistical significance. A sensitivity analysis (subgroup analyses to test the strength and validity of the result of a meta-analysis) of the trials in the Cochrane review of epidural vs. nonepidural or no epidural analgesia likewise found an association with timing.[56] When trials randomizing participants in active labor are excluded, meta-analysis of the remaining trials finds an increased cesarean rate (16.5% vs. 7.0%, OR 2.6). (See also mini-review 4.)

Three trials report no association. In one, 60 nulliparous women in term, spontaneous labor were randomly allocated (30 in each arm) to receive an epidural before or after 4 cm dilation.[67] No woman received narcotic analgesia prior to her epidural. Two women in the early group had cesareans vs. one in the late group (overall rate 8%), and four vs. five had instrumental vaginal deliveries (overall rate 15%). This study is too small to detect any but very large differences between groups, and moreover, both cesarean and instrumental delivery

rates are low compared with other studies of similar populations. The second trial (N = 221) of early (epidural at first request) vs. late (no epidural until ≥ 4 cm) reports similar cesarean (13% early vs. 11% late) and instrumental vaginal delivery (17% early vs. 19% late) rates, but investigators excluded women who had babies weighing > 4000 g, a subgroup more likely to be disadvantaged by having an early epidural, thus weakening any conclusions.[76] The third trial was in 12,793 healthy, nulliparous women at term in spontaneous labor with singleton, vertex babies.**[103] Median dilation at epidural initiation was 1.6 cm in the early group vs. 5.1 cm in the late group. Cesarean rates were identical (23%) in both groups, and instrumental vaginal delivery rates were similar (12% vs. 13%). The extraordinarily high cesarean rate in an ultra-low-risk population suggests that where practitioners have a low threshold for performing cesareans, epidural timing makes no difference.

12. Data contradict the theory that aggressive use of oxytocin will eliminate excess cesareans for dystocia in women with epidurals. (See also chapter 9.) Reviewers hypothesized that the finding from RCTs that epidural analgesia does not increase the cesarean rate cannot be generalized to conventional U.S. and Canadian obstetric management because those countries' practitioners do not generally practice active management of labor (AMoL).[58] To test their theory, they conducted a systematic review of eight trials of epidural vs. narcotic analgesia in which augmentation protocols were known, that reported outcomes according to "intent to treat," and in which women were required to be in active labor before analgesia administration. Trials varied as to whether study populations were nulliparous or of mixed parity (2 trials), whether they included only women in spontaneous labor or also women being induced (1 trial), in percentage of crossover from systemic narcotic to epidural (2-56%), and in percentage of women being augmented in the narcotic (15-82%) and epidural (32-75%) groups. All but one trial reports similar cesarean rates between trial arms, and that was the sole trial that did not augment labor according to a high-dose oxytocin protocol. Reviewers also verified that AMoL protocols were not in common use by conducting a convenience survey of 10 U.S. and 17 Canadian academic centers as well as reporting the recommendations of the Canadian and U.S. obstetrician professional organizations. However, the reviewers fail to consider other factors that may affect the likelihood of cesarean. For example, they mention that the low institutional cesarean rate in trials conducted at a particular U.S. center means results cannot be extrapolated to other U.S. hospitals, but they do not consider that midwives were the primary care providers at this center, which could explain both the low institutional cesarean rate and the low cesarean rate with epidurals. (See chapter 19.)

Other research contradicts their theory. A systematic review of trials of AMoL reports that both epidural rates (56% vs. 53%) and cesarean rates (13% vs. 15%) were similar in AMoL and usual care groups.[15] In addition, an Irish academic center that practices AMoL conducted an analysis of 14,867 nulliparous, term women with a singleton, cephalic fetus who were induced or began labor spontaneously between 1989 and 2005 to evaluate the effects of maternal age, induction, epidural analgesia, and birth weight on mode of delivery over time.[92] The unplanned cesarean rate rose from 8-9% in the early years to 15-21% in the later years, and epidural analgesia remained an independent factor after taking the other three factors into account.

** This trial took place in China but is included because it was well conducted and provides the strongest evidence on this issue.

13. Ambulation and upright positioning in first stage does not affect mode of delivery compared with recumbence in women with regional analgesia.

Meta-analyses of five RCTs (N = 1161) comparing ambulation and upright positioning in first stage with recumbency in women with regional analgesia report similar rates of spontaneous vaginal birth, instrumental vaginal delivery, and cesarean surgery.[84] Subgroup analyses according to parity and type of anesthesia also found no difference. A trial published subsequently in 703 nulliparous women also found no differences in cesarean or instrumental vaginal delivery rates in ambulatory (≥ 1 h) vs. sedentary women.[106]

14. Discontinuing epidural analgesia late in first stage may result in a modest reduction in instrumental vaginal delivery rates but has no effect on cesarean or fetal malposition rates, and it increases pain.

A systematic review of five RCTs of nulliparous women (N = 462) reports reduced instrumental vaginal delivery rates (23% vs. 28%) when epidural analgesia was discontinued late in first stage labor.[99] The difference failed to achieve statistical significance (RR 0.84, CI 0.61 – 1.15), but a much larger trial would be needed to rule out a potential benefit. (None has taken place.) Cesarean rates were 6% in each group, and fetal malposition rates (OP and OT) were similar (11% vs. 8%). Analgesic agents and administration techniques differed among trials, but subgroup analysis did not find any effects on outcomes. Discontinuing epidural analgesia greatly increased the likelihood of women reporting inadequate pain relief (22% vs. 6%). Reviewers note that overall instrumental vaginal delivery rates varied substantially among studies, ranging from 15% to 35%. This would mean that practice variation would outweigh any benefits gained by discontinuing analgesia and that this factor must be balanced against women experiencing more pain.

15. Delaying pushing decreases instrumental vaginal delivery rates, though they remain high in both groups, but it has no effect on cesarean or episiotomy rates, the latter being excessively high in both groups as well.

A systematic review of seven RCTs of nulliparous women (N = 2827) with effective epidural analgesia reports a decreased likelihood of instrumental vaginal delivery (35% vs. 46%, OR 0.8) with delay in pushing compared with immediate pushing.[14] Cesarean surgery rates (4.2% vs. 5.4%) and episiotomy rates (45% vs. 46%) were similar. In six trials, control-group women began pushing at full dilation, although in one trial the mean difference from the delayed pushing group was only 10 minutes, and in one trial "immediate" meant within 1 hour of complete dilation, resulting in a median delay of 52 minutes in the immediate group vs. 168 minutes in the delayed group. By far the largest trial, a trial of 1862 women (the next largest was of 252 women), at 12 institutions (11 North American and 1 Swiss), mandated at least a two-hour delay unless the woman experienced a strong urge to push, the head was on the perineum, or medical indications dictated shortening second stage,[34] whereas five of the six smaller trials limited delay to 1-2 hours. Delaying pushing in this largest trial reduced (51% vs. 37%, OR 0.7) instrumental vaginal delivery rates. Reviewers note that studies varied in epidural agents and concentrations, and pushing method was inconsistent, which also could affect outcomes.

16. Some evidence suggests that upright position in second stage may reduce instrumental and cesarean delivery.

A systematic review pooled data from two RCTs (N = 281).[83] One trial included nulliparous women with epidural analgesia of whom 25 were able to stand or walk in second stage vs. 41 women who sat in a chair or lay in bed, while the other was of 221 women of mixed parity (67% nulliparous) of whom 141 walked, sat in a chair, or reclined semisupine vs. 74 women who lay in bed in a supine, semisupine, or lateral position. Both trials report fewer instrumental vaginal (OR 0.77) and cesarean (OR 0.57) deliveries, but differences did not achieve statistical significance either in the individual trials or when data were pooled in a meta-analysis. In light of the potential benefits, the reviewers recommend conducting an adequately powered trial. A secondary analysis of a trial of standard epidural vs. mobile regional analgesia in nulliparous women published after the systematic review reports that, among women giving birth vaginally, few (43 ambulatory vs. 357 recumbent) were ambulatory (standing or walking for ≥ 20 min) after full dilation, which weakens conclusions, but fewer ambulatory women (30% vs. 44%) had instrumental vaginal delivery.[106]

17. CSE analgesia offers no advantages over epidural analgesia but increases the likelihood of adverse effects. (See also mini-review 7.)

A Cochrane systematic review of CSE vs. epidural analgesia reports no differences in delivery mode in trials comparing CSE with low-dose epidural.[93] Pooled spontaneous birth rates (12 trials, N = 1632) were similar overall (60% vs. 61%) and identical (43%) in both arms of the sole trial (n = 701) conducted in nulliparous women. Pooled instrumental vaginal delivery rates (10 trials, N = 1572) were also similar overall (20% vs. 18%) and similar in the sole trial (n = 701) conducted in nulliparous women (29% vs. 28%). Pooled cesarean rates (10 trials, N = 1572) were identical (20%) and similar in the trial in nulliparous women (28% vs. 29%). An RCT published after the systematic review comparing intrathecal fentanyl and bupivacaine with epidural fentanyl and low-dose bupivacaine in 127 women of mixed parity also report similar cesarean rates (19% vs. 17%).[95]

The review failed to find a significant difference in the incidence of post-dural puncture headache or in women treated with a blood patch for such headaches, but this may have been because the trials were too small even when aggregated to detect it. Pooling data from the meta-analyses of CSE vs. traditional epidural and CSE vs. low-dose epidural, we find that among the 12 trials (N = 839) reporting on headaches, rates were higher in the CSE group (1.2% vs. 0.5%). Rates were also higher for treatment with blood patches (1.3% vs. 0.3%) in the 8 trials (N = 610) reporting on this. If real, an excess of 1 woman per 100 would be clinically significant because of the severity of the postdural puncture headache and the disruption it poses to maternal attachment, breastfeeding, and caring for the newborn.

The review fails to find a difference in nausea and vomiting, but this may be because reviewers did not stratify according to narcotic agent. Pooling data from the meta-analyses of both traditional and low-dose epidural comparison groups, among the 9 trials (N = 652) reporting this outcome, rates were 17% vs. 13%. However, rates with intrathecal sufentenil (18%, n = 179) and epidural sufentanil (24%, n = 162) were substantially higher than rates with intrathecal fentanyl (10%, n = 173), and rates with epidural fentanyl (4%, n = 146) were the lowest of all. Results may be confounded by some trials including epinephrine in the intrathecal or epidural dose or both. (See mini-review 7.) The trial published after the

Cochrane review reports similar nausea rates in the same range as the review: 9% CSE vs. 21% epidural.[95] These results contradict our hypothesis that sufentanil is the more problematic agent, as fentanyl was the narcotic in both arms of the trial.

Pruritis (itching), by contrast, is much more common with CSE. Again, pooling data from both meta-analyses, 11 trials (N = 852) report on this outcome, with rates of 47% with CSE vs. 28% with epidural analgesia. Itching rates in the trial published after the systematic review paralleled the meta-analysis: 50% CSE vs. 30% epidural.[95]

The Cochrane review does not report on prolonged fetal heart rate decelerations or episodes of bradycardia within an hour of administration, but other reviews and studies do, finding a troubling association with CSE analgesia. The excess does not appear to lead to more cesareans, but women in the trials are generally healthy and carrying term fetuses, and large numbers would be needed to detect a small but clinically important difference. To begin with, a meta-analysis of 9 trials (N = 927) comparing intrathecal narcotics with epidural analgesia reports almost double (OR 1.8) the bradycardia rates within one hour of administration in the intrathecal narcotics group (7.3% vs. 4.8%).[69] Overall cesarean rates were identical (17%), and cesarean rates for fetal heart rate abnormalities were similar (6.0% vs. 7.8%) too.

Since the review, five trials have been published, two comparing intrathecal with epidural narcotics and three comparing intrathecal with systemic narcotics. All five report an excess incidence of prolonged decelerations in the intrathecal group. One intrathecal vs. epidural narcotic trial compared a 7.5 microg dose of intrathecal sufentanil (n = 100) with a 1.5 microg dose (n = 98) vs. a narcotic-epidural containing a 7.5 microg dose (n = 98).[101] It reports a dose-dependent effect for the intrathecal narcotic. Rates of prolonged decelerations or bradycardia were similar for the epidural and low-dose intrathecal groups (11% vs. 12%) compared with 24% in the high-dose intrathecal group. The other trial (N = 127), of intrathecal fentanyl and bupivacaine vs. epidural bupivacaine and fentanyl, likewise reports higher rates of prolonged decelerations in the intrathecal group (6.2% vs. 3.2%), but the difference did not achieve statistical significance, probably because the study was underpowered to do so.[95] Both trials report similar cesarean rates in their trial arms. Comparing intrathecal narcotics with epidural analgesia may diminish the true difference, as epidurals may increase risk of prolonged decelerations or bradycardia as well.

Turning to trials of intrathecal vs. systemic narcotics, one compared intrathecal fentanyl with systemic hydromorphone in 750 nulliparous women laboring spontaneously or with ruptured membranes.[109] It reports a higher incidence (3.9% vs. 0.6%) of prolonged decelerations in the intrathecal group in the first hour after administering analgesia, whereas rates had been 0.3% in both groups before analgesia. Cesarean rates for nonreassuring fetal status were similar (4.1% vs. 5.2%). A subsequent trial using the same protocol in 806 induced nulliparous women reports similar results: a higher incidence of prolonged decelerations in the intrathecal group (7.4% vs. 3.3%) compared with before analgesia (1.0%).[108] Cesarean rates for nonreassuring fetal status were higher (6.7% vs. 4.0%) in the intrathecal group, but statistical significance was not calculated. The increased rates compared with noninduced women suggest that the stress of induction works synergistically with intrathecal narcotic. A third trial compared intrathecal sufentanil with systemic meperidine.[37] Among 752 protocol-compliant participants, 2% experienced "profound fetal bradycardia" (not defined) in the intrathecal group vs. none in the meperidine group. This trial reports a significant difference in cesareans for nonreassuring fetal heart rate (3% vs. 1%).

The literature also reports cases of respiratory arrest[52, 54, 59] and altered consciousness[33, 88] shortly after administration of intrathecal narcotic. A large series of 4164 CSE analgesias at a community hospital gives us an idea of how common these complications may be.[6] Sedation and low oxygen saturation requiring treatment with nalbuphine or naloxone occurred in 0.6% of the population and difficulty swallowing (dysphagia) requiring treatment in 1.7%. The authors attribute the absence of respiratory arrest to observation for one to two hours after administering intrathecal narcotic and to prompt treatment of severe drowsiness and low oxygen saturation unresponsive to mask oxygen.

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Second-Stage Labor: Lead, Follow, or Get out of the Way?

"You keep your mouth shut and you do what I tell you when I tell you, or I'm not delivering this baby!"

Obstetrician quoted in Diamond 1996, p. 136[13]

"With [the] uniquely evolving sequence of events [in second stage], it's obvious that the mother should be the judge of what to do, as long as there is no undue arrest of progress or any sign of fetal distress. . . . [A provider's] role is to offer support and guidance as needed."

Davis 1997, p. 99[9]

Historically and across cultures women have given birth upright, often supported by labor companions, propped up on special chairs or stools, or gripping ropes, slings, or posts.[15] Obvious changes in the laboring woman's behavior as she began spontaneously bearing down marked the transition to what we now know as the second stage of labor. This instinctive effort combined with uterine contractions would result in the birth of the baby without direct assistance of labor attendants. Over the course of the past century in "modern" maternity settings, however, posts and birth chairs have given way to labor beds with stirrups, watchful waiting has given way to routine intervention, and the locus of control has shifted from the laboring woman to the doctor at the foot of the bed or delivery table. This chapter explores the conditions that promoted this shift and considers whether medical management of second stage has improved outcomes for mothers or infants. Our conclusion is that it has not.

GIVING BIRTH VERSUS BEING DELIVERED

In physiologic second stage, the laboring woman is in charge. She follows her inner dictates and uses movement, position-changes, breath, vocalization, and spontaneous bearing down to birth her baby. Studies of spontaneous maternal behavior in second stage show that women often begin spontaneously bearing down before full dilation but rarely before the fetus reaches +1 station; usually grunt, groan, or expel air (all "open-glottis" techniques) during pushes; bear down with increasing

frequency as second stage progresses; usually take several quick breaths rather than one deep breath before bearing down efforts; change positions frequently; and often assume upright positions.[7, 20, 21, 27]

With modern medical management, care providers direct second stage. Although a woman's involuntary bearing down reliably indicates that second stage has begun, obstetric providers use measurement of full cervical dilation to determine its onset. Performing a vaginal exam to "certify" full dilation thus becomes the first task of conventionally managed second stage.[4] Subsequent management typically involves coaching the woman to hold her breath and perform sustained, strenuous pushes (Valsalva or closed-glottis pushing) while staff count to 10, a style nicknamed "purple pushing" for the color the woman's face turns due to lack of circulating oxygenated blood. Conventional management of second stage also dictates confining the woman to the bed, usually on her back or propped up slightly with legs in stirrups or held in exaggerated flexion by the woman, nurses, or labor companions.[8]

Conventionally managed second stage is the norm in the United States. In Listening to Mothers II, a national survey of women giving birth in 2005, only 21% of women reported following their own urge to push. The rest reported that nurses or other providers coached them to push a certain way.[12] Likewise, only 28% of women responding to an earlier survey about second-stage pushing and perineal outcomes reported following their own pushing urges.[22] A subsequent study, however, suggests that even when women are pushing spontaneously, hospital staff still frequently resort to directing women's pushing efforts.[23] Thus, the proportion of women who experience coaching and employ prolonged closed-glottis pushing is likely underreported in such surveys. As for positioning, in contrast to positions women choose spontaneously, 57% of respondents reported giving birth lying on their backs, and an additional 35% gave birth propped in a semi-sitting position.[12]

There are several drivers behind the predominance of managed second stage. To those looking through the lens of medical-model bias, normal and adaptive behavior in second stage is easily mistaken for pathology or suffering. Babies may experience harmless heart rate decelerations as they descend through the pelvis. Contractions may space out at the onset of second stage, and women may appear physically exhausted and even sleep between contractions, a normal occurrence that allows women a break in which to recoup their strength for pushing. Some women cry out or express fear and pain, a problem that almost always can be prevented or alleviated by good supportive care. And, as second stage extends past two hours, the likelihood of adverse outcomes begins to rise, although most morbidity from long second stages arises not from the duration per se but iatrogenically from the very practices and policies imposed in the name of preventing it: supine positioning; prolonged, forceful pushing; episiotomy; and preset limitations on second-stage duration leading to instrumental vaginal delivery or cesarean surgery.

Nonetheless, these observations reinforce beliefs that second stage labor is a flawed process and that letting nature take its course is asking for trouble.

Epidural analgesia compounds that reinforcement. Even with modern, lighter epidurals, women usually have a diminished or delayed urge to push and almost always lack the mobility to assume the full range of birthing positions. These and other factors result in a longer second stage than in women laboring without epidurals. Thus, epidural analgesia increases both the need for and the duration of exposure to non-physiologic second-stage management strategies and their adverse effects.

Medical-model beliefs and practices, however, are not the whole story. In the beginning of the last century, the earliest proponents of managed second stage were additionally motivated by a desire to elevate the profession of obstetrics and distinguish it from midwifery.[18] Achieving this goal depended on "selling" the need for treatments or assessments that only doctors could perform. Focusing these treatments and assessments on second stage enabled doctors to avoid the need to be present throughout labor—nurses could be delegated to handle labor support and prepare the woman for birth—while establishing that only the doctor could "deliver" the baby. By the mid 1900s, a rigid hierarchy was in place. Doctors had become the central figure in the drama, served by nurses complicit in an elaborate, ritual charade to preserve the illusion of the obstetrician's starring role.

Maintaining this illusion meant ensuring that the obstetrician arrived in time to conduct the delivery, which meant controlling women's instinctive pushing urges. For decades nurses have instructed women to resist pushing urges, using such techniques as blowing or panting, until a doctor performs a vaginal exam and pronounces the woman "ready" to push. A study in which researchers transcribed videotapes of women's labors includes a particularly egregious example of this.[5] Two nurses and a medical student insist that the woman not push until a physician performs the certifying exam, scolding and stalling her for 28 minutes while she struggles with her urge and begs to be allowed to push. Permission comes only when the doctor arrives and performs the certifying vaginal exam, although he merely repeats an exam performed by the medical student six minutes earlier.

The physical setup for the "delivery" also ensures the centrality of the obstetrician's role. On a delivery table, the woman literally cannot birth the baby on her own as it would fall several feet onto the floor. The shift to delivery in labor room beds should have done away with this, but the delivery table concept moved right along with the shift in locale. Women now labor in a specialized delivery bed, and when the time for the birth approaches, nurses break away the bottom half, insert stirrups, position women on their backs, lift their legs into the stirrups, and shift their buttocks to the bed's edge, duplicating the delivery table scenario. The usual supine or semi-supine position for birth affirms the status of the doctor as the active agent, with the woman assuming a submissive and vulnerable posture

that grants the obstetrician access to the perineum and the unimpeded ability to "deliver" the baby by whatever means deemed necessary.

CRITIQUING MANAGED SECOND STAGE: SHORTCOMINGS IN THE RESEARCH

Medical-model practitioners believe that second stage must be managed in order to ensure vaginal birth, minimize perineal injury, and protect fetal wellbeing, but the research, despite being riddled with medical-model bias and methodological flaws, paints a very different picture.

With few exceptions, randomized controlled trials (RCTs) of second-stage care have been conducted in settings characterized by overuse of harmful practices such as supine positioning, directed forceful pushing, preset time limits on second stage duration, routine episiotomy, and instrumental vaginal delivery. For this reason, benefit obtained by tweaking one aspect of second-stage care will likely be overwhelmed by the effects of the background harmful practices. For example, a decrease in the likelihood or severity of perineal lacerations with spontaneous pushing would likely go undetected in a study where episiotomy was performed frequently because few women would be eligible to tear spontaneously. Worse, many reports do not even provide information about routine second-stage management, making it impossible to judge its confounding effects.

Trials isolating a single intervention also prevent us from determining if elements of physiologic care work synergistically to produce better outcomes. Trials of spontaneous versus coached pushing typically require women in both arms to push on their backs. Conversely, trials comparing supine with nonsupine positioning use coached pushing in both arms. By deconstructing the package of physiologic care into its component parts, such trials cannot tell us how coached pushing on one's back compares with spontaneous pushing in the position(s) of a woman's choosing.

The limitations of RCTs compel us to turn to other study designs to determine optimal practice, but here, too, the body of literature is riddled with problems primarily rooted in the ubiquity of the medical management model.

Retrospective study designs have the advantage of allowing for much larger study populations, which increases their ability (power) to detect statistically significant differences. However, these studies usually obtain their data from chart review or electronic databases. Again, important aspects of care such as pushing style and position are not documented, potentially confounding results. In settings where conventional management is the norm, even if these data were available, it would be nearly impossible to find a sufficiently large population of women receiving physiologic care to comprise a comparison cohort.

Ultimately, when it comes to researching second-stage care, we don't know what we don't know. What are likely to be important aspects of supportive second-stage

care are not being captured in any study. For example, how might pushing effectiveness and outcomes be affected by care that promotes the woman's feeling secure, empowered, and encouraged as opposed to vulnerable, frightened of injury, or incompetent at her task? Lacking this information, no research provides us adequate data from which to determine optimal practice.

GLIMPSES IN THE FOG: WHAT CAN BE GATHERED FROM THE RESEARCH?

As this chapter's mini-reviews will attest, emerging from the fog of the second-stage research are glimpses that suggest that optimal outcomes will be achieved by a "package" of physiologic care. Let us look more closely at a couple of illustrative examples.

The first comes from the University of New Mexico Health Sciences Center, a research institution adhering to best practices in both second-stage care and conducting research. This institution provides a rare opportunity to observe the true effects of various elements of second-stage care on genital trauma against a backdrop of physiologic care. The episiotomy rate across *all* providers is 1% and "the obstetric culture favors patience and vaginal delivery technique that is calm and controlled, with emphasis on slow expulsion of the infant" (p. 371).[2] In one trial, four out of five women gave birth upright, less than one-quarter used Valsalva pushing, and only 2% had instrumental vaginal deliveries, despite about 40% of the study population's having epidural analgesia. Researchers meticulously documented second-stage care, including maternal position at birth, pushing method, and whether and how the provider supported the perineum. Likewise, all genital tract trauma was documented, no matter how minor, and a second midwife independently assessed the presence and severity of lacerations. The primary aim of a trial at this hospital was to compare perineal massage with lubricant, warm perineal compresses, or a "hands off" policy. Outcomes in all three groups were excellent and not significantly different from one another, suggesting that it was the overall approach to care rather than "management" of the perineum that promoted optimal tissue integrity. In fact, nearly a quarter of participants achieved the strictest definition of "intact"—no tissue separation whatsoever of the vagina, labia, periurethral area, clitoris, perineum or cervix. Employing a commonly used, broader definition of "intact"—trauma that is minimal and requires no sutures—the rate was a "startlingly high" 73% (p. 371).

We see a similar, "startlingly high" intact rate in midwife-attended home births, where, again, the norm is physiologic second-stage care. A descriptive study of home births found that 70% of women had either no trauma or minimal trauma not requiring sutures.[19] As with the University of New Mexico trial, this study carefully documented elements of physiologic care, including maternal positioning and pushing method, along with medical and obstetric variables that might affect perineal outcomes. No woman in the study gave birth supine, only 38% experienced verbal guidance or directed pushing, and the episiotomy rate was 1.4%.

Evidence also suggests that conventional management of positioning and pushing technique may be harmful. RCTs of coached versus spontaneous pushing have shown worse long-term pelvic floor strength with coached pushing. (See mini-review 10.) Likewise, women giving birth on their backs are more likely to experience perineal trauma, have more severe perineal trauma, and report more severe pain during birth. (See mini-reviews 3 and 6.) More abnormal fetal heart rate (FHR) patterns are also observed with coached pushing or supine positioning, raising the possibility that these practices compromise fetal wellbeing. (See mini-reviews 7 and 11.) In addition to these outcomes, observational studies reveal adverse physiologic effects of supine positioning and closed-glottis pushing, including altered uterine functioning and aortal compression, which, while not in and of themselves clinically significant, raise concern about the potential for harm, especially under suboptimal fetal or maternal conditions.[15, 28]

Simple common sense predicts these effects. Breath-holding will decrease circulating oxygen and increase circulating carbon-dioxide. Bearing down more strenuously than innate reflexes dictate will increase pressure on the baby, the umbilical cord, and the woman's pelvic floor and expel the baby more forcefully, increasing risk of perineal injury. Supine positioning will decrease blood flow to the baby and maternal vital organs. Supine positioning also prevents gravity from assisting fetal descent, limits pelvic mobility, and unfavorably alters fetal alignment with the maternal pelvis.

IS PHYSIOLOGIC SECOND STAGE HARMFUL?

Those espousing the medical model believe active management will avert harms supposedly intrinsic to physiologic second stage, such as excess blood loss, harms of pushing before full dilation, and adverse outcomes with "prolonged" second stage. These claims have no evidence to support them.

The concern for excess blood loss arises from the literature on the use of upright positions during second-stage labor. The Cochrane systematic review comparing supine with nonsupine positions found that women giving birth upright or in a lateral position were more likely to lose over 500 mL than women giving birth supine.[15] However, methods for estimating blood loss were poorly defined and in some cases clearly unreliable, the absolute difference was small, and there were no significant differences in clinically significant outcomes such as need for blood transfusion or hysterectomy. One study with particularly rigorous methodology found increased blood loss in the sitting or semi-sitting positions compared with recumbent positions;[11] however, the difference was observed only when perineal trauma occurred. This suggests that it is not the position the woman assumes in second stage that contributes to excess blood loss but the position she assumes after birth and before perineal repair. (See mini-review 5.)

The most common harm attributed to spontaneous pushing, and the rationale for requiring a vaginal exam prior to "allowing" a woman to push, is that women may push "too soon," resulting in cervical swelling, which in turn may promote cervical lacerations or prolong first stage labor. The only study that sheds any light on the effect of bearing down prior to full dilation described the spontaneous bearing down efforts of 31 nulliparous women who had not taken prenatal childbirth classes and received no coaching in labor about when or how to push.[20] More than two-thirds of participants (n = 20) began bearing down before full dilation. The researchers provide no information about cervical swelling, but two of the three cervical lacerations occurred in women who reached full dilation before bearing down. The third began pushing at 6.5 cm dilation and had a low-forceps delivery. In contrast, a 2009 trial compared the effects of immediate pushing upon full dilation versus awaiting a strong maternal urge in women without epidural analgesia.[17] Outcomes, including spontaneous vaginal birth rate and postpartum fatigue scores, significantly favored delayed pushing, which suggests that conventional obstetric management, not physiologic care, may cause women to push "too soon." (See mini-review 12.)

Proponents of managed second stage assert that spontaneous pushing increases the duration of second stage. While some studies of spontaneous pushing have shown an increase in the total duration of second stage, differences are not clinically significant, and the duration of *active* pushing is equivalent across groups. No differences in operative delivery have been observed, and findings related to maternal and fetal wellbeing universally favor spontaneous bearing down. In fact, research suggests that adverse maternal and fetal outcomes that are attributed to long second stages result from policies and procedures imposed on women to shorten the duration of second stage. For example, Thomson (1993) found that a longer second stage was associated with newborn acidemia with coached pushing but not with spontaneous pushing, despite a significantly longer mean duration of second stage in women assigned to spontaneous pushing.[28] (See mini-reviews 8-11.)

Although we need more and better research, what we do know makes a compelling case that conventional management of second stage does harm and that physiologic care, although it stands accused of harm, is innocent. As usual, physiologic care should be the norm. The fact that no study has demonstrated that women or babies benefit from interventionist management should suffice for abandoning it; we need not wait for clearer proof of its harm.

CLEARING THE SLATE: OPTIMAL CARE FOR WOMEN IN SECOND STAGE

To determine optimal care for women in second stage, we need to start from scratch. We cannot continue to evaluate physiologic care practices within the context of medical management's turning a blind eye to the harms that model

imposes. We must analyze the settings and providers that yield the best perineal outcomes with the least newborn compromise. Even more important than quantifying the use and outcomes of interventions in these contexts, we must scrutinize the process of care—the nuances of the interactions among the laboring woman, the people supporting her, and her physical environment. Qualitative research along these lines, which some midwifery researchers have already begun, will produce both fruitful lines for quantitative research and replicable best practice strategies and behaviors.

We need research as well that will enable us to individualize our approach to second-stage care according to characteristics of the mother, fetus, or labor. Different positions might work for different pelvic shapes or fetal positions, for example. Some positions and pushing techniques may be useful early in second stage to promote progress and maintain fetal wellbeing, while others may prove more useful during the birth itself to protect perineal integrity. And as studies of second-stage care in women with epidural analgesia suggest, excess perineal harm arising indirectly from epidural analgesia use may be preventable by modifying care in second stage. (See chapter 12.) Last but not least, we need to identify what circumstances call for caregiver intervention and, for those cases, what action produces the best outcomes with the least harm.

Strategies to do away with the cultural drivers of medically managed second stage are beyond the scope of this book, but assuming that we could do so, how could we go about determining an optimal system for care? We must begin by returning control to women to behave as they see fit and ask for what they need. Care providers must understand the "art of doing nothing well" (p. 12).[16] They must learn to rely on unobtrusive observation, have respect for variations in normal behavior and labor progress, defer to the laboring woman, and communicate openly. Intervention should not be imposed routinely or arbitrarily, and when difficulties occur, the first approach should be to engage the woman in resolving the problem, resorting to medical intervention only when her efforts prove insufficient. Intervention should always be preceded by truly informed consent and should proceed with full explanations, attention to the woman's anxieties, and validation for the woman's disappointment or frustration. In other words, under any and all circumstances, care should be mother-centered.

After generations of medicalized birth and its ubiquitous portrayal in the media, too many of today's childbearing women lack the knowledge and confidence to trust and follow their instincts in second stage. Care providers must help them restore this. It is not enough to "permit" women's mobility; providers must encourage it. Supportive props such as "birth balls," devices to assist with squatting, and birth stools can help. Providers must also minimize the use of interventions that limit movement and provide encouragement and physical support to assume various positions. They must provide sensitive guidance as

well. As researchers analyzing videotapes of second stage found, the very words caregivers use can have a profound effect on women's behavior in second stage.[23] Supportive communication such as "you're doing well" and affirming the woman's experience with phrases like "you're probably feeling a lot of burning and stretching" freed women to relax into instinctive open-glottis pushing. But when the provider gave instructions or used vaginal exams to direct pushing ("push my fingers out"), women engaged in closed-glottis pushing.

Returning the locus of control to women will require a tectonic shift in second-stage care. But while it means ceding the limelight to the birthing woman, becoming less visible does not mean becoming less important. As facilitators, midwives, doctors, and nurses providing physiologic care offer encouragement, prepare a conducive environment, minimize distraction, allay fears, and safeguard maternal and fetal wellbeing. Neither does it mean becoming less valued. Women have sought guidance and support from skilled and knowledgeable companions during birth for millennia. This seeking may itself be an instinctive behavior. Like other biological instincts, perhaps the social needs of laboring women function to ensure safety and, ultimately, promote optimal reproduction of the species. And if honoring the need for "being" rather than "doing" is the best approach to second-stage care, is not becoming less visible worth the trade-off?

STRATEGIES FOR OPTIMAL CARE

The following strategies facilitate a physiologic second stage, maximize the chance of spontaneous birth, and minimize the chance of genital, perineal, or pelvic floor injury:

- Encourage non-supine positions.
- Avoid interventions that restrict movement and position-changes.
- Make physical props available and encourage position-changes, enlisting labor companions to assist with support, encouragement, and mobility as needed.
- Encourage women to follow their spontaneous pushing urges. Discourage prolonged breath-holding.
- If coaching seems prudent, suggest open-glottis techniques rather than prolonged breath-holding.
- In women laboring with epidural analgesia, await a spontaneous bearing down urge before beginning active pushing efforts. Encourage open-glottis pushing when the urge develops.
- Use a supportive and encouraging communication style to promote the woman's sense of safety and wellbeing and diminish her fears.
- Guide the laboring woman in birthing the baby's head gently between contractions.

MINI-REVIEWS

Note: Assume differences are statistically significant unless otherwise noted.

1. Nonsupine positioning in second stage shortens the duration of second stage, especially when the upright position is squatting. (The use of nonsupine positions in women with epidural or combined spinal-epidural analgesia is discussed in chapter 12.)

A Cochrane systematic review and meta-analysis of upright positioning in second-stage labor in women without epidural analgesia (9 trials, 3163 women) reported second-stage duration.[15] Comparing all women allocated to nonsupine positions with women allocated to recumbent positions, the duration of second stage was reduced by a mean 4.3 min, a difference that is statistically, although not clinically, significant. However, in trials where the nonsupine position was squatting or modified/supported squatting, the difference in duration was much greater. Subgroup analysis of trials in which the upright group was assigned to squat on a birth cushion (2 trials, 711 women) revealed a mean second-stage duration 15 min shorter in the squatting group than the supine/lithotomy group.

2. Nonsupine positioning in the second stage of labor results in a small decrease in the likelihood of instrumental vaginal delivery.

The Cochrane systematic review of upright positioning in women without epidural analgesia revealed a small reduction in assisted delivery among women assigned to nonsupine positions (9.2% vs. 11.3%, absolute difference 2.1%).[15] As with duration of second stage, a larger effect was seen in the two trials (1044 women) in which the upright group assumed a supported squat position on a low cushion (5.0% vs. 9.8%, absolute difference 4.8%).

3. Giving birth in a nonsupine position is associated with an overall decrease in perineal trauma, primarily resulting from decreased use of episiotomy.

The Cochrane systematic review and meta-analysis of nonsupine positions for second-stage labor evaluated the effect of birthing position on episiotomy (12 trials, 4899 women), second-degree lacerations (11 trials, 5310 women), and anal sphincter tears (4 trials, 1478 women) in women without epidural analgesia.[15] The included trials varied considerably in methodological quality, inclusion criteria, and specific positions studied. In addition, episiotomy rates were high, ranging from 21% to 69% across trials. These limitations obscure the true relationship between birth position and perineal integrity, but the data strongly suggest that supine positioning increases the risk of genital tract trauma. The increase was primarily the result of a higher likelihood of episiotomy when women gave birth supine vs. nonsupine (6.6% absolute difference). Because some women who had episiotomies would have torn spontaneously had the episiotomy not been performed, it is not surprising that some of the decrease in episiotomy use was offset by an increase in second-degree lacerations in women giving birth nonsupine (2.4% absolute difference). (There was no difference in the rate of anal sphincter lacerations between nonsupine and supine groups [0.7% in both].) Unfortunately, the Cochrane reviewers did not report rates of intact perinea or first-degree

lacerations, so we have no direct knowledge of the effect of positioning on these outcomes. However, we can calculate the combined difference in intact perinea and first-degree lacerations using the other study data. By subtracting the absolute increase in second-degree lacerations from the absolute decrease in episiotomy, the remaining difference (6.6% - 2.4% = 4.2%) represents an absolute increase in intact perinea or minor trauma favoring nonsupine positions.

A secondary analysis of a large Dutch trial measured the effect of birth position (recumbent [n = 921], semi-sitting [n = 602], or sitting [n = 119]) on perineal outcomes, after controlling for maternal age, parity, ethnicity, duration of second stage, and birth weight.[10] All of the women had spontaneous vaginal births of vertex infants and were attended by midwives either at home or in the hospital. The episiotomy rate was 14% among multiparous women and 35% among nulliparous women. The occurrence of any perineal damage was similar across the three groups, although the type and location of damage varied. Compared with the recumbent position, women who gave birth sitting were less likely to have episiotomies (12% vs. 23%, OR 0.3) but more likely to experience first- or second-degree perineal lacerations (55% vs. 44% OR 1.8). Outcomes for women birthing in a semi-sitting position were nearly identical to those of recumbent women, except for an increase in labial tears (12% vs. 8%, OR 1.4), which occurred far less frequently overall compared with episiotomies and perineal lacerations.

An RCT of midwifery measures to reduce genital tract trauma allows a rare opportunity to evaluate the effect of upright positioning on spontaneous lacerations without the confounding effect of episiotomy.[2] The trial took place in a teaching hospital where the episiotomy rate across all providers is 1%. While the study protocol assigned participants to different perineal support techniques rather than to different birthing positions, multiple logistic regression of trial data allowed analysis of the association of birthing position with genital tract trauma. This analysis revealed a 32% reduction in spontaneous lacerations of any degree among women who assumed an upright sitting position compared with those who gave birth in a supine or side-lying position. (Too few participants gave birth squatting, standing, or on hands and knees to evaluate the effects of these positions on genital tract trauma.)

4. Among nonsupine positions, kneeling and sidelying are associated with the least perineal trauma while squatting is associated with increased risk.

The Cochrane review of second-stage positions reports outcomes of *all* upright and lateral births compared with *all* supine births, then reports subgroup analyses of several specific upright positions (e.g., birth stool, lateral position), again comparing against supine positioning.[15] This systematic review, therefore, can tell us nothing about the relative advantages and disadvantages of the various nonsupine positions women may assume in second stage. Fortunately, an emerging body of literature provides some evidence to help women choose among nonsupine positions.

The largest such study, and the only one with the power to detect statistically significant differences in anal sphincter lacerations, reports perineal outcomes from nearly 13,000 women who had spontaneous vaginal births of singleton infants between 2002 and 2005 at a single Swedish hospital.[14] Attending midwives recorded maternal birth position in a computerized database after the birth. The most common position was sitting (42%), followed by lithotomy (21%), kneeling (12%), supine (8.5%), lateral recumbent (8%),

semi-recumbent (2.7%), squatting (1.8%), birthing stool (1.5%), and standing (1.2%). The episiotomy rate in the study was 5%, with all but a handful of those cut mediolaterally. The overall anal sphincter tear rates were high (5.8% of primiparous women and 1.7% of multiparous women). However, 325 of the 380 third-degree tears were "partial," which involve interruption of the capsule of the external anal sphincter but minimal damage to the sphincter muscle itself. Other studies that report much lower anal sphincter rates may exclude partial third-degree lacerations. After controlling for risk factors such as parity, gestational age, and birth weight, lithotomy and squatting position were independently associated with a doubling of risk of anal sphincter tears compared with sitting. In women having first vaginal births, 4% of those who gave birth sitting had third- or fourth-degree tears, compared with 9% who gave birth supine and 12% who gave birth squatting. The other positions provided no benefit or harm compared with sitting. Although researchers did not report direct comparisons between these positions and the lithotomy position, the data imply that every position except squatting was superior to lithotomy with respect to anal sphincter lacerations.

Shorten (2002) analyzed relationships among birth position, birth attendant, and perineal outcomes in a retrospective cohort of 2891 women giving birth vaginally in an Australian teaching hospital.[25] Ninety percent of the births were attended by midwives with the remaining births attended by obstetricians (8%) or general practitioners (2%). Birth positions were categorized as semi-sitting (56%), side-lying (12%), all fours (19%), kneeling (1%), standing (10%), or squatting (2%). Physician-attended births were far more likely (84%) to occur in the semi-sitting position. The episiotomy rate across all providers was 6.5%, with physicians more than five times more likely than midwives to cut episiotomies. After controlling for risk factors such as birth weight, parity, and length of second stage, the lateral birth position was associated with a decrease in the incidence of tears requiring sutures in multiparous women (OR 0.3) but not nulliparous women compared with semi-sitting. The lateral birth position was also associated with the highest rate of intact perinea (67% overall) among all positions in multiparous women (OR 3.52) although not in nulliparous women. Squatting was associated with the highest rate of tears requiring sutures (53%) and the lowest intact rate (42%), though only 2% of the sample (n = 62) birthed in this position, raising the possibility that these data are not reliable. Differences reached statistical significance among nulliparous women (OR 2.4 tear requiring suture; OR 0.4 intact perineum). The semi-recumbent position significantly increased likelihood of episiotomy (data not shown), an association that was mostly, although not entirely, explained by the physicians' favoring this position. The remaining positions were no more or less likely than semi-sitting to result in intact perinea, though evidence suggested that trauma in these positions was more likely to result from spontaneous tears than from episiotomy.

The only RCT of two different upright birth positions did not report perineal outcomes, but a secondary analysis of trial data did.[3] The researchers compared outcomes of trial participants who gave birth in an upright sitting position (n = 112) with those who birthed kneeling and leaning forward (n = 106). In a multivariate risk analysis model, episiotomy was more common in the sitting group (8% absolute increase), while the kneeling group was more likely to have intact perinea (14% absolute increase). Anal sphincter laceration rates were similar, although all three third-degree tears occurred in the sitting group.

A prospective study allows us to explore the association between birth position and perineal integrity in the context of physiologic care and when episiotomy is avoided.[19] Multiple logistic regression revealed similar rates of trauma and intact perinea among 1068 women having planned home births regardless of birth position, with one exception: nulliparous women assuming a kneeling or all-fours position were less likely to have perineal lacerations (RR 0.6). All women in the study used nonsupine positions at birth and only 1.7% had episiotomies.

5. Nonsupine positions increase the likelihood of > 500 mL of estimated blood loss, but there is no evidence of an association with any clinically significant excess. In the Cochrane systematic review and meta-analysis, 11 trials (5358 women) reported estimated blood loss.[15] In at least three of these trials, contributing 1195 women, blood loss was estimated visually, a method that is unreliable and likely to favor supine positions since blood is collected on absorbent pads rather than in a receptacle such as a bowl. (The Cochrane reviewers note that another included trial did not report the method of estimating blood loss and do not comment on the estimation method for the remaining trials.) Estimated blood loss > 500 mL was more common in women allocated to the upright or lateral position, but the absolute difference was small (2.5%). The result remained significant after excluding four trials based on trial quality. Blood transfusion rates did not differ significantly, although the larger of the two trials that reported this outcome reported a trend favoring the supine group (RR 1.7). In this trial, women giving birth upright used a birth chair. The review did not evaluate the effects of birth position on blood loss > 1000 mL or > 1500 mL, anemia, or hysterectomy.

A more recent Dutch study provides the clearest evidence for the association between birth position and postpartum blood loss.[11] Data from 1646 spontaneous vaginal births attended by independent midwives were collected prospectively. The midwives used digital scales, measuring jugs, and perineal pads to accurately measure blood loss during the first postpartum hour. The researchers also measured hemoglobin levels at 36 weeks postpartum and again on the fourth to sixth postpartum day. The likelihood of losing > 500 mL of blood was greater in the sitting (50%) or semi-sitting (42%) positions compared with recumbency (35%). The relationship was linear: risk of blood loss > 500 mL was lowest in recumbent, increased in semi-sitting, and further increased in sitting. This was also true for blood loss > 1000 mL. Hemoglobin results were consistent with measured blood loss; that is, mean postpartum hemoglobin was lower in both upright groups compared with supine, and the sitting group experienced a larger drop from baseline hemoglobin compared with the recumbent group. However, further analysis revealed that sitting and semi-sitting were risk factors for excess blood loss only when perineal trauma occurred. Among women with intact perinea, there was no association between birth position and blood loss. The researchers hypothesize that sitting upright occludes venous return of blood, possibly resulting in more vigorous blood loss from traumatized tissue.

6. Women who give birth nonsupine are less likely to report severe pain at birth. The Cochrane systematic review includes one trial (517 women) that reports experience of severe pain at birth.[15] That trial found that women allocated to give birth squatting on a low, soft stool were less likely to report severe pain than those giving birth in bed (0.7 RR,

13% absolute difference). Meta-analysis of seven trials (3593 women), however, found no difference in use of analgesia or anesthesia in second stage.

7. Supine positioning may result in fetal compromise, although no studies demonstrate clinically significant differences in newborn outcomes.

The Cochrane systematic review included one trial that reported FHR abnormalities.[15] This trial allocated low-risk women to remain in a supine position throughout second stage (n = 260) or sit on a low birthing stool (n = 257). All women were encouraged to change positions and walk throughout the first stage of labor. Abnormal FHR patterns were more likely in the supine group (0.3 RR, 3% absolute difference). The review did not find any differences in neonatal intensive care unit admissions (2 trials, 1524 women) or perinatal deaths (3 trials, 828 women). These findings rule out the possibility that supine positioning is advantageous for the newborn and raise the possibility that supine positioning may be harmful to fetal/newborn wellbeing.

8. Compared with coached pushing, spontaneous pushing may increase total duration of second stage but does not increase amount of time spent actively pushing or the likelihood of operative delivery.

In the largest RCT of pushing method, researchers randomized healthy, nulliparous women in labor without epidurals to coached pushing (n = 163 women) or to "do what comes naturally or whatever the patient feels the urge to do while in bed" (p. 11) (n = 157).[6] All women in both groups were cared for by midwives and confined to either a lateral position or on their backs with the bed propped to 30 degrees throughout second stage. Women in the coached group were instructed to take a deep breath at the peak of the contraction, hold the breath, push for 10 sec and repeat until the contraction ended. The mean length of second stage was 13 min shorter in the coached group (46 min vs. 59 min). However, researchers did not find differences in the likelihood of pushing beyond 2 h (9% coached vs. 11% uncoached) or 3 h (1% coached vs. 3% uncoached), nor in mode of birth (93% spontaneous vaginal coached vs. 95% uncoached).

A smaller RCT of spontaneous (n = 15) vs. directed (n = 17) pushing in nulliparous women also found a longer mean duration of second stage in the spontaneous pushing group (121 min vs. 58 min, absolute difference 63 min).[28] However, despite random assignment, women in the spontaneous pushing group also had significantly longer first stages of labor, which may have predisposed these women to longer second stages. The researcher found no harm associated with the longer second stage. In fact, longer second stages were associated with more newborn acidemia in the directed pushing group but not the spontaneous pushing group.

A small observational study of 20 women provides evidence of length of labor by actual pushing technique. The researchers viewed videotapes of nulliparous women in second stage and classified women into two groups depending on whether they primarily used spontaneous (n = 13) or directed (n = 7) pushing.[23] The average length of second stage and the average actual time spent pushing were similar.

The only researchers to evaluate spontaneous pushing in women with epidurals looked at spontaneous pushing in combination with passive fetal descent and compared this with Valsalva pushing immediately after full cervical dilation in nulliparous women.[26] Women

were assigned to coached, closed-glottis pushing immediately upon full dilation (n = 22) or spontaneous, open-glottis pushing (n = 23) beginning when the urge developed or 2 h after full dilation, whichever occurred first. The total duration of second stage was longer in the delayed/spontaneous group (139 min. vs. 101 min.). However, the duration of active pushing was shorter (59 min. vs. 101 min.)

Three trials report mode of birth, with none finding a statistically significant difference between coached and uncoached groups.[6, 26, 28]

9. Coached pushing may result in excess perineal damage.

The body of evidence examining the relationship between pushing method and perineal trauma is difficult to interpret because, with one exception, none of the studies provides adequate information about the type and duration of coaching or the degree of trauma. However, as we will see, despite variation in size, methods, and quality of studies, no study reports an increase in perineal damage with spontaneous pushing, and some found differences favoring spontaneous pushing.

The only study focused specifically on the association between type of pushing and perineal tissue injury relies on survey responses from women asked to recall their pushing method, a method that has not been validated.[22] Researchers sent questionnaires to primiparous women who had taken part in a larger study of pelvic floor changes and had had spontaneous vaginal births vaginally within the previous 9-14 months (N = 47). Eighty-three percent (n = 39) responded. Women were asked to recall whether they were told how and when to push (classified as directed pushing) or whether they were told to push how and when they felt like it (classified as spontaneous pushing). They were also asked to rate their perineal pain in the first postpartum week on a scale of 0-10. There were no differences across groups in other factors that might affect perineal outcomes, including infant birth weight, duration of second stage, type of provider (midwife or obstetrician), or epidural use. The researchers found a higher likelihood of intact perineum (45% spontaneous vs. 7% directed) and reduced likelihood of second- or higher-degree trauma or episiotomy in the spontaneous pushing group (45% vs. 71%). Unfortunately, the investigators did not report episiotomy rates separately, instead reporting that 3 of 11 women (27%) in the spontaneous pushing group compared with 15 of 28 (54%) in the directed pushing had second-degree tears *or* episiotomies. This omission makes it impossible to evaluate if providers who were more likely to coach women to push a certain way were also more likely to cut episiotomies, which could explain an increase in episiotomy use, if such existed, in the directed pushing group. It is also possible that directed pushing resulted in greater incidence of fetal hypoxia and nonreassuring heart rate changes, which then led to episiotomy to expedite the birth. (See mini-review 11.)

A pilot study allocating 32 women to spontaneous or directed pushing found no difference between the two groups in needing perineal suturing.[27] However, the trial is almost certainly underpowered to detect a clinically important difference, and the researcher provided no data on episiotomy use or degree of spontaneous lacerations. On the other hand, a trial in which nulliparous women with epidural analgesia were randomized either to coached Valsalva pushing immediately upon complete cervical dilation or to open-glottis pushing after passive descent of the fetus found that women in the open-glottis group were less likely to suffer lacerations (59% closed glottis vs. 22% open glottis, 37% absolute difference).[26] While the magnitude of the difference is large, the researchers give no information

about the severity of lacerations, and study design does not allow us to tell if the difference is attributable to the timing, style of pushing, or the combination of the two.

The only study to evaluate risk of genital tract trauma in normal spontaneous vaginal births in which episiotomy was *not* performed is a secondary analysis of an RCT of perineal support techniques.[1] Researchers identified significant risk factors for sutured trauma in 452 women experiencing first vaginal births and 724 multiparous women. In both groups, women who used Valsalva pushing were more likely to suffer trauma requiring suture. After adjusting for multiple factors, Valsalva pushing remained an independent risk factor for sutured trauma in the nulliparous group only. In the parent study, which included women who had experienced cesarean surgery (n = 9), instrumental vaginal delivery (n = 16), or episiotomy (n = 10), Valsalva pushing was not an independent risk factor for genital tract trauma.[2]

10. Coached pushing is associated with postpartum pelvic floor weakness.

Data on postpartum pelvic floor strength and function are limited to a single RCT.[24] Researchers assigned low-risk nulliparous women to coached (n = 67) or uncoached pushing (n = 61). Study protocol dictated that women allocated to coached pushing should begin sustained bearing down only at the peak of the contraction, potentially dampening differences, as women are more typically directed to begin bearing down at the onset of contractions. Despite this limitation and the fact that the two groups did not differ in likelihood of anal sphincter tears, the investigators found short-term evidence of pelvic floor dysfunction in the coached pushing group. Pelvic floor neuromuscular testing conducted at three months postpartum by providers blinded to the management of second stage revealed that the coached group had lower bladder capacity and experienced an urge to void at a lower volume.

11. No study has demonstrated that coached pushing benefits babies, and some evidence suggests it reduces fetal oxygenation during labor.

Several studies have looked at effects of pushing method on fetal or newborn outcomes. However, they are underpowered to detect any clinically meaningful differences in newborn outcomes, and instead rely on surrogate measures such as Apgar scores, fetal oxygen saturation, FHR decelerations, and newborn acid-base levels. Taken together, these studies rule out any fetal or newborn benefits of coached pushing and raise the possibility that coached pushing may be deleterious to fetal and newborn wellbeing.

An RCT of nulliparous women in normal, spontaneous (no induction or augmentation) labors who had not had epidural analgesia evaluated the effect of coached (n = 163) or uncoached (n = 157) pushing on several measures of fetal and newborn wellbeing.[6] Groups were similar with respect to umbilical cord blood pH, Apgar scores, need for resuscitation, neonatal intensive care admission, and sepsis workups. An increase in meconium-stained amniotic fluid in the coached group was almost certainly a chance finding, as meconium was present before second stage in at least 50 of the 56 cases. The trial's power to detect clinically signficant differences was dampened by the stringent inclusion criteria that limited the investigation to ultra-low-risk women. Further, the trial protocol mandated breath-holding and sustained bearing down in the coached pushing group beginning at the peak of the contraction, rather than throughout, as is more typical with directed pushing. Although the trial did not find clinically significant harm to newborns with coached pushing, the data cannot be extrapolated to newborns at increased risk of compromise.

Similarly, a small but well designed pilot trial that allocated nulliparous women without epidural analgesia in spontaneous labor to coached (n = 17) or spontaneous (n = 15) pushing found no differences in umbilical cord blood acid-base values or need for resuscitation.[28] However, the researcher analyzed the data to determine if the duration of pushing affected newborn outcome. She found that a longer second stage was associated with lower venous cord blood pH (i.e., more acidemic) in the coached group but not in the spontaneous pushing group despite a significantly longer mean duration of second stage in women allocated to spontaneous pushing.

The only trial to evaluate pushing method in women with epidural analgesia allocated women to coached pushing beginning immediately after achieving complete dilation or spontaneous pushing following up to 2 h of passive descent.[26] Infants born to women in the immediate/coached group were more likely than those born to women in the delayed/spontaneous group to experience periods of fetal oxygen desaturation, variable FHR decelerations, and prolonged FHR decelerations. No differences were observed in other FHR changes, umbilical cord acid-base status, or Apgar scores.

12. Instructing a woman to push before she feels a strong urge may increase the chance of instrumental vaginal delivery and exacerbate postpartum fatigue. (The effects of delayed vs. immediate pushing in women with epidural analgesia are discussed in chapter 12.)

One study compared the outcomes in women who push immediately upon full dilation (n = 36) with those of women who awaited a strong urge to push (n = 36).[17] The quasi-experimental design allowed women to self-select their group at time of enrollment into the study. In both groups, vaginal exams were performed every 30 min after 8 cm dilation, pushing began with the fetal head in the occiput-anterior position at +1 station, and the women were instructed to push using an open-glottis technique in a semi-sitting position. Up to two hours was allowed before pushing in the delayed group, although researchers did not report the average time of delay or how many women reached 2 h before a strong urge developed. The groups were similar in demographic, medical, and obstetrical variables. More women in the delayed pushing group had spontaneous vaginal births (89% vs. 70%, absolute difference 19%), a difference largely accounted for by higher vacuum extraction rates in the immediate pushing group (19% vs. 6%). Women who had pushed immediately suffered higher levels of fatigue at 1 and 24 h postpartum.

13. Birthing the baby's head between contractions, rather than with a contraction, is associated with decreased likelihood of genital tract trauma.

In an RCT of midwifery measures to prevent genital tract trauma, researchers found no differences in likelihood of trauma in women assigned to warm compresses (n = 404), massage with lubricant (n = 403), or no treatment ("hands off," n = 404).[2] To determine if other clinical or demographic factors were confounding results, researchers constructed a logistic regression model assessing variables predictive of genital tract trauma. This model revealed that birthing the head between, rather than with, contractions reduced the likelihood of trauma by about 18%. In a subsequent analysis of trial data, researchers excluded women who had had episiotomies (n = 10) or instrumental vaginal deliveries (n = 25), and assessed factors associated with genital tract trauma separately in nulliparous women (n = 452) and

those with previous vaginal births (n = 724). Birthing the head between contractions reduced the likelihood of sutured trauma in both groups (absolute difference 11% in both nulliparous and multiparous women). These findings may not be applicable to settings practicing conventional management of second stage, as the study setting is known for its excellent perineal outcomes and noninterventive approach to second-stage care.

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Instrumental Vaginal Delivery and Fundal Pressure: When Push Comes to Pull—or Shove

"[R]educing the rate of cesarean delivery may lead to . . . more complications for mothers and babies. The reason is that . . . increasing the number of operative vaginal deliveries, [is] associated with . . . neonatal trauma. . . ."

Sachs 1999, p. 54-55[79]

"As for the forceps operation, in skillful hands the danger is nil."

DeLee 1920, p. 44[31]

"Advocates described [vacuum extraction] as a procedure that safely augmented the natural process of birth."

Lucas 1994, p. 794[55]

"When second stage of labour problems are going to affect maternal or fetal well-being, first consideration should be given to non-operative intervention. When non-operative interventions have been maximized, the options and risks of operative vaginal birth compared to Caesarean section must be considered. . . . The most appropriate intervention needs to be chosen on an individual basis, within the context of each woman's unique circumstances."

Society of Obstetricians and Gynaecologists of Canada 2004,[16] p. 752

So which is it? Is instrumental vaginal delivery so dangerous that we must take care that obstetricians are not pressured into doing more of them in lieu of (presumably safer) cesarean surgeries? Is instrumental vaginal delivery perfectly safe? And what about fundal pressure, the manual form of assisted delivery, off the radar screen but more common than either instrument? According to Listening to Mothers II, a survey of U.S. women giving birth in 2005, 17% of women having vaginal birth reported a "health professional pressing down on her belly to help

push the baby out" (p. 35).*[30] Is fundal pressure safe? Is it effective? This chapter explores the realities behind the bipolar myths that influence choices related to mode of vaginal birth. An examination of the evidence will enable better informed and more rational decisions when spontaneous birth seems unlikely.

A SHORT HISTORY OF INSTRUMENTAL VAGINAL DELIVERY AND FUNDAL PRESSURE

Instrumental vaginal delivery has a checkered past. Before the availability of cesarean surgery, forceps were a life-saving invention that could deliver some babies in situations where the only alternative was to destroy the fetus, if it had not already succumbed, in a last-ditch attempt to save the mother. As use widened beyond desperate cases, however, women were at much greater risk of dying from infection—the dreaded puerperal fever, which could be spread through forceps lacerations—than ever were rescued by its use.[69, 95] Even asepsis was not completely preventive because the deadly bacteria lived in maternal genital tracts, wanting only an entry wound to take hold.[95]

Even so, during the early decades of the twentieth century concerns about harms fell on the deaf ears of practitioners of the newly established specialty of obstetrics. The inaugural issue of the *American Journal of Obstetrics and Gynecology*, published in 1920, contained an article by Joseph DeLee entitled "The prophylactic forceps operation," which argued for routine forceps delivery to protect the fetus from the rigors of being "driven through the pelvic floor" (p. 39).[31]

The appearance of this seminal article in the first issue of the gray journal is not coincidental. As Barbara Bridgman Perkins (2004) explains, the new specialists needed a means of distinguishing themselves from other medical specialties in order to "define their distinctive commodities and create markets for them" (p. 20) as well as establish a vertical division of labor that "fragmented hospital care into a sequence of discrete procedures assigned to a hierarchy of personnel" (p. 21).[69] The "prophylactic forceps operation," which dictated general anesthesia, perineal surgery, and instrumental delivery, fit this bill admirably while at the same time "enhancing identity as a surgical specialty" (p. 39).

Forceps delivery served as the sine qua non for obstetricians for more than the next 50 years. As the authors of a 1965 textbook wrote: "Obstetrical forceps are the one surgical instrument characteristic of the obstetrician. . . . Cesarean section is not the panacea for all obstetrical problems. Such an arbitrary use of (cesarean) sections would quickly make nothing but midwives and surgeons out of the members of our specialty" (p. 785).[98] Fifteen years later, obstetricians would embrace their surgical identity with a vengeance, but in the early 1970s, self-definition as forceps users translated into a U.S. national forceps rate of nearly 40%.[69]

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* It is possible that some women were reporting suprapubic pressure for shoulder dystocia, not fundal pressure.

The popularity of forceps did not wane until alternatives arrived on the scene. One was cesarean surgery, but the other was vacuum extraction. Vacuum extraction appeared in the 1960s, but the metal cup resulted in "discouragingly high rates of scalp lacerations, cephalhematoma, and difficulty in applying the instrument in certain fetal presentations" (p. 934).[96] The invention of a malleable plastic cup in the early 1970s did away with those objections.[68] Now that obstetricians believed they had a safe, easy-to-use replacement,[34, 35, 55] they could acknowledge the harms of forceps, and in the U.S., at least, forceps use plummeted. In 1980, 18% of women having vaginal delivery were delivered by forceps and 1% had vacuum extraction.[51] By 1985, overall use of instrumental vaginal delivery had declined to 15%, remaining stable between 14% and 15% of vaginal births until 1999. Forceps use, however, fell from 13% to 5% during that time period while vacuum use climbed from 2% to 9%. In 1989, a *British Journal of Obstetrics and Gynaecology* article proclaimed vacuum extraction "the first choice for operative vaginal delivery" (p. 935).[96]

A 1998 FDA warning disabused obstetricians of the illusion that vacuum extraction was safe for babies. Vacuum extraction, it had been discovered, could cause a lethal hemorrhage: subgaleal hematoma (or hemorrhage), also known as subaponeurotic hematoma (or hemorrhage). The danger lay in the fact that the soft swelling resembles its benign cousins, cephalhematoma and caput succedaneum, the latter occurring in all vacuum deliveries,[39] and the difference may be missed until it is too late. Subgaleal hematoma occurs above the periosteum, the membrane covering the skull bones, which means that unlike cephalhematoma, the potential space for blood to accumulate is large because it is not bounded by the skull suture lines.[18]

After a dip in the early 1990s, the cesarean rate once more began to rise. The perceived dangers of both instruments now provided motivation for discarding operative vaginal delivery altogether in favor of operative abdominal delivery. Writes one commentator: "The vacuum-versus-forceps debate is a serious irrelevance because it distracts us from asking more important questions. Are there too many assisted deliveries? . . . If (as I suspect) a pregnant woman reading this Commentary would find it frightening [because of the potential harms of both instruments], we should face this fact and engage in the real debate—between instrumental delivery and caesarean section" (p. 610).[35] In 1999, the proportion of instrumental vaginal deliveries in vaginal birth slid to 12.6% in the U.S.[51] By 2004, it had slipped to 8.4%, with the forceps rate a mere 1.6%.[59]

By the beginning of the twenty-first century, the common view appeared to be that forceps delivery was always dangerous while the riskiness of vacuum extraction altered according to the nature of the argument. Vacuum was dangerous when defending against curbs on cesareans,[79] but safe when a result of having epidural analgesia. Despite obstetric maternal and neonatal trauma being health

quality indicators for childbirth,[64, 65] the American Society of Anesthesiologists (ASA) does not think it necessary to disclose the risks of instrumental vaginal delivery in its labor analgesia patient education brochure, although it acknowledges that need for it is a possibility.[5]

Meanwhile, lurking in the shadows is the ongoing use of fundal pressure both alone and in conjunction with instrumental delivery. Fundal pressure is common in some countries and considered obsolete in others.[91] In the U.S. it may be used in more than one in six U.S. women having vaginal delivery,[30] a rate we speculate may be fueled by the ubiquity of epidurals.

Reading commentaries on fundal pressure is to fall down Alice's rabbit hole. On one hand, practitioners treat it cavalierly. A nursing article states that nurses may feel "pressured by physicians to use this technique even when they feel it is not in the best interest of the woman and her fetus" (p. 65).[86] The article goes on to say that while it is generally applied by a nurse, there have been reports of physicians asking the woman's partner, an anesthesia provider, or unlicensed assistive personnel to perform it or for more than one person to apply pressure simultaneously. The authors also write that fundal pressure is not formally taught in nursing or medical schools and no practice guidelines or standards exist; yet, they add, "fundal pressure continues to be passed on—mythical style—from generation to generation . . . through informal channels and anecdotal clinical experiences" (p. 66). Clearly, the belief that fundal pressure needs no guidelines and that anyone can do it under any circumstances indicates that its practitioners think it is harmless. Along the same lines, a narrative review's authors think it likely that some doctors use fundal pressure to avoid the harms and litigation risk of instrumental vaginal delivery, which implies that doctors perceive fundal pressure as less, or not, risky.[61] On the other hand, citing a U.S. survey in which physicians acknowledged using fundal pressure but not documenting it, these same reviewers observe, "Fear of litigation may have contributed to the failure of physicians to document" (p. 602). Leaving aside the shocking ethical implications of failing to record procedures to avoid being called to account for using them, obviously obstetricians who use fundal pressure know very well that it can injure the fetus.

The obstetrician authors themselves seem to suffer from cognitive dissonance. They write, "[A]lthough the extant literature does not demonstrate any benefits and hints at potentially serious risks, surveys suggest that it is still commonly used. If its use is going to continue in the absence of reassuring studies, it seems appropriate to suggest that clinicians follow a few modest guidelines" (p. 602). This makes about as much sense as suggesting guidelines for safer drunk driving. Logic dictates a call to end the practice.

Fundal Pressure and Obstetricians: Damn the Evidence; Full Speed Ahead

As with aggressive use of oxytocin (see chapter 9), obstetricians have been on the wrong side of the fight with intrapartum nurses over fundal pressure. Even after nurses at a Kentucky hospital presented their concerns about their liability and a literature search showing no evidence supporting it, the obstetricians' position remained that it was the physician's call.[89] The practice was halted only after the Kentucky Board of Nursing issued an Advisory Opinion Statement forbidding RNs to apply fundal pressure in second stage for any reason. The policy was based on similar statements issued by the Maryland and Mississippi Boards of Nursing, which suggests that the Kentucky nurses' struggle with obstetrician intransigence may be a widespread problem.

Like instrumental vaginal delivery, obstetricians want to have it both ways: fundal pressure is both so innocuous that anyone can apply it and research to establish its safety and efficacy or training and protocols are not needed, and so risky that the specter of a delivery-injury malpractice case is motivation for not documenting it.[61] What ties together these opposing characterizations of instrumental delivery and fundal pressure?

UNDERLYING UNITIES OF THE BIPOLAR VIEWPOINT

One unifier of these seemingly irreconcilable viewpoints is medical-model thinking: the belief that intervention is frequently needed to avert the inherent risks of the natural process. Medical-model thinking dictates that the dangers of one interventionist strategy will only be recognized when a new one arises to supplant it. It closes out the possibility that what is really needed in the vast majority of cases is patience and care that supports the physiologic process. Within this mindset, fewer cesareans necessarily means more vaginal instrumental deliveries and therefore more subgaleal hematomas from vacuum extractions.[79] It does not occur to medical-model thinkers that there is a third alternative—more spontaneous births—because they reject the premise that spontaneous birth is almost always best and safest.

Another unifier is the belief that nonmedical factors can determine treatment legitimately. Preeminent among these is defensive medicine. As one protesting commentator writes, "Practitioners began to shy away from instrumental delivery largely because of self-preservation instincts. . . . The threat of litigation should not dictate the method or route of delivery" (p. 786).[98] Another explains, apparently without finding the deskilling of obstetricians or the reasons for it either problematic or surmountable: "The future for all instrumental delivery remains

unclear, as adequate training . . . is increasingly difficult to obtain because of the retirement of classically trained obstetricians; the inability to conduct training operations; a malevolent medico-legal climate; and changes in practice, including the high frequency of cesarean delivery."[71] Other determinants include convenience. An analysis of a city-wide perinatal database revealed that women in spontaneous, normally progressing labor, with babies weighing 2500-4000 g who were not in distress were least likely to have an instrumental vaginal delivery between 12 a.m. and 6 a.m. After that, rates rose steeply, peaking between 12 p.m. and 2 p.m. and declining thereafter.[93] (Not surprisingly, incidence of anal sphincter laceration followed the same pattern.) And, as we saw earlier, economic self-interest trumps the right to informed consent in the ASA's patient-education epidural brochure.[5]

THE TRUTH, THE WHOLE TRUTH, AND NOTHING BUT THE TRUTH ABOUT INSTRUMENTAL DELIVERY AND FUNDAL PRESSURE

What, then, are the facts about instrumental vaginal delivery and fundal pressure? Let us begin by exploding the falsehood that fetal status deteriorates with lengthening second stage and that the infant should be delivered at a preset time limit. The "two-hour rule," first promulgated in 1952,[98] might have had some validity but only because of the iatrogenic effects of medical-model management. Many women received large doses of narcotics, which compromises newborn respiration. All women pushed supine, which compresses the major maternal blood vessels serving the uterus, compromising placental perfusion. All women also were directed to push using a prolonged Valsalva maneuver, which diminishes fetal oxygenation.[15] Almost all modern studies fail to find ill effects with longer second stages, and in the few that do, it cannot be determined whether this is due to duration per se or management. (See mini-review 1.)

As for neonatal harms, instrumental vaginal delivery increases the risk of neonatal death and delivery injury. (See mini-reviews 2 and 3.) Compared with spontaneous vaginal birth, it results in:

- One more neonatal death per 10,000 with either instrument after adjustment for confounding factors.†
- One more intracranial hemorrhage per 1000 with either instrument.
- As many as 1 more neonatal seizure per 1000. A large Canadian study reported this difference with either instrument, but a large U.S. study reported much smaller absolute differences.
- Four to 5 more facial nerve injuries per 1000 with forceps delivery and 0.5-1 more per 1000 with vacuum extraction.
- Two more brachial plexus (a complex of nerves serving the shoulder and arm) injuries per 1000 with either instrument.

† This does not argue for substituting cesarean surgery. The inherent risk of death is much higher with cesarean as is the risk of loss in future pregnancies. (See chapter 5.)

- Eleven more shoulder dystocias (the head is born, but the shoulders hang up behind the pubis) with vacuum extraction and 1 more per 1000 with forceps delivery.
- A 5% linear (as opposed to depressed) skull fracture rate with vacuum extraction, according to a study that routinely x-rayed all infants after vacuum delivery. No infant displayed neurologic symptoms or required treatment, which the investigators viewed as reassuring, but we do not. Lack of overt neurologic symptoms does not rule out subtler adverse effects such as pain, which might interfere with breastfeeding and attachment during the crucial early days of life. Indeed, all instrumental-delivery-related nerve compressions, swellings, and bruising hold this potential.[87]

Studies comparing the two instruments do not find major differences in neonatal outcomes. (See mini-review 10.) One to 3 more babies per 100 experience shoulder dystocia with vacuum extraction compared with forceps, and 3 to 4 more babies per 1000 experience facial nerve injury with forceps compared with vacuum. Clavicle fracture, skull fracture, brachial plexus injury, intracranial hemorrhage, and seizure rates are similar. (One explanation for excess shoulder dystocias with vacuum is that forceps cradle the head, taking up room whereas the vacuum cup takes up no space[13] In marginal situations, vacuum may enable delivery of the head while forceps delivery would fail. We speculate that forceps may also allow manipulation of the fetus through the cardinal movements while vacuum extraction does not.)

Instrumental delivery also increases maternal morbidity compared with spontaneous birth. (See mini-review 4.) In the U.S. and Canada, where median episiotomy is the norm, 8 to 18 more women per 100 experience anal sphincter tears with vacuum extraction, and the excess may be as high as 26 per 100 in primiparous women. With forceps delivery, 19 to 47 more women per 100 have anal sphincter injury. In countries where mediolateral episiotomy is usual, differences are much smaller. One to 8 more women per 100 have anal sphincter injury with vacuum, and primiparity may not increase risk. With forceps delivery, as few as 1 to 3 more women per 100 may have sphincter tears. Differences between instrumental delivery and spontaneous birth would undoubtedly be greater were episiotomy, especially median episiotomy, not also used at spontaneous birth. In addition, women having instrumental vaginal delivery are more likely to be readmitted after hospital discharge: 2.2% with forceps delivery and 1.8% with vacuum extraction versus 1.5% with spontaneous birth. The reasons for excess admissions included "pelvic injury/wounds," "genitourinary complications," "obstetric surgical complications," and "major puerperal infection." (See mini-review 4.) Finally, instrumental delivery may be associated with increased risk of severe hemorrhage. (See mini-review 5.) Case-control studies have reported increased risk of transfusion and peripartum hysterectomy, although differences are not always significant.

Instrumental vaginal delivery is not, however, strongly associated with pelvic floor dysfunction. (See mini-reviews 6-8.) By six months to a year postpartum, few women with instrumental delivery are anally incontinent, and of those who are, most are incontinent to flatus only. This is understandable when one considers that anal incontinence largely occurs secondary to sphincter injury.[66] Most women who have instrumental deliveries will escape sphincter laceration, and even among those who do not, most women with sphincter injury remain continent. Yet this is not a reason for complacency: aging and further childbearing may alter this picture. The sole longitudinal study found that women with a history of forceps delivery were more likely to report fecal incontinence 12 years after the index birth compared with women having only spontaneous vaginal births. Likewise, associations with stress urinary incontinence are weak, and what little data we have do not suggest an association with pelvic floor prolapse.

Instrumental vaginal delivery has adverse psychological impact as well. One study reported that both forceps and vacuum delivery were associated with symptoms of psychological trauma.[26] Another reported that vacuum extraction (no data on forceps) at first delivery was an independent risk factor for fear of delivery in the second pregnancy.[80] A third study that surveyed women's experience of instrumental vaginal delivery (type not specified) reported that 70% of respondents said instrumental delivery had upset them, increased their fear of childbirth, or both.[9] One-quarter of the group preferred cesarean surgery to a repeat instrumental vaginal delivery.‡ A fourth found that three years after difficult instrumental vaginal delivery, 16% of survey respondents had no further children because they could not go through childbirth again.[10]

When the two instruments are compared, meta-analysis finds that more women experience anal sphincter laceration (14% vs. 8%) or vaginal trauma (26% vs. 12%) with forceps. (See mini-review 9.) As one would expect, the highest adverse outcome rates occur when both instruments are used. (See mini-review 12.) Rates of maternal injury are not much higher than with forceps delivery alone, though, and are generally similar for neonatal outcomes with one exception: an analysis of a case series of subgaleal hematoma revealed that 40% occurred after vacuum failures were succeeded by forceps attempts.

Vacuum is less likely to achieve delivery than forceps, but success rates are high (86% vs. 90%) with both instruments; however, vacuum extraction tends to end in cesarean surgery less often, although cesarean rates are low (3% vs. 5%) in both cases.§ (See mini-review 11.) This is probably because failed vacuum extraction may

‡ Women with negative experiences may have been more likely to respond to the survey, but this does not negate that at least some women experience instrumental vaginal delivery as traumatic.

§ The discrepancy between instrumental delivery and cesarean rates is because they come from meta-analyses of two different sets of trials.

be followed by successful forceps delivery whereas failed forceps delivery is usually followed by a cesarean.

It also seems likely that failure rates are low because many obstetricians have such a low threshold for intervening. Most instrumental vaginal deliveries probably could be spontaneous births with a patient birth attendant who practiced physiologic care. For example, a study at 14 U.S. academic centers reported that among women having instrumental vaginal delivery (half forceps, half vacuum) for failure of descent, half the babies had descended two-thirds of the distance between the ischial spines and vaginal opening—descent equivalent to station of +4 or more—half the group had spent 2-2 ½ hours or less and one-quarter of the group had spent 1 ½ hours or less in second stage.[24] This seems inadequate considering that most women probably had epidurals. In less straightforward cases, most obstetricians would probably opt for cesarean over instrumental vaginal delivery, although the probability of success and the morbidity attendant on cesarean surgery argue for an attempt at instrumental delivery under most circumstances.

Fundal pressure, unlike instrumental vaginal delivery, is not only harmful but ineffective. (See mini-review 14.) Despite its common use, until 2009 we had no evidence on effectiveness. Now we do. A randomized controlled trial (RCT) found that routine application of fundal pressure had no appreciable effect on length of second stage while increasing incidence of fetal hypoxia. Other studies have reported increased likelihood of brachial plexus injury, anal sphincter injury, and painful intercourse (dyspareunia) at 12 to 18 months postpartum *in women without anal sphincter laceration.*

In a system centered on what best serves the needs of mother and child, care providers would have a healthy respect for the potential harms of both forceps and vacuum extraction and would engage in practices and policies that promote spontaneous vaginal birth. They would not, however, refrain from the judicious use of either mode of instrumental delivery when potential benefits outweighed potential harms, and they would ensure that physicians were skilled in the use of both. In difficult cases or cases where use of one or the other instrument has failed, they would weigh with the laboring woman the benefits versus harms of cesarean surgery. Every woman is entitled to an accurate, unbiased appraisal on which to make decisions, and no woman's options should be limited by her obstetrician's failure to acquire knowledge and skills that should fall within every obstetrician's purview.

Here We Go Again: Vacuum Extraction at Cesarean Delivery

As early as 1994, a narrative review and guidelines concluded that "in some circumstances, [vacuum extraction] may even be a useful aid in abdominal delivery" (p. 804),[55] and a 2009 narrative review stated that it can be used with a high unengaged fetal head or as an alternative to extending the uterine incision.[2] No mention is made of possible complications. Meanwhile, two recent case studies report subgaleal hemorrhage after cesarean vacuum extraction.[22, 37] One of them, noting that vacuum extraction during cesarean has become routine in some facilities, warns, "There is no clear rationale for routinely and electively subjecting a mother/baby pair to the risks of both cesarean delivery and vacuum delivery. More importantly, neither the benefit nor the safety of routine vacuum use at time of cesarean delivery has ever been established in the medical literature" (p. e4).[22] Leaving aside whether vacuum extraction has any role at cesarean delivery, will anybody listen?

STRATEGIES FOR OPTIMAL CARE

To maximize the likelihood of spontaneous vaginal birth:

- Encourage continuous labor support by a trained or experienced woman who is not a hospital medical staff member. (See chapter 18.)
- Use intermittent auscultation. (See chapter 10.)
- Encourage the use of pain coping strategies other than epidural analgesia. (See chapter 12.)
- Delay pushing in women with no urge to push,[16] and allow passive descent in women with epidural analgesia.
- Recommend pushing in an upright position with second stage delay. Upright positioning is possible with epidural analgesia, although it may require some physical support.
- Attempt manual rotation of persistent occiput posterior (OP) babies.[16] Success and subsequent spontaneous vaginal birth rates are high,[53, 73, 82] and discomfort is minimal.[16]
- Have patience with second-stage delay provided mother and fetus are tolerating labor and some fetal descent is occurring.[1]
- Augment with oxytocin to achieve adequate contractions before resorting to instrumental delivery.

To minimize the likelihood of maternal or neonatal morbidity with assisted vaginal delivery:

- Do not use fundal pressure.

- Train doctors in the proper selection of instrument and in proper technique.[20]
- Attempt manual rotation of persistent OP babies.[16] Studies find an association between posterior or rotational delivery and severe maternal injury compared with babies delivered from the anterior position.[11, 41, 97]
- In most cases, choose vacuum extraction over forceps.
- Refrain from median episiotomies. Studies disagree on whether mediolateral episiotomy predisposes to sphincter tears, is neutral, or is protective compared with no episiotomy. (See mini-review 13.)
- Use judgment when instrumental delivery does not proceed smoothly. Difficult deliveries and the use of multiple instruments increase the likelihood of serious neonatal morbidity and maternal injury, but risks must be weighed against those incurred with cesarean surgery for mother, baby, and future pregnancies.
- Ensure that the woman is making an informed decision and maintain good communication that is sensitive to her concerns and feelings before, during, and after the procedure.

MINI-REVIEWS

Notes:

- In addition to the universal exclusions discussed in chapter 3, we excluded studies that did not disaggregate forceps and vacuum delivery because the two modalities have different effects on maternal and neonatal outcomes.
- We report only on major or life-threatening morbidity or on morbidity with clinically significant consequences for quality of life beyond postpartum healing. Accordingly, to ensure complete healing, we excluded studies on postpartum pelvic floor symptoms with < 6 months' follow-up.
- Where feasible, we excluded studies that failed to account for at least some of the confounding and correlating factors affecting outcomes.
- We could find no studies of the relationship between sexual dysfunction and instrumental vaginal delivery that reported separately on forceps delivery and vacuum extraction. Well known, however, is that severe tears are associated with painful intercourse (dyspareunia), at least in the early months after delivery, and as we will document here, both vacuum and forceps delivery increase the likelihood of severe tears.
- Assume differences are statistically significant unless otherwise noted.

1. Studies generally fail to find increased risk of neonatal morbidity with longer second stages.

Note:

- In contrast to neonatal morbidity, studies consistently report that maternal morbidity increases with second-stage duration because of the increasing use of instrumental or cesarean delivery.
- Since conventional obstetric second-stage management involves recumbent pushing position and directed Valsalva maneuver, both of which can compromise placental perfusion, outcomes can be considered worst cases.

A systematic review reported on four retrospective cohort studies, three prospective cohort studies, and a case-control study.[4] The cohort studies ranged in size from 1432 women to 25,069 women, and the case-control study matched 182 cases with 182 controls. Results were not pooled because the studies were too dissimilar; however, studies consistently failed to find adverse effects on newborn outcomes with prolonged second stage, including Apgar scores, umbilical artery pH, length of hospital stay, neonatal seizures, need for ventilation, or stillbirth/neonatal death. One study reported an increase in neonatal intensive care admissions with second stage longer than 2 h while the other seven did not.

Since publication of the systematic review, three more studies have been published evaluating the relationship between second stage duration and neonatal outcome, all of which adjusted for confounding factors such as mode of delivery. The strongest of these, because data were collected prospectively, reported on 4126 nulliparous women, and investigators reported no increase in neonatal morbidity with longer duration.[78] In contrast, a retrospective study in 5158 multiparous women (VBAC labors not excluded) reported that as second stage lengthened from 0-1 h to ≥ 3 h, more newborns (7.1% rising to 12.8%) experienced morbidity (one or more: 5-min Apgar < 7, pH < 7.0, base excess > -12, shoulder dystocia, delivery injury, intensive care admission).[19] The third study analyzed data on 121,517 women.[3] In nulliparous women having spontaneous vaginal birth, longer second stages were associated with greater likelihood of poor condition at birth and intensive care admission (rates not reported). In multiparous women, longer second stages likewise were associated with increased likelihood of poor condition at birth and intensive care admission (ORs not calculated according to mode of delivery).

2. Instrumental vaginal delivery increases the likelihood of neonatal and infant mortality, although excess risk is extremely small.

Investigators analyzed data from 11.5 million singleton live births in the U.S., excluding cesareans, breech deliveries, infants with congenital malformations, and infants born at less than 35 w gestation, to ascertain the risk of adverse neonatal and infant outcomes with instrumental vaginal delivery compared with spontaneous vaginal birth.[32] Rates of neonatal death (0-27 d) were 5.0 per 10,000 with forceps delivery (n = 435,339), 4.7 per 10,000 with vacuum extraction (n = 891,340), and 3.7 per 10,000 with spontaneous vaginal birth (n = 10,137,144).

Using forceps delivery as the reference group, newborns born spontaneously were 25% less likely to die (OR 0.75) after adjustment for maternal age, race, parity, education, gestational age, birth weight, diabetes, pre-existing hypertension, pregnancy induced hypertension, premature rupture of membranes, induction of labor, fetal distress, placental abruption, and intrapartum bleeding. Neonatal mortality rates did not differ significantly between forceps delivery and vacuum extraction. Absolute differences from spontaneous birth, though, were small: 1.3 per 10,000 for forceps delivery and 1.0 per 10,000 for vacuum extraction. Rates of infant death (0-364 d) were 16.4 per 10,000 with forceps delivery, 15.8 per 10,000 with vacuum extraction, and 18.1 per 10,000 with spontaneous vaginal birth. While raw rates were highest with spontaneous delivery, after adjustment, compared with forceps, infants were less likely to die with spontaneous birth (OR 0.87) and with vacuum extraction (OR 0.88). A Canadian analysis of 305,391 singleton, term, cephalic births (255,649 spontaneous, 31,015 vacuum, 18,727 forceps) failed to find a significant difference in neonatal death rates among spontaneous (2 per 10,000), vacuum (3 per 10,000), and forceps (3 per 10,000) deliveries after adjustment for maternal age, birth weight, gestational age, congenital malformation, prior cesarean, dystocia, fetal distress, gestational diabetes, pregnancy-induced hypertension, placenta previa, placental abruption, premature rupture of membranes, uterine infection, and labor induction.[94] Nonetheless, absolute differences from spontaneous birth were identical to the U.S. study, 1 per 10,000 for both instruments, which suggests that the larger study had greater power to detect statistically significant differences.

3. Instrumental vaginal delivery increases the likelihood of severe neonatal morbidity, but it is rare.

The same U.S. and Canadian population-based studies cited in mini-review 2 examined neonatal morbidity according to mode of vaginal delivery. The U.S. study, however, analyzed New Jersey data in women with singleton, cephalic, normally formed babies at ≥ 35 w gestation (327,323 spontaneous births, 19,120 vacuum extractions, and 26,491 forceps deliveries), controlling for gestational age, deep transverse arrest, persistent OP, long labor, fetal distress, cord prolapse, placental abruption, and intrapartum bleeding.[32] The Canadian study, as before, analyzed 305,391 singleton, full term, cephalic births (255,649 spontaneous, 31,015 vacuum, 18,727 forceps) and controlled for maternal age, birth weight, gestational age, congenital malformation, prior cesarean, dystocia, fetal distress, gestational diabetes, pregnancy-induced hypertension, placenta previa, placental abruption, premature rupture of membranes, uterine infection, and labor induction.[94]

Both studies reported on intracranial hemorrhage.[32, 94] Rates were 0.3 per 1000 and 0.4 per 1000 with spontaneous birth vs. 1.2 per 1000 and 1.6 per 1000 with vacuum and 1.0 per 1000 and 1.7 per 1000 with forceps delivery. Absolute differences between spontaneous birth and vacuum were 0.9 per 1000 and 1.2 per 1000 and between spontaneous birth and forceps were 0.7 per 1000 and 1.3 per 1000, all favoring spontaneous birth. Three additional studies also reported on intracranial hemorrhage. A case-control study compared 66 full-term infants with intracranial hemorrhage with 104 control women.[48] Investigators attempted to isolate the direct effect of forceps delivery by matching cases and controls for year and delivering obstetrician to account for practice variation and by adjusting for 1-min Apgar score and resuscitation category, which eliminated hypoxia both as a reason for forceps delivery and the possible underlying cause of intracranial hemorrhage. Cases

remained much more (OR 4.3) likely to be delivered by forceps than controls. Forceps-associated hemorrhages were also much more likely (OR 12.6) to be subdural hemorrhages than those occurring during spontaneous birth and much less likely (OR 0.1) to be intraparenchymal hemorrhages, a site strongly associated (OR 7.0) with low platelet count. Taken together, this suggests that coagulation abnormalities are not a confounding factor in brain bleeds and that excess risk with forceps is directly related to mechanical pressure. A second study analyzed a case series of 1123 women having attempted vacuum extraction whose newborns routinely underwent skull X-ray and ultrasound scan.[85] Eight infants (0.9%) had intracranial hemorrhage, of whom seven had no clinical symptoms, although one had a brachial plexus injury. The symptomatic case (severe anemia and irritability) was delivered by low-station vacuum for prolonged second stage. He had a subarachnoid hemorrhage in the tentorium (a fold of the dura mater than can tear if overstretched) and recovered fully. Finally, a study analyzed a series of 37 cases of subgaleal hematoma admitted to a tertiary pediatric hospital.[18] Thirty-three of the cases were primary vacuum attempts. Of these, vacuum failed in 17 cases, leading to 15 cases of attempt with forceps, and of the 16 delivered by vacuum, 8 were difficult deliveries (deliveries requiring several applications of the cup for prolonged periods). Only three cases were primary forceps attempts. One baby among the 37 cases died of the injury (27 per 1000), although as only severe cases would have been referred, this probably does not represent the general mortality risk of subgaleal hematoma.

The same large U.S. and Canadian population studies reported on seizure incidence.[32, 94] The U.S. study reported rates of 5 per 10,000 with spontaneous birth, 7 per 10,000 with vacuum extraction, and 9 per 10,000 with forceps delivery.[32] Compared with forceps delivery, newborns were less likely to experience seizure with spontaneous birth (OR 0.8) or with vacuum extraction (OR 0.8) than with forceps. The Canadian study reported rates of 8 per 10,000 with spontaneous birth, 20 per 10,000 with vacuum extraction, and 23 per 10,000 with forceps delivery.[94] After adjustment, compared with spontaneous birth, newborns were more likely to experience seizure with vacuum extraction (OR 1.8, absolute difference 12 per 10,000) or forceps delivery (OR 2.0, absolute difference 15 per 10,000).

Turning to delivery injury, both the U.S. and Canadian population studies reported on rates of facial nerve injury.[32, 94] Rates were 0.4 per 1000 and 0.2 per 1000 with spontaneous birth vs. 1.2 per 1000 and 0.5 per 1000 with vacuum and 5.1 per 1000 and 3.7 per 1000 with forceps delivery. Absolute differences from spontaneous birth were 0.8 per 1000 and 0.3 per 1000 with vacuum and 4.7 per 1000 and 3.5 per 1000 with forceps, all favoring spontaneous birth. The study with smaller absolute differences did not calculate an odds ratio for this outcome.[32] The Canadian study reported on brachial plexus injury.[94] Rates were 0.7 per 1000 with spontaneous birth compared with 3.0 per 1000 with vacuum and 2.8 per 1000 with forceps. Absolute differences from spontaneous birth were 2.3 per 1000 with vacuum and 2.1 per 1000 with forceps. Finally, the case series routinely screening 1123 infants after vacuum extraction with X-ray and ultrasonography reported on skull fracture, which was found in 5.0% of the population.[85] The authors observed that all fractures were linear, which, unlike depressed fractures, are not problematic and that no infant had symptoms or required treatment. We do not know whether newborns incur linear skull fractures during spontaneous birth because these babies were not screened. Still, this percentage is troubling and the lack of symptoms not reassuring. Linear fractures could have subtler adverse effects such as pain, for example, which might interfere with breastfeeding and attachment during the crucial early days of life.

The U.S. population study compared rates of shoulder dystocia and need for mechanical ventilation.[32] Rates of shoulder dystocia were 4.5 per 1000 with spontaneous birth, 5.5 per 1000 with forceps delivery, and 11.3 per 1000 with vacuum extraction. Absolute differences from spontaneous birth were 5.8 per 1000 for vacuum extraction and 1.0 per 1000 for forceps delivery. Rates of mechanical ventilation were similar in all three modes of delivery.

4. Instrumental vaginal delivery increases the likelihood of severe maternal injury, and forceps delivery is more likely to do severe damage than vacuum extraction.

> **Note:** The comparative rates of anal sphincter injury reported here may have been affected by numerous factors, including percentage of primiparous women in the population, use of episiotomy, whether episiotomy was median or mediolateral, the angle and length of mediolateral episiotomy,[52] use of fundal pressure, accuracy of diagnosis of anal sphincter laceration, and accuracy of recording anal sphincter injury in medical records. Differences from rates with spontaneous birth will also vary according to how spontaneous vaginal birth is managed with respect to these same factors and according to pushing technique and delivery position and technique.

The association between vacuum extraction and anal sphincter injury varied according to type of episiotomy and parity, but most studies reported an excess with vacuum extraction. Among five large U.S. and Canadian (median episiotomy the norm) population-based studies, anal sphincter tear rates in mixed-parity studies ranged from 1.7% to 6.6% with spontaneous vaginal birth and from 9.3% to 22.6% with vacuum extraction, and absolute differences varied from 7.6% to 17.5%, all favoring spontaneous birth.[6, 27, 32, 75, 94] A U.S. study limited to primiparous women reported higher rates in both categories: 12.3% with spontaneous birth, 38.7% with vacuum extraction, absolute difference 26.4%.[40] In two European (mediolateral episiotomy the norm) mixed-parity studies, rates with both birth modes were much lower:[29, 81] 1.7% and 2.9% with spontaneous birth, 3.0% and 10.7% with vacuum extraction, absolute differences 1.3% and 7.8%. In contrast to the U.S. study, rates in a European study of primiparous women were in the same range as the European mixed-parity studies: 0.6% with spontaneous birth and 2.1% with vacuum extraction and did not differ significantly from spontaneous birth.[44] A likely explanation for the dramatically lower rates is the use of mediolateral rather than median episiotomy. Among case-control studies, a U.S. mixed-parity study, two mixed-parity European studies, and a U.S. study of multiparous women all failed to find a statistically significant association between anal sphincter injury and vacuum extraction after adjustment for correlating factors;[21, 33, 63, 70] however, a U.S. study of primiparous women did (OR 6.3).[41] Finally, four large population analyses looked at factors associated with anal sphincter injury: a large U.S. study and three European studies reporting exclusive use of mediolateral episiotomy.[46, 72, 74, 83] All reported that women with anal sphincter lacerations were more likely to have had vacuum extraction after adjustment for correlating factors.

Forceps delivery has a much stronger and more consistent association with anal sphincter injury, although episiotomy type and parity still modify outcome. Among the

same five mixed-parity U.S. and Canadian studies, anal sphincter tear rates associated with forceps consistently exceeded those with vacuum extraction in the same study.[6, 27, 32, 75, 94] Rates with forceps delivery ranged from 19.2% to 46.8% and absolute differences from spontaneous birth varied from 14.1% to 41.7%. In the U.S. study of primiparous women 43.1% having forceps delivery had anal sphincter tears (absolute difference from spontaneous birth 30.8%).[40] In the two European studies reporting forceps delivery data, one of them confined to primiparous women, sphincter tear rates were greater with forceps (1.6% and 4.7%) than vacuum but absolute differences compared with spontaneous birth were smaller than in the U.S. and Canadian studies (1.0% and 3.0%). All six case-control studies but one[47] that looked at association between anal sphincter tear and forceps delivery reported that forceps delivery remained an independent factor after adjustment.[21, 33, 41, 47, 63, 70] This held true regardless of whether the study was conducted in the U.S. or Europe or was of mixed-parity, primiparous, or multiparous women. Odds ratios ranged from 3.0 to 13.6, with the greatest being in a U.S. study of primiparous women. The same four large, population-based U.S. and European studies that looked at factors associated with anal sphincter injury also reported that, after adjustment, women with anal sphincter lacerations were more likely to have had forceps deliveries.[46, 72, 74, 83]

Finally, a retrospective study of 900,108 women, 16,404 (1.8%) of whom were readmitted to the hospital within 60 d of postpartum discharge, revealed that women having forceps delivery (2.2%, OR 1.4) or vacuum extraction (1.8%, OR 1.2) were more likely to be readmitted than women having spontaneous vaginal birth (1.5%).[54] The highest comparative rates of readmission with forceps delivery were for "pelvic injury/wounds" (OR 5.6, absolute difference 3.0 per 1000), "genitourinary complications" (OR 2.2, absolute difference 2.7 per 1000), "obstetric surgical complications" (OR 1.7, absolute difference 0.5 per 1000), and "major puerperal infection" (OR 1.6, absolute difference 1.6 per 1000). The highest comparative readmittance rates with vacuum extraction were for the same indications: "pelvic injury/wounds" (OR 2.7, absolute difference 1.1 per 1000), "genitourinary complications" (OR 1.5, absolute difference 1.1 per 1000), "obstetric surgical complications" (OR 1.3, absolute difference 0.2 per 1000), and "major puerperal infection" (OR 1.2, absolute difference 0.6 per 1000), although differences were smaller, and the difference in rates for "obstetric surgical complications" just missed achieving statistical significance (CI 0.99 – 1.60).

5. Instrumental vaginal delivery may increase the likelihood of severe bleeding. Two case-control studies reported on the risk of peripartum hysterectomy with instrumental vaginal delivery vs. spontaneous birth. A U.S. study looked at risk factors associated with hysterectomy within 30 d postpartum (867 cases vs. 3584 controls).[12] Women who had vacuum extraction or forceps delivery were at equal excess risk (OR 1.7) of hysterectomy compared with spontaneous birth, although the difference only achieved statistical significance in women having vacuum extraction. A U.K. study (315 cases vs. 608 controls) reported similar excess risk (OR 1.75) of hysterectomy during delivery admission in women having instrumental (not differentiated) vs. spontaneous vaginal delivery.[50] The difference also did not achieve statistical significance, but the consistent findings and strikingly similar odds ratios suggest that the association may be real. The U.S. study's authors theorized that tissue injury could lead to increased severe hemorrhage, a theory bolstered by a case-control study of factors associated with postpartum hemorrhage (666 cases vs. 154,311 controls).[84]

Instrumental delivery was independently associated with postpartum bleeding > 500 mL. Women having vacuum extraction were more likely to require transfusion (6.5% vs. 1.9%). This was not true of forceps delivery, but few women had forceps deliveries.

6. Instrumental vaginal delivery appears to have only minor impact on anal incontinence, but effects may be greater than they appear.

> **Note:** The relationship between instrumental vaginal delivery and anal incontinence is complex. Anal incontinence rates largely relate to anal sphincter injury rates associated with instrumental vaginal delivery, and these vary widely. (See mini-review 4.) In addition, differences between vaginal instrumental delivery and spontaneous birth depend on anal sphincter tear rates with spontaneous birth, which in turn depend on how spontaneous birth is managed regarding use and type of episiotomy and whether fundal pressure was applied. Finally, women experiencing problems would be more likely to respond to follow-up surveys, which means that rates reported in studies may not be reflective of the general population who had instrumental delivery.

Three studies evaluated the relationship between anal incontinence and instrumental delivery at 9-12 months postpartum, all European (mediolateral episiotomy the norm). None reported a major effect, although this may be due to study limitations. Studies were underpowered to detect small but clinically important differences, especially with forceps delivery, which is likely to be the more significant problem because of its stronger association with anal sphincter tears. Studies also would not have captured incontinence that may have been attributable to forceps delivery but that developed after subsequent childbearing and aging. The largest surveyed 906 women at a mean of 10 months postpartum regarding stool incontinence (soiling or staining) and urgency (felt the need and could not hold on).[56] Four percent of the overall population (n = 36) who were free of bowel disease had developed new anal incontinence, 2.4% (n = 22) said the problem was unresolved, and 1.0% (n = 8) said it affected their lifestyle. Both vacuum extraction and forceps delivery were independently associated after adjusting for such factors as degree of perineal trauma, birth weight, head circumference, and length of second stage. The authors advise interpreting results with caution because of the small numbers of women involved. The second study interviewed 300 women at three months postpartum and followed up at one year all women who were experiencing gas or fecal incontinence.[43] At three months, 21 women were incontinent, 19 had gas incontinence only (6.3%) and two stool incontinence (0.7%). Fifteen women described their symptoms as mild, five as moderate, and one as severe. Vacuum extraction was more common in incontinent women (10/21, 47.6%) than in continent women (30/279, 10.8%), and too few women had forceps deliveries (n = 3) for statistical analysis. At one year, 19 women were available for follow-up. Eight women (2.7%) still reported anal incontinence, of whom three reported "spontaneous improvement" and five (1.7%) wanted further evaluation and treatment. These women also had persistent urinary incontinence. Delivery mode is not reported for these eight women. The

third study surveyed 278 primiparous, vaginally delivering women during the first days after birth and at five and nine months postpartum.[101] Women were asked about frequency of involuntary leakage of intestinal gas or stool, including symptoms prior to pregnancy. At nine months three women (1%) had fecal incontinence of any frequency, similar to rates before pregnancy (2 women, 1%), although not necessarily in the same women, and 71 women (26%) had gas incontinence, while only 20 women (8%) experienced this prior to pregnancy. All but one of the 29 instrumental deliveries were vacuum extractions. Instrumental delivery, i.e., vacuum extraction, was not an independent risk factor at nine months in the multivariate analysis.

The only longitudinal study we have seen, also European, looked at the effect of birth mode on fecal incontinence (involuntary loss of fecal matter) in 3763 women 12 y after the index birth.[57] Compared with only spontaneous vaginal births, women with any forceps delivery were more likely (16.7% vs. 11.5%, OR 1.5) to report fecal incontinence while history of vacuum extraction had no effect.

7. Instrumental vaginal delivery does not appear to have a major impact on clinically significant stress urinary incontinence, and forceps delivery appears to pose more risk than vacuum extraction.

> **Note:** Determining pelvic floor dysfunction related to pelvic floor weakness is not straightforward. Instrumental vaginal delivery may serve merely as a marker for other factors that may overstress the pelvic floor, such as excessively long active-pushing phase, carrying and bearing a macrosomic baby, and having a high body mass index (BMI). Moreover, rates with both instrumental delivery and spontaneous birth will depend on second stage management factors such as pushing position and technique. Finally, women experiencing problems would be more likely to respond to follow-up surveys, which means that rates reported in studies may not be reflective of the general population who had instrumental delivery.

Five studies looked at urinary stress incontinence and instrumental delivery, three U.S. (median episiotomy the norm) and two European (mediolateral episiotomy the norm).[8, 14, 38, 77, 92] Two of the U.S. studies were of primiparous women. The larger included 484 women who completed questionnaires on frequency and severity of urinary incontinence at six months. Among women continent before pregnancy, forceps delivery (24/74, 33%) increased risk of urinary incontinence at six months compared with spontaneous birth (50/223, 22%). Vacuum extraction did not increase risk (no numbers given but only 14 vacuum deliveries among the original group were continent before pregnancy). No adjustments were made for correlating factors. Among the 85 incontinent women, 12 (13.5%) had clinically significant incontinence (daily episodes) and 13 (14.8%) had severe incontinence (incontinence precipitated by daily activities); 3 women (3.4%) said incontinence limited activity. No information is given on how severity related to mode of vaginal delivery.

The other U.S. study surveyed previously continent primiparous women regarding urinary incontinence (urine loss of any amount on two or more occasions) at two weeks,

three months, and one year.[8] A severity score was assigned based on frequency and amount of leakage. At one year, among the women still in the study, 4 of 135 women (2.9%) with spontaneous birth had incontinence of any degree vs. 2 of 70 women (2.8%) with vacuum extraction and 9 of 81 women (11%) with forceps delivery. Rates of incontinence and severity scores were similar for spontaneous birth and vacuum extraction, but forceps delivery increased risk both of incontinence (OR 3.5, adjusted for maternal age, birth weight, and first- and second-stage duration) and of having a higher severity score.

The third U.S. study surveyed 523 women, of whom 132 had previously experienced urinary incontinence, at six weeks, three months, six months (n = 447), and one year (n = 385).[14] At one year, 51 women (13.2%) reported current incontinence, of whom 29 (56.9%) reported losing only a drop or two; only 3 (3.9%) reported restricting activity, and only 13 (25.5%) reported not being disturbed by their incontinence. Rates were little changed from six months. After adjustment for correlating factors, forceps delivery was significantly associated (OR 1.8) (no vacuum deliveries in the dataset) with urinary incontinence.

Investigators in one of the European studies surveyed 11,397 community dwelling (not living in a nursing home or rehabilitation facility) women aged 20-65 who had had at least one and no more than five vaginal births.[77] Stress urinary incontinence was defined as any leakage, and a severity score was applied. Neither ≥ 1 vacuum extractions (n = 574) nor ≥ 1 forceps deliveries (n = 662) were associated with any incontinence or with moderate to severe incontinence after adjustment for age, BMI, parity, and years since last birth.

In the other European study, 305 primiparous women were interviewed after their first birth, of whom 278 responded to a second survey five years later regarding urinary stress incontinence.[92] All women were at least 1.5 y postpartum after delivery of their most recent child. Thirty percent (n = 83) reported stress incontinence, 6% (n = 17) reported daily incontinence, and 8% (n = 23) said incontinence was a hygienic or social problem. Compared with the 166 women who were continent before and at least until three months after their first birth, women with new onset of stress incontinence after their first birth (n = 19) were more likely to have had vacuum extraction (no forceps deliveries in this dataset) at their first delivery (OR 2.9) after adjustment for second-stage duration, episiotomy, and birth weight.

8. Instrumental delivery does not appear to be associated with pelvic floor prolapse, but we have little data.

See *note* introducing mini-review 7.

Two European case-control studies looked at the association of instrumental delivery with pelvic floor prolapse. One, of 454 women self-reporting prolapse symptoms, failed to find an association with either forceps or vacuum delivery,[88] and the other, of 352 women having pelvic floor surgery for prolapse or urinary stress incontinence at a mean age of 57 (range: 36-81), failed as well to find an association with forceps delivery.[90]

9. Forceps delivery is more likely to result in maternal injury than vacuum extraction.

> **Note:** Use of episiotomy, whether episiotomy is median or mediolateral, and fundal pressure are modifiable confounding factors that may not have been taken into account but that can affect rates of severe maternal injury.

A systematic review included 13 RCTs of vacuum extraction vs. forceps delivery in women requiring instrumental vaginal delivery.[67] Meta-analysis found that women were more likely (14.0% vs. 7.5%, OR 1.9) to sustain anal sphincter injury (10 trials, 2810 women) and more likely (26.0% vs. 12.1%, OR 2.5) to sustain vaginal trauma (8 trials, 2443 women) with forceps delivery. A single trial of 130 women reported more anal incontinence with forceps (59% vs. 33%, OR 1.8), but continence was assessed at 3 months,[42] so women may have recovered with further healing. A 5-year follow-up to a different RCT included in the systematic review, in which 228 women responded to a survey, found that bowel symptoms were common, but prevalence was similar between groups.[49] The follow-up authors caution, however, that the study was too small to rule out small but clinically important differences. Meta-analyses in the review were underpowered to detect differences in pain on day 4 (1 trial, 264 women) and did not report on the preset outcomes perineal pain or pain during sexual intercourse.

10. With the exception of shoulder dystocia, which occurs more often with vacuum extraction, and facial nerve injury, which occurs more often with forceps delivery, neonatal harms associated with instrumental vaginal delivery occur at similar rates.
The systematic review cited in mini-review 9 included only one trial (637 women) that looked at shoulder dystocia, finding that outcomes "tended to favour forceps" (p. 9) (1.9% vs. 4.7%, absolute difference 2.8%, OR 0.4 CI 0.16 – 1.04).[67] Possibly the difference would have achieved statistical significance with more women. Meta-analyses were underpowered to detect differences in such rarer outcomes as shoulder dystocia, intracranial injury, fracture, composite death/severe morbidity, or death and did not report on the preset outcomes neonatal encephalopathy or subgaleal hemorrhage, although they would have been underpowered to detect differences in the latter two had they done so. We have, however, three large observational studies controlling for confounding factors that provide us with more data. Two studies reported more shoulder dystocias with vacuum extraction: 3.5% vs. 1.5% in one study[17] and 1.1% vs. 0.5% in the other.[32] All three studies reported that facial nerve injuries were more common with forceps delivery.[17, 32, 94] Rates ranged from 0.5 to 1.2 per 1000 with vacuum extraction and from 3.7 to 5.1 per 1000 with forceps delivery, and absolute differences varied from 3.0 to 4.0 per 1000. Brachial plexus injury rates were similar in the two studies[17, 94] reporting on this, as were rates of intracranial hemorrhage in all three studies[17, 32, 94] and rates of neonatal seizure in the two studies[32, 94] reporting this outcome. One study evaluated need for mechanical ventilation and failed to find a difference[32] while a second failed to find a difference in rates of skull or clavicle fracture.[17]

11. Forceps are more likely to succeed at delivery, although success rates are high with either instrument.

The same systematic review cited in mini-reviews 9 and 10 reported that forceps delivery was less likely to fail (9.3% vs. 14.1%, OR 0.7) when it was the allocated instrument (7 trials, 2419 women), but there was a trend toward more cesarean deliveries (4.6% vs. 2.6%, OR 1.8 CI 0.95 – 3.2) compared with vacuum extraction (4 trials, 1222 women).[67] The reviewers resolve the seeming paradox by explaining that vacuum failure may be followed by successful forceps delivery while forceps failure is usually followed by cesarean surgery.

12. Risk of maternal injury and neonatal morbidity is highest when both vacuum and forceps are used.

When both vacuum and forceps are used, anal sphincter injury rates increase over rates with either instrument alone. A U.S. (median episiotomy the norm) population-based analysis reported rates of 5.8% with spontaneous birth, 15.9% with vacuum extraction, 22.3% with forceps, and 28.9% with both,[32] while a European (mediolateral episiotomy the norm) study reported rates of 1.7% with spontaneous birth, 3.0% with vacuum, 4.7% with forceps, and 7.8% with both.[29] Similarly, a European case-control study reported that after adjustment, "complete tears" (presumably fourth-degree sphincter tears) were not associated with vacuum extraction, but the odds ratio with forceps delivery was 4.4 and with use of both was 18.5.[63]

As for neonatal outcomes, a study compared neonatal outcomes in 1889 cases of vacuum plus forceps with 26,491 cases of forceps delivery alone.[32] All women had singleton, cephalic, vaginal deliveries to normally formed infants ≥ 35 w gestation. Investigators reported similar rates of facial nerve injury, intracranial hemorrhage, and shoulder dystocia after adjustment for a long list of medical and obstetric factors. Only the likelihood of need for mechanical ventilation (rates not reported) after use of both instruments (OR 2.2) exceeded that with forceps alone. Finally, analysis of a series of 37 cases of subgaleal hematoma revealed that of the 33 cases that began with an attempt at vacuum extraction, 15 were vacuum failures succeeded by an attempt at forceps delivery.[18]

13. Median episiotomy increases the risk of anal sphincter injury with instrumental delivery, but studies disagree on whether mediolateral episiotomy prevents anal sphincter tears compared with no episiotomy.

> **Note:** We have assumed that episiotomies are median in U.S. studies and mediolateral in European studies because those are the norms. However, some doctors who normally cut median episiotomies may use mediolateral episiotomy with instrumental vaginal delivery because it is reputed to reduce the risk of anal sphincter tear, and some episiotomies with instrumental delivery in European countries may be median.[28]

Four studies evaluating the relationship between median episiotomy and instrumental delivery reported a marked increase in the likelihood of anal sphincter laceration. One used a statistical analysis technique that groups factors hierarchically according to their ability to

predict the outcome of interest.[45] It found that, among 25,150 women, 10% with episiotomy and spontaneous birth (n = 1867) had anal sphincter laceration vs. 28% with episiotomy and vacuum extraction (n = 593) and 52% with episiotomy and forceps delivery (n = 60). Another reported that among women having vacuum extraction, anal sphincter tear rates were 17% in the 18,724 women having episiotomy and 6% in the 3386 women not having episiotomy.[27] Similarly, rates with forceps delivery were 21% in the 18,826 women having episiotomy and 7% in the 1163 women not having episiotomy. The third study looked at episiotomy and instrumental vaginal delivery in 323 women.[76] Among the 161 women having vacuum extractions, 35% of women with episiotomy had anal sphincter lacerations vs. 9% of women not having episiotomy. Among the 162 women having forceps deliveries, 55% of women with episiotomy had anal sphincter lacerations vs. 46% of women not having episiotomy. After controlling for correlating factors, compared with vacuum extraction with no episiotomy, women having vacuum extraction with episiotomy increased their risk of anal laceration 7-fold (OR 6.8), women having forceps without episiotomy increased it 11-fold (OR 11.0), and women having forceps with episiotomy increased it 16-fold (OR 15.8). The fourth study, of primiparous women, looked at risk factors associated with sphincter injury in 407 cases vs. 390 controls.[41] Investigators reported that after adjustment, forceps delivery increased the risk more than 13-fold (OR 13.6), and forceps plus episiotomy increased risk more than 25-fold (OR 25.3). Vacuum extraction with episiotomy is not listed as an independent factor, although vacuum extraction is, so it is presumed that adding episiotomy to vacuum extraction did not further increase risk.

The effect of mediolateral episiotomy is unclear. One study specifically evaluating the role of mediolateral episiotomy in forceps delivery found it was strongly associated with anal sphincter injury.[47] Investigators compared 46 cases of anal sphincter injury with 155 controls. After adjustment for correlating factors, forceps delivery alone did not increase the risk of sphincter laceration, but forceps plus mediolateral episiotomy increased it 5.6-fold. In another study, investigators evaluated risk factors associated with anal sphincter lacerations in 2832 instrumental vaginal deliveries, 80% of which were forceps deliveries.[23] As one would expect, median episiotomy increased risk. Forty percent of women with median episiotomy had anal lacerations compared with 14% of women with no episiotomy, but only 10% of women with mediolateral episiotomy had sphincter injury. Investigators do not statistically compare risk with mediolateral vs. no episiotomy, but mediolateral episiotomy clearly did not increase risk and may have been protective. Two studies report similar anal sphincter injury rates in instrumental deliveries with episiotomy after adjusting for correlating factors. One, a study of 2153 women, reported similar rates of anal injury with vacuum extraction regardless of whether they had episiotomy (2.3% vs. 1.7%), and rates were not statistically significantly different for forceps delivery (9.1% vs. 4.7%).[99] Almost all women (89%) had episiotomies (71% of vacuum extractions and 96% of forceps deliveries), so it is possible that the excess rate in women having episiotomies in the forceps group might have achieved significance if fewer women had episiotomies (because the group without episiotomies would be larger). The second, of nulliparous women, reported similar anal tear rates with vacuum (n = 456) (4.3% episiotomy vs. 5.5% no episiotomy) and forceps (n = 904) (11.7% episiotomy vs. 10.6% no episiotomy).[58] In marked contrast, a large, population-based study reported that after adjustment for correlating factors (no information given on adjustment factors), mediolateral episiotomy was strongly protective

in both vacuum extractions and forceps deliveries.[28] The rate with vacuum extraction and no episiotomy was 9.4% (408/4340) vs. 1.4% (228/16,780) (RR 0.1) with mediolateral episiotomy. Similarly, the rate with forceps delivery and no episiotomy was 22.7% (168/739) vs. 2.6% with episiotomy (173/6657) (RR 0.1). Rates in this study are so much higher with no episiotomy (23% vs. 5-14% with forceps; 9.5% vs. 2-5.5% with vacuum) and so much lower with forceps and episiotomy (2.5% vs. 9-12%) than the other European studies that it suggests that results cannot be generalized.

14. Fundal pressure is both ineffective and harmful.

We have extraordinarily little data on fundal pressure, none of it supportive of its safety or effectiveness. The only study to evaluate effectiveness is a Turkish RCT.¶[97] All participants (94 routine fundal pressure, 103 controls) were 37-42 w gestation with a singleton, cephalic fetus and free of obstetric or medical problems. No woman had an epidural, and oxytocin infusions were stopped at onset of second stage (full dilation with spontaneous urge to push). A care provider applied fundal pressure during each contraction from the onset of second stage until delivery of the fetal head, using a forearm to press at a 30-45 degree angle toward the woman's pelvis. Mean lengths of second stage were similar overall (17 min in both groups), among nulliparous women (fundal pressure 19 ± 10 min vs. control group 23 ± 12 min), and among multiparous women (fundal pressure 14 ± 9 min vs. control group 15 ± 9 min). One woman in each group had a cesarean section, and one woman in the fundal pressure group had vacuum extraction for fetal distress. Mean cord blood pO2 levels were lower and mean pCO2 levels higher in the fundal pressure group, but no baby had a pH less than 7.2. The blood oxygenation deficit with fundal pressure raises the possibility that a compromised infant might not be able to tolerate the additional stress imposed by fundal pressure. No further information is given on maternal or neonatal morbidity other than to state that rates were similar. The study was powered to detect a difference in second stage length of ≥ 5 min but underpowered to detect differences in uncommon but serious adverse outcomes.

Four retrospective cohort studies and two case-control studies reported excess harms associated with fundal pressure. Four of the six evaluated anal sphincter injury. Investigators in the case-control study asked nurses to record births at which fundal pressure was performed.[25] They reported 34 cases (of which 14 were not documented in the medical records). Cases were matched with 34 control women who also had spontaneous vaginal births but without fundal pressure. Sixteen women in each group had median episiotomies; 10 of the women having episiotomy had anal sphincter tears in the fundal pressure group vs. 1 woman in the control group. One retrospective study evaluated risk factors associated with anal sphincter tears in a population of 845 women, of whom 54 (6.4%) had anal injury.[100] Fundal pressure was independently and strongly associated with sphincter injury (OR 4.6). Anal sphincter tear rates could be calculated from the data: 20.7% having fundal pressure vs. 3.4% no fundal pressure. A second retrospective study examined the relationships among fundal pressure, vacuum extraction, and episiotomy (type not reported) and anal injury in 661 Japanese women birthing vaginally of whom 39 had fundal pressure.[60] Among the 32 women with anal injury, 28% had fundal pressure vs. 4% of women not

¶ We included it for this reason, although we normally exclude studies in developing countries because results may not be comparable to those in resource-rich countries.

having fundal pressure (OR 7.8). Episiotomy (OR 6.5) and vacuum extraction (OR 7.0) in combination with fundal pressure increased the risk over fundal pressure alone (OR 2.7). A third retrospective study looked for associations with anal sphincter tear in 238,503 women having spontaneous vaginal births and 46,280 women having instrumental vaginal delivery.[29] The addition of fundal pressure increased risk of anal sphincter injury with spontaneous birth (2.1% vs. 1.7%) and forceps delivery (5.2% vs. 4.7%), although not, oddly enough, with vacuum extraction.

The fifth study, also retrospective, evaluated factors associated with brachial plexus injury during vacuum extraction in 13,716 women.[62] Fundal pressure was an independent risk factor (OR 1.6) for brachial plexus injury (1.7% with fundal pressure vs. 0.8% no fundal pressure) after adjustment for shoulder dystocia, birth weight > 3999 g, multiparity, indication for vacuum delivery, fetal head at ischial spines, number of tractions ≥ 5, vacuum application time, silicone cup, and epidural analgesia. Study authors theorized that fundal pressure may impact the anterior shoulder behind the pubic bone.

The sixth study, the other case-control study, compared rates of painful intercourse (dyspareunia) 12-18 months postpartum in 110 primiparous women who had had mediolateral episiotomy (cases) with 96 similar women who did not (controls).[36] Women with anal sphincter injury were excluded. Fundal pressure was independently associated with painful intercourse. Nineteen of the 55 women (35%) with dyspareunia had experienced fundal pressure compared with 10 of the 143 women (13%) free of dyspareunia (OR 2.7).

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Episiotomy: The Unkindest Cut

"An episiotomy is a controlled, straight clean cut that's better than a tear or rip that could go in many directions, including tearing or ripping into the bladder, large blood vessels or rectum. An episiotomy also heals better than a ragged tear. . . . Others suggest an episiotomy to avoid stretching the vagina, bladder, and rectum."

Curtis and Schuler 2004, p. 342-3[17]

"Like any surgical procedure, episiotomy carries a number of risks: excessive blood loss, haematoma formation, and infection. . . . There is no evidence . . . that routine episiotomy reduces the risk of severe perineal trauma, improves perineal healing, prevents fetal trauma or reduces the risk of urinary stress incontinence."

Sleep, Roberts, and Chalmers 1989, p. 230[67]

The Two Types of Episiotomy:
Episiotomies come in two varieties: median, also called midline, the type usual in the U.S. and Canada, in which the cut is made straight towards the anus, and mediolateral, the type usual in most of the rest of the world, in which the cut is angled off the midline. Study results of one type cannot be generalized to the other because, as the mini-reviews will make clear, the two types disrupt different tissues and have different complication profiles.

The 2004 publication date of our opening quotation is not a typo. Despite decades of evidence discrediting every justification given for prophylactic episiotomy and documenting its harms, a popular book written by an obstetrician still lists a litany of supposed benefits as if they were established facts. Nor is this the only contemporary example of ignoring the evidence. A 2004 German randomized controlled trial (RCT) allocated nulliparous women to groups in which doctors could perform episiotomy for "imminent tear" or only for "fetal indication."[21] Three-quarters of the "imminent tear" group had episiotomies as did more than one-third of the women in the "fetal indication" group. Trialists never questioned that so many women required surgical enlargement of their vaginas to ensure a healthy baby or avert an anal laceration. British investigators in a 2006 study of

primiparous women—two-thirds of whom had an episiotomy—found that mediolateral episiotomy increased likelihood of anal sphincter injury, which occurred in one in four women.[4] They concluded that cutting episiotomies at a wider angle from the midline might reduce this rate, it apparently never occurring to them that not cutting them at all would do just as well or better. And Brazilian investigators defended the ethics of conducting a 2008 RCT of median episiotomy in nulliparous women on grounds that Brazilian obstetricians continued to perform them in 50-60% of this population in defiance of the evidence.[62] The investigators hoped to demonstrate the error of this, which, of course, they did.

True, we have made progress. The U.S. national episiotomy rate in women birthing vaginally was 25% in 2004,[34] down from most women having episiotomies regardless of parity a few decades earlier. But a 2005 systematic review concluded that episiotomy rates could safely be less than 1 in 10,[39] and a U.S. university hospital reported a rate of less than 1 in 100.[2] Episiotomy remains so accepted as a "normal" part of labor management that it is the only surgical procedure for which permission rarely is sought. A survey of U.S. women giving birth in 2005 reported that three out of four women who had episiotomies were not asked for their consent.[25]

That episiotomy is ineffective and harmful is almost certainly old news to readers of this book, but because it is still relatively common, we must know its history, the arguments against it—evidentiary and otherwise—and the reasons why episiotomy has not all but disappeared by now if we want it to continue its decline.

THE CASE AGAINST EPISIOTOMY

We do not need research to demolish the rationales for prophylactic episiotomy. Logic alone will do the job: How can episiotomy protect the perineum from injury by slicing through perineal skin, connective tissue, and muscle? And anyone who has ever snipped fabric in order to tear off a length knows that cutting the perineum is the *last* thing you would want to do if you wanted to prevent an extension into the anus. As for cutting an episiotomy to avoid "imminent" tears, no one can predict that an episiotomy will do less damage than the tear that might—or might not—have happened. Episiotomy is supposed to preserve pelvic floor function by forestalling over-distension of the pelvic floor muscles, but it is not done until the head is crowning, by which time the pelvic floor muscles are already fully distended. Nor has anyone ever explained how cutting muscles and stitching them back together preserves their strength. In any case, most older women currently having repair surgery for incontinence or prolapse had episiotomies, so clearly the strategy did not work. Surely women with no or only a minor perineal wound must fare best with respect to muscle strength, pain, blood loss, problems with dyspareunia (pain during sexual intercourse), and complications such as infection or poor repair, but by definition, every woman having an episiotomy will have at

least the equivalent of a second-degree perineal tear and probably more: a study found that episiotomies were much longer than the typical spontaneous tear even after excluding anal extensions from analysis.[52] Finally, another major justification is that episiotomies are easier to repair. Even if this were true, convenience is a benefit reaped by the care provider and, as such, should form no part of an argument for performing surgery.

Grades of Perineal Injury[11]

- First degree involves skin and vaginal mucous membrane but not perineal fascia or muscle.
- Second degree involves skin and perineal muscle.
- Third degree involves tears into the anal sphincter.
- Fourth degree involves tears through the anal sphincter (p. 2).

Third- and fourth-degree tears often are combined into the single category "anal sphincter laceration" or "injury," which we will do as well.

The supposed fetal benefits make no sense either. By shortening second stage, episiotomy is alleged to curtail the accumulating effects of oxygen deprivation during pushing. Leaving aside the iatrogenic effects of unphysiologic positions and pushing techniques on fetal oxygenation, episiotomy cannot possibly reduce second-stage duration by more than a few minutes because it is done at crowning. Perhaps the most absurd rationale of all is preventing brain damage from the fetal head's "pounding on the perineum," a phrase used by Joseph DeLee in 1920 and repeated down through the decades.[26] A woman's perineum is soft, elastic tissue. "Pounding" on it is about as harmful as bouncing on a trampoline.

As with prophylactic use, rationales for performing "indicated" episiotomies likewise don't hold water. Vacuum extraction? Why would vacuum extraction require an episiotomy any more than spontaneous birth? Forceps delivery? Forceps predispose to anal tears; why increase the probability with an initiating snip? Shoulder dystocia? Shoulder dystocia is not a soft tissue problem; episiotomy could have no effect. Granted, logic alone will not tell us whether nulliparous women are more likely to require an episiotomy, but a U.S. home birth study reported a mere 2% rate versus 1% in parous women.[51] Perhaps the only valid justification for episiotomy is sudden fetal distress late in second stage, but as the German trial above illustrates, this is liable to abuse, and even in true cases, when the birth is close, delivery often may be effected rapidly just by forceful pushing. All episiotomy will accomplish—at least median episiotomy—is increased likelihood of anal sphincter injury.

Even the idea of conducting RCTs of episiotomy flunks the logic test. The underlying assumption is that episiotomy is normal and *not* intervening has to prove itself. How else could one justify randomly allocating healthy women to a surgical procedure? In a rational universe, observational studies alone should have been enough to discredit it.

That said, 40 years of research fails to support any of the claims made for episiotomy. Episiotomy does not prevent anal tears; median episiotomy provokes them, and mediolateral episiotomy may as well. (See mini-reviews 1 and 2.) In fact, nonextending median episiotomy at the first birth predisposes to increased spontaneous tearing, including anal sphincter tears, at the next birth. Episiotomy increases the risk of anal incontinence. (See mini-review 6.) Episiotomy does not preserve pelvic floor strength, and mediolateral episiotomy may decrease it. (See mini-review 6.) Episiotomy does not hurt less or heal better; the opposite is true. (See mini-reviews 4 and 5.) Far from improving sexual functioning, episiotomy increases the likelihood of painful intercourse. (See mini-review 7.) Episiotomy has no effect on neonatal outcomes either. (See mini-review 3.) Episiotomy neither prevents nor relieves shoulder dystocia, nor does it improve neonatal outcomes with shoulder dystocia, and median episiotomy with shoulder dystocia is a disaster for the woman's anal sphincter. (See mini-review 8.) Finally, women are more likely to experience anal injury with instrumental vaginal delivery when they have median episiotomies, and the jury is still out on whether mediolateral episiotomy is harmful, neutral, or protective. (See chapter 14.)

WHAT DO OBSTETRICIANS KNOW AND WHEN DID THEY KNOW IT?

As the nineteenth century drew to a close, a few upstart doctors (obstetrics as a specialty did not yet exist) in the U.S., eager to take a more active hand in managing labor, began clamoring for greater use of episiotomy, claiming that it would prevent lacerations, shorten labor, diminish pain, and protect against fetal brain damage.[35] They made little headway, however. They were early in their careers and lacked the authority to sway opinion in the face of opposition by more eminent doctors who persisted in the old-fashioned notion that childbirth was a normal process best left alone. "Am I to believe," wrote one of the latter, "that nature, after making such admirable provision for the earlier stages of labour, bungles matters to such an extent at the end, as to render the aid of the obstetrician in every case necessary to remedy a mechanical deficiency?" (p. 28).[35]

Physicians had practical as well as philosophical reasons for rejecting episiotomy. In that era, doctors still competed with midwives for obstetric cases, and it would have been unwise to risk alienating their customer base. Stated one doctor: "Most patients will forgive a doctor for almost any degree of laceration if he explains the conditions that caused it and makes an honest attempt at repair, but very few of them fail to be critical of an episiotomy that fails to heal readily" (p. 30).[35]

The twentieth century saw a sea change, as prominent physicians espousing the pathologic view of childbirth took up the episiotomy crusade. Joseph DeLee, the best known of prophylactic episiotomy's champions, articulated the platform of the pro-episiotomy movement in 1920 in the inaugural issue of the *American Journal of Obstetrics and Gynecology*.

> Labor has been called, and still is believed by many, to be a normal function. . . . [Y]et it is a decidedly pathologic process. . . . If a woman falls on a pitchfork, and drives the handle through her perineum, we call that pathologic—abnormal, but if a large baby is driven through the pelvic floor, we say that is natural, and therefore normal. If a baby were to have its head caught in a door very lightly, but enough to cause cerebral hemorrhage, we would say that it is decidedly pathologic, but when a baby's head is crushed against a tight pelvic floor, and a hemorrhage in the brain kills it, we call this normal (p. 39-40).[26]

DeLee's solution: once the head passes through the dilated cervix, anesthetize the woman with ether, cut a large mediolateral episiotomy, pull the baby out with forceps, and manually remove the placenta, then give the woman scopolamine and morphine for the lengthy repair work and to "prolong narcosis for many hours postpartum and to abolish the memory of labor" (p. 35).[26] Repair involved pulling down the cervix with forceps to examine it, stitching any tears, and laboriously reconstructing the vagina to restore "virginal conditions." DeLee made episiotomy the centerpiece of a package of interventions that converted birth from a natural process unfolding in women into a surgical procedure conducted by physicians. DeLee dismissed concerns raised by the physiologic birth camp about the dangers of infection in the wound and brain injury from forceps deliveries. The former, he said, would not be a problem unless the woman was already infected, and in skillful hands, the risks of the latter were nil.

DeLee admitted he lacked evidence for the benefits of his recommendations, adding that he believed he probably would be able to produce some eventually, but at the same time he disparaged statistics as a basis for forming judgments.[35] The ensuing years saw no emergence of evidence to support episiotomy from DeLee or anyone else. As the use of episiotomy grew throughout the 1930s, none of its proponents saw the need for any justification of its use beyond their expert opinions. By the end of the 1930s, the debate was over. The episiotomy enthusiasts had won.

This state of affairs persisted until the late 1970s. At that time, birth activists and midwives began to question episiotomy—the subtitle of this chapter is the title of the earliest professional article[13]—but to little effect.[35] In the early 1980s, an exhaustive review of the research was published that should have been harder to ignore. Thacker and Banta (1983) reviewed more than 350 articles, reports, and book chapters published between 1860 and 1980 and found no viable evidence

that episiotomy prevented tears into the rectum, damage to the pelvic wall, or trauma to the fetal head, or that episiotomies were easier to repair than tears.[70] They also reported that its harms included extension of the incision, excess blood loss, dyspareunia, excess pain, poor healing, and infection, including *fatal* infection. Other studies and reviews followed, including the first RCT of restricted versus liberal use of mediolateral episiotomy, published in 1984, and its follow-up published three years later.[68, 69] By 1990, a sizeable body of literature had accumulated, none of it favorable to the frequent, let alone routine, use of episiotomy.

We can track the impact of the episiotomy research on the obstetric community through successive textbook editions, which are, as Graham (1997) observes, repositories of conventional wisdom.[35] Starting before much had been heard from the anti-episiotomy movement, the 1980 edition of *Williams Obstetrics* states that episiotomy "substitutes a straight, clean surgical incision for the ragged laceration that otherwise frequently results," is "easier to repair and heals better," and "spares the baby's head the necessity of serving as a battering ram against perineal obstruction," going on to explain that, "if prolonged, the poundings of the infant's head against the perineum may cause brain injury" (p. 323).[70]

The subsequent publication of reviews and the RCT changed little. The 1985 edition of *Williams* dropped the "battering ram/brain injury" rationale but not the assertion that episiotomy was easier to repair and healed better than a tear.[57] The *Williams* editors dismissed the massive Thacker and Banta review and countered that fewer women were experiencing pelvic floor complications since episiotomy had become the norm. They provided no sources, finding it sufficient merely to state that "the reasons for [episiotomy's] popularity are clear" (p. 347).

The 1989 edition of *Williams Obstetrics* admitted that the reduction in pelvic floor complications was "unproved" (p. 323) and added a paragraph summarizing the counterclaims of the research evidence.[15] This was strictly for show and not meant to guide practice, as it was followed by a paragraph listing "important" (p. 323) questions about episiotomy, all of which had to do with when and how episiotomy should be performed, not whether it should be done at all.

By the early 1990s, the evidence against episiotomy was indisputable. This was irrelevant, though, because episiotomy use was not based on science but was the behavioral expression of an underlying belief system. This can be seen in an RCT of median episiotomy. (See text box "The Power of Myth: The North American RCT of Median Episiotomy.) The investigators found that participating physicians who self-reported viewing episiotomy favorably were more likely to withhold their patients from the trial, most often for "fetal distress," and to perform episiotomies in the restricted arm usually for "perineum not distensible" or "about to tear."[41] They were also more likely to augment labor with oxytocin, to deliver women in the lithotomy position, and to perform cesareans.

The Power of Myth: The North American RCT of Median Episiotomy

The first and, until 2008, only RCT of median episiotomy was not published until 1992. Although observational research had begun refuting the justifications for episiotomy years earlier, the trial investigators encountered resistance from the obstetric establishment in mounting, carrying out, and publishing the trial.[41] First came obtaining funding, which opponents argued was unwarranted. Wrote one reviewer, "The research questions are not relevant to clinical practice and the answers will not likely provide assistance in practice. . . . It is not a significant health problem" (p. 484-5). Then the trial was severely compromised by clinician bias. Participating doctors would not limit their use of episiotomy. More than half of nulliparous women in the restricted group (57%) still had episiotomies, as did nearly one-third of parous women (31%).[42] Because RCT data is analyzed according to "intent to treat" (participants are kept with their original group regardless of actual treatment), the trial failed to show a statistically significant increase in anal sphincter lacerations with median episiotomy. In point of fact, 52 out of the 53 anal sphincter tears were preceded by an episiotomy. Publication was the final hurdle.[41] The *New England Journal of Medicine* rejected the paper out of hand, saying it belonged in a specialty publication. *JAMA* rejected it too, one criticism being that the investigators had a bias against episiotomy. Eventually, the trial was published in the *Online Journal of Current Clinical Trials*. Unfortunately, though, the large degree of protocol violation allowed only the weak conclusion that median episiotomy did not prevent anal sphincter lacerations, not the truth, which is that it causes them.

As the 1990s advanced, evidence-based practice gained traction. The U.S. episiotomy rate declined from 56% of vaginally birthing women in 1990 to 33% in 2000.[43] Yet, because episiotomy use depended on entrenched beliefs, the decline did not occur across the board. For example, episiotomy rates in primiparous women having spontaneous births between 1994 and 1998 at 18 Philadelphia hospitals ranged from 20% to 73%.[71]

In light of the overwhelming evidence, the 1997 edition of *Williams* somewhat tempered its recommendation: "It seems reasonable to conclude that episiotomy should not be performed routinely" (p. 342-3).[16] Nevertheless, it continued to assert the benefits of a "surgical incision" over a "ragged laceration" and listed unsupported indications, including "instances where it is obvious that failure to perform an episiotomy will result in perineal rupture" (p. 342-3), essentially giving obstetricians carte blanche. German obstetricians in the trial mentioned earlier thought impending perineal rupture was "obvious" in 77% of first-time mothers.

By 2005, an extensive systematic review published in *JAMA* concluded:

> The time has come to take on the professional responsibility of setting and achieving goals for reducing episiotomy use. . . . [C]linicians must attend to aligning research evidence and episiotomy use. . . . The goals for quality of care must remain focused on both optimizing safety for the infant and minimizing harm to the mother. Given that focus, clinicians have the opportunity to forestall approximately 1 million episiotomies each year that are not improving outcomes for mothers (p. 2147).[39]

That same year, a new edition of *Williams Obstetrics* still asserted that the repair of perineal tears was "often less satisfactory because of the irregular lines of tissue cleavage."[14] And while acknowledging that episiotomy increases the incidence of anal lacerations and that it neither hurts less nor heals better, the new edition states as "unproven"—not disproved—that episiotomy prevents pelvic floor relaxation. Like the 1997 edition, it finds it "reasonable" not to perform episiotomy routinely, but includes imminent anal tear as an appropriate indication.

Published the following year, the American Congress of Obstetricians and Gynecologists' (ACOG) Practice Bulletin on episiotomy took a similar tack.[1] After summarizing the research that dismantles the rationales for episiotomy, it concluded with this tepid recommendation, which, like *Williams Obstetrics,* contradicted the research presented immediately before it: "The best available data do not support liberal or routine use of episiotomy. Nonetheless, there is a place for episiotomy for maternal or fetal indications, such as avoiding severe maternal lacerations or facilitating or expediting difficult deliveries" (p. 4). ACOG's literature review omits the German RCT, published two years earlier, which looked at the effects of performing episiotomy for "imminent tear" and found that it did not improve perineal outcomes.[21] We cannot help thinking that ACOG omitted it because it would have closed the loophole that permits obstetricians to perform episiotomies at will.

WHY HASN'T EPISIOTOMY WITHERED AWAY?

The persistence of episiotomy over the decades in the face of science, logic, and common sense tells us that other, more powerful, drivers are in play. Foremost among these was the shift from thinking of childbirth as a normal, physiologic process to one fraught with potential for pathology, which we saw exemplified in DeLee's quotation. This belief became the conceptual underpinning for the differentiation of obstetrics into a surgical specialty, a conversion that elevated the status of obstetricians by distinguishing them from general practitioners and distancing obstetrics from midwifery.[35, 55] By transforming birth into a surgical procedure, episiotomy embodied the foundational obstetric belief that mothers and babies

needed obstetricians to protect them from the ravages of the natural process. As Davis-Floyd (1992) puts it, with episiotomy, the obstetrician, by his skills, safely delivers the baby from the inherently defective female "birth machine" (p. 52).[23] Considered as ritual, Davis-Floyd writes, episiotomy inculcates the cultural values of the supremacy of technology over nature and, until the latter part of the twentieth century when female obstetricians became common, of male over female.

Converting birth by the mother into delivery by the doctor conveyed other meanings as well. With episiotomy, the physician takes control, determining when the delivery will occur and the nature and location of any perineal wound.[35] Davis-Floyd (1992) explains that episiotomy thereby reinforces that it is the obstetrician, not the mother, who delivers the baby to the community, the community being symbolized by the nurse, who receives the baby from his hands.[23]

Episiotomy also fit in with the assembly-line hospital model of childbirth, itself a reflection of a technology-oriented processing mentality.[35] Hospital-based physicians caring for several women simultaneously could literally cut labor short and make the timing of delivery predictable, allowing them to move on to the next patient. Davis-Floyd (1992) notes too that episiotomy reinforces the cultural messages of the assembly-line model in which the female "birth-machines" are subjected to the same routines and where time-efficient production is of paramount importance.[23]

Deeper motivations lurk in the implications of DeLee's statement about restoring "virginal conditions." Episiotomy desexualizes birth by transforming it into a surgical procedure in which the obstetrician deconstructs and reconstructs the vagina, imposing male control over the "cross-cultural symbol par excellence of the natural, powerfully sexual, creative, and male-threatening aspects of women" (p. 129).*[23] At the same time, the point of restoring virginal conditions is to promote male sexual pleasure, hence the once-popular "husband's knot," an extra tightening during suturing that made many women's sex lives a permanent misery. With these powerful forces behind episiotomy, we should not be surprised that rationality and science would not be able to counteract them.

THE "CUT ABOVE": DÉJÀ VU ALL OVER AGAIN?

Understanding the history of and the forces behind episiotomy enlightens us on another front: the push for primary elective cesarean, for the parallels are striking:

- Both convert normal birth into surgical procedures, which confers the symbolic and ritual advantages discussed in the previous section, all of which are intensified with cesarean surgery.
- Both start from the covert assumption that the physiologic process is on trial, not the intervention. Calls for randomly assigning healthy women

* This aspect of episiotomy also may apply to some women obstetricians. Women in predominantly male professions may "out male the males" in order to be accepted or simply because sharing a common mindset was what led them to choose that profession in the first place.

to a surgical procedure, as the 2006 National Institutes of Health State-of-the-Science Conference statement "Cesarean Delivery on Maternal Request" did,[53] whether cesarean or episiotomy, would instantly be recognized as unethical if this were not so.

- The rationales for both are identical. Both are claimed to prevent pelvic floor dysfunction, to protect the fetus, and to be less painful, more controlled, and more convenient.
- Both are intended to preserve the vagina for male sexual pleasure, one by returning it to its prebirth status, the other by bypassing it altogether.
- Both allow predictable, efficient processing through an assembly line, planned cesarean surgery much more so than episiotomy.
- Both movements began with a few extremist practitioners making what were, at the time, radical proposals. The initial call for universal elective cesarean surgery, "Prophylactic cesarean at term?", appeared in the *New England Journal of Medicine* in 1985."[31] It may be no coincidence that it appeared only two years after Thacker and Banta's review dealt the first heavy blow to the foundations of episiotomy. Like episiotomy, the concept gradually gathered momentum because it fit the obstetric belief system, first gaining the allegiance of prominent obstetricians and eventually spreading to the mainstream.
- Both distinguish obstetricians from their economic competitors, midwives and most family practitioners (some perform cesareans), a distinction lost once midwives were allowed to cut episiotomies.
- In both cases, enthusiasts cling to their beliefs despite logic and strong, consistent evidence to the contrary. (See chapters 4 and 5.)
- In both cases, proponents shoot the messenger. The NIH "cesarean at maternal request" conference statement characterizes the solid body of evidence affirming that no benefits are gained from a cesarean surgery rate greater than 15% in a mixed-parity, mixed-risk population as "some authors" making "artificial declarations of an ideal rate," a practice that "should be discouraged" (p. 4).[53]

There are, however, two important differences: First, unlike episiotomy, obstetricians had to sell elective cesarean surgery to the public as well as their colleagues. Once obstetricians moved childbirth out of women's homes and into the hospital, they were free to do as they liked with little fear of protest or lost business, an anxiety of the previous generation of obstetricians who had attended women at home. The women's movement, which emphasized gender equality and control over one's body, changed all that. Women became increasingly vocal in the 1970s and 1980s about not having their genitals cut and much less inclined to accept their obstetrician's explanations for doing it. This opposition spurred the reviews and studies of the 1980s and early 1990s that ultimately discredited

episiotomy. With elective cesarean surgery, obstetricians have been careful to frame the issue as one of women's preference despite evidence contradicting this, hence, for example, the use of "maternal request" cesarean instead of "elective" cesarean. Second, instigating elective cesarean surgery on the basis of expert opinion alone, as was done with episiotomy, would not fly in the modern age of evidence-based medicine. Pro-cesarean apologists have been obliged to spin the evidence so that the risks of elective surgery and planned vaginal birth appear equivalent or even that elective surgery has the edge. (See chapter 4.)

At stake is a belief system that sustains the hegemony of the medical model of childbirth, a model that enables obstetricians to reap political and economic rewards. A challenge to an intervention so deep-rooted and carrying such symbolic weight becomes a challenge to the system itself. Once this is understood, it makes perfect sense that the rise of episiotomy and elective cesarean surgery should follow the same trajectory, that neither practice can be defended on the basis of reason or science, that challenges would be met with fierce resistance, that when the evidence against episiotomy became overwhelming, the arguments made for it would be transferred to cesarean surgery, and that cesarean rates would rise as episiotomy rates fell. Episiotomy *had* to be replaced by something. To admit that the principles behind it were wrong would be to admit that the philosophy behind the obstetric model was wrong.

If care were truly determined by what is best for mother and child, episiotomy long since would have been relegated to the trash heap of useless medical procedures. That episiotomy is still common enough that we needed to write this chapter says little to the credit of the obstetric profession. That the history of episiotomy is being recapitulated and the same specious arguments resurrected to promote elective cesarean surgery says even less. This campaign to maintain obstetric hegemony is far from bloodless. The wounds sustained by its casualties are all too real.

STRATEGIES FOR OPTIMAL CARE

- Engage in practices and policies that promote intact perineum. (See chapter 13.)
- Limit use of episiotomy to extraordinary circumstances.
- Refrain from episiotomy during vacuum extractions and forceps deliveries. (See chapter 14.)
- Do not use episiotomy to prevent or routinely treat shoulder dystocia. If the need for fetal manipulation makes episiotomy necessary, mediolateral episiotomy is less likely to extend into the anal sphincter than median episiotomy.
- Do not perform median episiotomy in women with prior anal sphincter injury. While many obstetricians recommend prophylactic cesarean for subsequent deliveries after anal sphincter injury to prevent the supposedly high rate of repeat injury and its attendant risk of anal incontinence, there is no excess risk in the absence of repeat episiotomy. (See mini-review 9.)

MINI-REVIEWS

Notes:

- The RCT design makes it difficult to determine the episiotomy's effects. RCTs analyze data according to "intent to treat"—that is, they keep participants with their assigned group regardless of treatment because to do otherwise would defeat the purpose of random assignment. However, substantial percentages of women in the episiotomy trials received the treatment of the other group (crossover). This made the groups more alike, diminishing the trials' ability to detect differences between them, a problem that carries over into systematic reviews of RCTs. Protocol deviation in RCTs is normally uncommon because it usually arises mostly from factors inherent to participants or events occurring during treatment, but episiotomy rates depend almost entirely on practice variation, which varies enormously. For this reason, while we report systematic review outcomes, we concentrate on observational studies and secondary analyses of RCTs that report outcomes according to actual treatment.
- We confine the mini-reviews to outcomes affecting quality of life in the short term (pain, pain during coitus, poor healing) or with morbid potential after healing is complete (anal sphincter injury, urinary or anal incontinence, sexual dysfunction), which we define as post six months postpartum.
- We excluded observational studies that failed to account for at least some of the confounding and correlating factors, but even those we included have systemic weaknesses, such as
  - » inability to capture pertinent confounding factors such as pushing position and technique, birth position, and perineal management at birth,
  - » failure to report frequency or severity of incontinence, which makes clinical significance unclear,
  - » overrepresentation of morbidity in postpartum symptom surveys because symptomatic women are more likely to respond (response bias).
- Many studies do not specify episiotomy type. Unless the study states otherwise, we assume that studies conducted in Europe or Australia are of mediolateral episiotomy and that studies conducted in the U.S. or Canada are of median episiotomy because those are the norms.
- Assume differences are statistically significant unless otherwise noted.

1. Median episiotomy predisposes to anal sphincter laceration, but studies conflict on whether mediolateral episiotomy increases risk or has no effect.

Note: Women who do not have an episiotomy are more prone to anterior trauma, but this does not appear to have morbid consequences.

A systematic review of RCTs of liberal vs. restrictive use of episiotomy reported a small decrease (1.0% vs. 2.0%) in rates of anal sphincter laceration (5 trials, 3261 women) with restrictive use of mediolateral episiotomy (RR 0.6);[11] however, in the largest trial—2606 women vs. ≤ 100 in the other four—30% of women assigned to restrictive use had episiotomies and 19% of women assigned to liberal use did not. If mediolateral episiotomy predisposes to anal sphincter injury, this crossover would diminish differences between groups, which means true differences might be greater. The same five trials also reported on rates in primiparous women (n = 2143), finding a similarly small difference (1.2% vs. 2.4%) favoring restrictive use (RR 0.5), just missing achieving statistical significance (CI 0.3 – 1.0). Rates of anal sphincter laceration with median episiotomy (2 trials, 1143 women) did not differ significantly, though crossover rates in one of the trials were extraordinarily high: 44% of the restricted use group had episiotomies and 35% of the liberal use group did not, which resulted in virtually identical anal sphincter injury rates. In the other trial, all women assigned to liberal use had episiotomies, as did 24% of the restricted group. This trial found that restrictive use of episiotomy halved the risk (RR 0.5) of anal sphincter injury (7% vs. 14%). The meta-analysis in primiparous women (n = 801) followed the same pattern. Both median episiotomy trials also reported outcomes according to actual treatment. In the former, 52/53 anal sphincter lacerations were preceded by an episiotomy,[42] while in the latter, 13/15 anal sphincter lacerations were episiotomy extensions.[62]

Of 12 observational studies of median episiotomy that adjusted for correlating factors,[5, 8, 12, 24, 27, 32, 33, 37, 38, 44, 61, 65] all but two found an increased risk of anal sphincter laceration with episiotomy.[24, 38] One of the exceptions analyzed factors associated with anal sphincter injury using a California database of over 2 million vaginal births. It reported that episiotomy as an independent factor reduced risk by 10%. The authors suggest the reason for this anomalous protective effect may be that clinicians avoid episiotomy in women thought to be at high risk for anal injury or because episiotomy may be less likely to be recorded in instances of anal injury. In the other exception, only 1% of the women having episiotomies had median episiotomies.[24] The circumstances under which clinicians performed median episiotomy might have biased results in ways not captured in the adjustment process.

In addition, a study (N = 6052) found that median episiotomy at first birth predisposed to spontaneous laceration, including anal sphincter laceration, at second birth.[3] Half the cohort (48%) had nonextending episiotomy at first birth and none of whom had episiotomy at second birth. After controlling for confounding factors, more women with episiotomy at first birth had second-degree (51% vs. 27%, OR 4.5) or anal sphincter tears (5% vs. 2%, OR 5.3).

None of the RCTs of mediolateral episiotomy report data according to actual treatment, and looking at observational studies, data conflict. Among 16 studies reporting the

association between mediolateral episiotomy and anal tears and accounting for factors such as instrumental vaginal delivery and parity, five found that mediolateral episiotomy increased the risk of anal injury,[4, 5, 9, 50, 61] one found a trend toward increased risk that fell just short of statistical significance,[40] five found that it had no effect,[8, 18, 32, 63, 64] one found that it decreased risk in primiparous women and increased it in multiparous women,[59] one found that it decreased risk in primiparous women and had no effect in multiparous women,[56] and three found that it decreased risk overall.[6, 24, 60] Looking at these 16 studies as a group, it seems probable that mediolateral episiotomy, too, increases risk of anal tears to some degree or is neutral. Even where it appears to be protective, the absolute decrease is small: 1% in two of the studies reporting a decrease in overall anal injury[6, 24] (the third study does not provide data from which absolute differences can be calculated[60]) and the difference is 0.5% in the study reporting a decrease in primiparous women.[59]

2. Performing episiotomy for "imminent tear" does not decrease anal sphincter injury rates.

Two studies of mediolateral episiotomy found that performing an episiotomy for "imminent tear" did not reduce the likelihood of anal sphincter laceration. An RCT compared groups in which episiotomy could be performed for fetal distress only (41% episiotomy rate) or for either fetal distress or imminent tear (77% episiotomy rate).[21] Five anal tears occurred in the imminent tear group (8%) vs. two in the fetal distress only group (4%), although this difference did not achieve statistical significance. In the imminent tear group, only 10% of women had an intact perineum vs. 29% of the fetal distress only group. An observational study reported similar anal laceration rates in women having episiotomy for imminent tear (3.9%) compared with all women having episiotomy (3.2%).[45]

An RCT of routine vs. selective use of median episiotomy also found that performing an episiotomy for imminent tear failed to prevent anal sphincter laceration.†[62] Episiotomy could be performed in the selective group for imminent tear, fetal distress, or forceps delivery. Fifty-four of 222 women (24%) had an episiotomy in the selective group, of which 46 (85%) were for imminent tear, while all 223 women in the routine episiotomy group had episiotomies. Fourteen percent of the routine group vs. 7% of the selective group ("intent to treat") had anal sphincter injury. Thirteen of 15 anal sphincter tears (87%) (actual treatment) were preceded by an episiotomy.

3. Episiotomy has no effect on neonatal outcomes.

The systematic review of restrictive vs. liberal use of episiotomy reports identical rates (3.8% vs. 3.9%) of babies born in poor condition (1 min Apgar < 7) (4 trials, 3908 women) and similar rates (3.0% vs. 4.0%) of babies admitted to special care units (3 trials, 1898 women).[11] It could be argued that if episiotomy is protective, the high crossover rates found in the trials might diminish differences between groups, but this seems unlikely in view of the small absolute differences between them.

† The trial was carried out in a developing country, but it was in an academic tertiary care center and is the only study providing data on median episiotomy for imminent tear.

4. Episiotomy causes more pain in the postpartum period than spontaneous tears.

Single trials of mediolateral episiotomy report various pain outcomes in the systematic review of restrictive vs. liberal use.[11] They include moderate to severe pain at 3 d (165 women; 18% assigned to restricted use had episiotomy, 31% assigned to liberal use did not); any perineal pain at discharge (2422 women; 30% assigned to restricted use had episiotomy, 19% assigned to liberal use did not); and one trial reporting on any perineal pain at 10 d, moderate/severe pain at 10 d, any perineal pain at 3 months, and moderate/severe perineal pain at 3 months (895 women; 10% assigned to restricted use had episiotomy, 49% assigned to liberal use did not). The only significant difference was reported for perineal pain at discharge (31% restricted vs. 43% liberal, RR 0.7). Differences in another trial for moderate/severe pain at 3 d might have achieved significance with more participants (32% restricted vs. 45% liberal, RR 0.7 CI 0.5 – 1.1).

Because of substantial crossover between groups in the trials, observational studies reporting according to actual treatment will be more useful in determining effects of episiotomy. A study of 447 women looked at the relationship between perineal trauma and pain.[46] Most women having episiotomies (91 of 109) had median episiotomies. After adjustment for instrumental vaginal delivery and other factors, women with spontaneous tears, episiotomies, and anal injury were all more likely (95-100% vs. 75%, RR 1.3) to experience pain on day 1 vs. women with no trauma. On day 7, women with tears (60%, RR 1.5) or episiotomy (71%, RR 1.6) were more likely to experience pain than women with intact perineums (38%), and women with anal laceration were most likely (91%, RR 2.1) to do so. At 6 w, only 5% of participants had been lost to follow-up. Differences were no longer statistically significant, but the same pattern persisted (4% tear, 13%, episiotomy, 20% anal sphincter injury vs. 0% intact perineum). When asked at 6 w when all pain had ceased, mean times were 1.9 w for intact perineum, 2.4 and 2.6 w for tears and episiotomies, and 3.2 w for anal injury. With mediolateral episiotomy, a study of instrumental vaginal delivery and episiotomy in 1360 women reported that after adjustment for correlating factors, women with episiotomy were more likely to require moderate to strong analgesia before discharge (91% vs. 68%, OR 3.7) and up to 10 d postpartum (66% vs. 32%, OR 3.4).[47] Another study surveyed 2064 women a year after vaginal birth of whom 482 responded (23%).[72] Some women with perineal injury were still experiencing perineal pain and rates with spontaneous tear (only 4 women had anal sphincter laceration) were similar to rates with episiotomy (28% vs. 34%). It is probable that symptomatic women were more likely to respond, which means that while prevalence cannot be taken as representative of the general population, perineal injury can result in long-term perineal pain.

5. Episiotomy causes more healing complications than spontaneous tears.

The systematic review of restricted vs. liberal episiotomy reports on one mediolateral episiotomy trial (1119 women) that evaluated healing complications and perineal wound dehiscence (reopening) at 7 d.[11] Women allocated to restrictive use of episiotomy were less likely to have healing complications (20.5% vs. 29.8%, RR 0.7) and wound dehiscence (4.5% vs. 9.4%, RR 0.5); however, 30% of women assigned to restrictive use of episiotomy had episiotomies and 19% assigned to liberal use did not, which means true differences may be greater. Infection rates (2 trials, 1298 women), though, were identical.

An observational study of mediolateral episiotomy also reported increased incidence of healing problems.[45] Investigators evaluated women at 1, 3, and 5 d after birth, the day on which stitches were removed, and again at 8-12 w. During the early postpartum period, more women with episiotomy required treatment for infection compared with spontaneous tears (10% vs. 2%), and 29% of women with an episiotomy had disturbed primary healing (redness, edema, or if wound edges opened when stitches removed on day 5). At the 8-12 w evaluation, more women with episiotomy had healing problems (scarring, asymmetry, perineal pain with palpitation) compared with spontaneous tear (11% vs. 5%). Results of this study are weakened by its failure to adjust for instrumental vaginal delivery, an independent risk factor for healing problems that is more likely to be accompanied by episiotomy; however, a second mediolateral episiotomy study of 1360 women having instrumental vaginal delivery reported that women with episiotomy were more likely to develop perineal infection (5.1% vs. 1.4%, OR 4.0).[47]

A study of median episiotomy compared healing complications 1-2 w after spontaneous birth (which eliminates instrumental delivery as a potential confounding factor) according to whether women had an episiotomy.[49] More women in the episiotomy group experienced delayed healing (visual presence of infection or dehiscence) compared with the no-episiotomy group (7.7% vs. 2.2%). After excluding women with intact perineums, the delayed healing rate in the no-episiotomy group rose to 4.6%, but this was still exceeded by the episiotomy group (7.7%). Women in the episiotomy group were more likely to have anal lacerations (15% vs. 2%), and women with anal sphincter injury were much more likely to experience delayed healing (16.1%).

6. Episiotomy does not preserve pelvic floor functioning as measured by pelvic floor muscle strength, urinary incontinence, and anal incontinence.

Notes:

- Women experiencing problems would be more likely to respond to a survey; however, while this means that prevalence rates cannot be generalized, associations between episiotomy and pelvic floor dysfunction remain valid.
- Because of high crossover rates, this mini-review is confined to observational studies.

A systematic review evaluated the effect of episiotomy on pelvic floor function.‡[39] Of five observational studies evaluating pelvic floor muscle strength, two of median and five of mediolateral episiotomy, none found that episiotomy conferred an advantage and one mediolateral episiotomy study reported a decrease in muscle strength with episiotomy. Failure to find that episiotomy preserves pelvic floor strength rules out clinical benefits dependent on that strength such as prolapse or incontinence.

‡ The reviewers do not report episiotomy type, but it is possible to determine this from the title of the study, the country where the study was performed, or because we have the study in our files.

Four studies correlating pelvic floor dysfunction with episiotomy have been published since the systematic review. Two found no protective effect with episiotomy and the other two reported excess harms. Three studies were of mediolateral episiotomy. In the first, investigators surveyed 482 women 12 months after birth regarding pelvic floor symptoms and found that rates of stress urinary incontinence were identical with perineal tear (only four women had anal injury) compared with episiotomy and similar for flatus, liquid, and solid fecal incontinence.[72] The second study followed up with participants in an episiotomy trial.[22] Investigators evaluated pelvic floor and anal sphincter strength as well as prevalence of urinary and anal incontinence at a mean 7.3 months postpartum in 68 primiparous women. The study found no differences in pelvic floor strength between groups when analyzed according to whether women had or did not have episiotomies. No differences were reported in prevalence of any degree of urinary incontinence or anal incontinence; however, while the study had reasonable power to detect differences in muscle strength, it was too small to detect differences in symptoms. Investigators in the third study surveyed 552 women six months postpartum on symptoms of urinary stress incontinence.[30] It reported that any history of episiotomy doubled the risk of urinary incontinence (OR 2.0) after adjusting for correlating factors such as previous incontinence, parity, and body mass index. The fourth study, a median episiotomy study, surveyed 626 primiparous women six months after birth regarding symptoms of anal incontinence.[66] After adjusting for nonmodifiable factors such as infant birth weight and restricting the population to women having uncomplicated labors and spontaneous births, episiotomy more than doubled the risk of flatus incontinence at six months (OR 2.3) compared with spontaneous tears of any depth beyond first-degree (superficial) tears (23.2% vs. 12.2%). Rates of fecal incontinence with episiotomy vs. spontaneous tear were not significantly different (4.1% vs. 1.5%). Of particular interest, *nonextending* episiotomies posed more risk for flatus incontinence than spontaneous second-degree tears (19.6% vs. 12.7%, OR 2.7), although fecal incontinence rates did not differ significantly (4.1% vs. 2.0%).

7. Studies consistently find episiotomy adversely affects sexual functioning.

> **Note:** We exclude data from RCTs reporting according to "intent to treat" because of the large degree of crossover between groups. Follow-up surveys, the only way of evaluating women's sexual functioning, have low response rates, and women with problems are more likely to respond.[10] While this means that prevalence rates cannot be generalized to the population overall, surveys are still valid for determining relationships between genital trauma and sexual functioning.

A systematic review, reported on prospective observational studies, including a 3-month follow-up study to a median episiotomy trial that analyzed data according to actual treatment.[39] The follow-up study found that women with spontaneous tears were similar to women with episiotomies, and women with intact perineums fared the best by far with respect to resuming intercourse by 6 w postpartum (77% vs. 63% spontaneous tear and 62% episiotomy), having the fewest women reporting "distressing" pain at first intercourse (7% vs. 24% spontaneous

tear and 29% episiotomy), and having the fewest women reporting dissatisfaction with their sexual functioning (5% vs. 16% spontaneous tear and 17% episiotomy). An observational study of mediolateral vs. no episiotomy reported higher rates of pain during intercourse persisting at three months (8% vs. 3%). Two observational studies of mediolateral episiotomy, the one just cited and another, were similar enough that they could be combined. Pooled data showed a trend toward more pain with intercourse at three months with episiotomy (RR 1.5) compared with no episiotomy. Two observational studies of mediolateral episiotomy (episiotomy type not reported in the review) that asked about pain with intercourse at any time in the previous three months reported more women answering "yes" in the episiotomy groups compared with, in one study, a no-episiotomy group, and in the other, a spontaneous laceration group, but differences did not achieve significance.

Four studies published subsequently, all of mediolateral episiotomy, also failed to find advantages for episiotomy, and three of the four found disadvantages either for episiotomy or its proxy, second-degree tears. A prospective study surveyed 2154 women serially regarding timing of first sexual intercourse after birth.[58] Investigators did not statistically compare women with episiotomy with women having spontaneous tears, but similar percentages of women with episiotomy vs. no episiotomy (31% vs. 23%) reported delaying first intercourse to ≥ 3 months as women with first- or second-degree tears vs. no tears (28% vs. 21%). The same held true for delaying first intercourse to ≥ 6 months, that is, 8.6% episiotomy vs. 7.6% no episiotomy and 9.7% tear vs. 6.6% no tear. This suggests that effects did not differ between mediolateral episiotomy and perineal tear and both differed from women with intact perineum. The second study retrospectively surveyed 494 primiparous women.[7] After adjustment for type of delivery, experience of painful intercourse in the year prior to pregnancy, and breastfeeding status, episiotomy was not associated with painful intercourse within either three or six months compared with intact perineum. The third study surveyed 2100 women a year after birth, of whom 482 women responded.[72] Women were more likely to report dyspareunia with perineal injury (25% intact perineum, 37% perineal tear, 44% episiotomy). As stated previously, the low response rate suggests that prevalence may not be representative of the general population, but the relationship between perineal injury and dyspareunia remains valid. The fourth study, a case-control study, looked at sexual functioning at 12-18 months postpartum in 110 primiparous women with mediolateral episiotomy matched with 96 control women who had not had episiotomy.[29] Women with anal sphincter injury were excluded. Episiotomy was independently associated with dyspareunia (69% vs. 49%, OR 2.1).

8. Episiotomy neither prevents nor relieves shoulder dystocia.

Three studies failed to find that episiotomy prevents shoulder dystocia. An analysis of 358,664 spontaneous vaginal births reported similar shoulder dystocia, brachial plexus injury, and clavicular fracture rates with median episiotomy vs. no episiotomy, and women with episiotomy were more likely (6.4% vs. 4.6%) to experience anal sphincter laceration.[20] After controlling for factors associated with both shoulder dystocia and episiotomy such as birth weight, women with episiotomy were 77% more likely to experience shoulder dystocia. Study authors explain that the likely reason for the positive association is that episiotomy may be performed to manage shoulder dystocia or in anticipation of a difficult birth. Over the time period of the study (1996-2001), episiotomy rates declined from 37% to 26%, but rates of shoulder dystocia

remained the same, which further confirms that episiotomy does not avert this complication. Two studies of maternal and neonatal morbidity in relation to mediolateral episiotomy and instrumental vaginal delivery, one of 1360 nulliparous women[47] and the other of 2153 women,[73] found that episiotomy did not reduce incidence of shoulder dystocia.

One study analyzed episiotomy's effects in managing shoulder dystocia.[36] To best determine this, the investigators restricted their study population to women experiencing severe shoulder dystocia (recorded head-to-body interval ≥ 90 s, deliberate proctoepisiotomy [cutting into the rectum], or neonatal depression as evidenced by 5 min Apgar score < 7 and/or umbilical artery pH ≤ 7.10) and cases where episiotomy or deliberate episiotomy extension was performed after birth of the head. Outcomes were compared according to management: fetal manipulation alone (n = 57), episiotomy alone (n = 22), or episiotomy plus fetal manipulation (n = 48). Incidence of neonatal depression was similar among groups. Incidence of brachial plexus injury was similar with episiotomy plus manipulation vs. episiotomy alone, but more injuries occurred with episiotomy alone vs. manipulation alone (59% vs. 35%). Incidence of anal sphincter injury was similar with episiotomy plus manipulation vs. episiotomy alone, but more injuries occurred with episiotomy alone vs. manipulation alone (68% vs. 11%). Among women having fetal manipulation alone, nearly half had an intact perineum (46%). Excluding proctoepisiotomies, 10 of the 11 median episiotomies used to facilitate fetal manipulation resulted in anal lacerations vs. none of the 3 mediolateral episiotomies. Study authors concluded that with severe shoulder dystocia, if episiotomy can be avoided, anal injury can be avoided without increasing risk of brachial plexus injury, but if episiotomy is necessary, mediolateral episiotomy may be preferable.

9. Anal lacerations rarely recur at subsequent births provided no median episiotomy is done.

Note: No study could be found that evaluated the effect of mediolateral episiotomy on repeat anal sphincter injury.

Four studies provide data on the effect of median episiotomy on likelihood of recurrent anal sphincter laceration. All found that avoiding episiotomy substantially reduces risk. One study looked at 1895 women having two vaginal births and no episiotomy at the second birth.[48] Of 220 women with an anal injury at first birth, two (0.9%) had an anal laceration at the second birth. This was similar to the anal laceration rate (0.7%) in women at second birth without prior anal laceration. Eighteen percent had vacuum extraction and 2% had forceps deliveries at the second birth. A second study of 4015 women reported that the anal laceration rate at second vaginal birth in women with prior anal laceration was 7.5%.[54] However rates were 2.1% in the 286 women having spontaneous birth without episiotomy vs. 10.6% in the 376 women having spontaneous birth with episiotomy and 0% in the 17 women having instrumental vaginal delivery without episiotomy vs. 21.4% in the 56 women having instrumental vaginal delivery with episiotomy. A third study reported on a population of 23,451 women giving birth vaginally, of whom 778 (3.3%) had anal sphincter laceration.[28] Among women with anal sphincter injury, 271 had a subsequent birth, of

whom 6 (2.4%) had a second anal sphincter injury, a similar percentage to the rate at first birth. Numbers were too small for statistical analysis, but women having recurrent anal laceration were more likely to have episiotomy (67% vs. 7%). The fourth study evaluated 14,990 subsequent vaginal deliveries in women who sustained anal sphincter injury at the first birth.[19] The recurrent anal laceration rate was 5.8% overall. Rates were 7.4% in women having spontaneous birth with episiotomy vs. 4.5% in women having spontaneous birth with no episiotomy, 17.7% in women having forceps delivery with episiotomy vs. 7.9% in women having forceps with no episiotomy, and 13.3% in women having vacuum extraction with episiotomy vs. 5.9% in women having vacuum extraction with no episiotomy. After adjustment for correlating risk factors, episiotomy more than doubled the chance of recurrent anal laceration (OR 2.1).

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CHAPTER 16

Third-Stage Active Management: The Wrong Answer to the Right Question

"Data support the use of active management of the third stage of labour (AMTSL) by all skilled birth attendants regardless of where they practice."

ICM FIGO 2006, p. 2[21]

"[T]reating excess bleeding when it occurs is as effective as giving uterotonic prophylaxis while avoiding the potential adverse effects of the interventions used in active management."

Begley 2010, p. 20[6]

What is Active Management of Third-Stage Labor?

Active management of third-stage labor (AMTSL) is a package of interventions intended to avert major maternal morbidity and mortality from postpartum hemorrhage. It consists of routine administration of uterotonic (also called oxytocic) drugs, umbilical cord traction to deliver the placenta, and immediate cord clamping (although the tide is slowly turning against early clamping). The package may also include fundal massage, manual placental removal after a predetermined time limit, or both. The uterotonic drug varies. Some protocols, such as those in the U.S., prescribe oxytocin (Pitocin), while others, such as those in the U.K., favor an ergot compound (Ergometrine) or a mixture of ergot compound and oxytocin (Syntometrine). Increasingly, oral or rectal misoprostol (Cytotec) may be used. Timing of administration varies as well.

No one disputes that hemorrhage kills childbearing women or that AMTSL reduces blood loss immediately after birth, but does reducing early postpartum blood loss translate into saving women's lives? Medical-model thinkers would answer "Yes," pointing to a 2000 Cochrane systematic review,[28] but we disagree. We argue that the consensus

around AMTSL is rooted in classic medical-model biases that women's bodies are prone to failure and that medical intervention is always the solution to the problem, never the cause. We further argue that those biases have prevented AMTSL proponents from seeing that they have made a number of erroneous assumptions and claims:

- that obstetric hemorrhage primarily consists of postpartum hemorrhage resulting from uterine atony (failure of the uterus to contract after placental delivery) after vaginal birth;
- that all women are at equal risk of postpartum uterine atony;
- that reducing the incidence of blood loss of 500 mL or more (the standard definition of postpartum hemorrhage after vaginal birth) translates into minimizing blood loss in amounts associated with clinically significant maternal morbidity and mortality;
- that AMTSL prophylaxis produces clinically superior results to treating excessive bleeding when it occurs;
- that components of AMTSL confer no harms—or at least no harms worthy of concern;
- that expectant management has been given a fair trial.

If the premises of AMTSL are false, then it inevitably follows that practices and policies based on them will be flawed. We further contend that medical-model biases prevent researchers from considering modifiable causes of excessive bleeding after birth, a consideration that would lead to solutions other than AMTSL.

We do not stand alone. A 2010 Cochrane review analyzed the same RCTs as its 2000 predecessor. Raising many of the same issues we do, reviewers came to much more nuanced conclusions about the tradeoffs between benefits and harms of active versus expectant management of third stage.[6] And, as we shall show, confidence in the safety and effectiveness of AMTSI's individual components also has begun to crumble.

Still, even progressive mainstream practitioners only want to revamp the package, not abandon it altogether and start afresh on the problem. We have no qualms with making a case for a fundamentally different approach. Let us begin that task by dismantling the assumptions behind AMTSL.

WOULD UNIVERSAL APPLICATION OF AMTSL IMPROVE OUTCOMES?

Trials to date have been too small even in the aggregate to detect differences in maternal mortality, but universal prophylactic treatment could have little effect on maternal mortality in high-resource settings because deaths from postpartum hemorrhage after vaginal birth are vanishingly rare. In the U.S., 41 women died of obstetric hemorrhage in 2007, a rate of 0.9 per 100,000 live births,[38] nor were all these deaths atony-related hemorrhage after vaginal birth. The U.K.'s triennial report for 2003 to 2005, *Saving Mothers' Lives*, reported an almost identical maternal mortality rate from obstetric hemorrhage: 0.8 per 100,000.[23] Unlike the U.S. data,

the U.K. report specifies the exact cause of death. Seventeen women died of obstetric hemorrhage overall, 9 of postpartum hemorrhage; however, not all deaths due to postpartum hemorrhage were in women who gave birth vaginally: 11 of the 17 women had cesareans. Six, therefore, is the maximum number of women birthing vaginally who could possibly have succumbed to postpartum hemorrhage. The remaining three postpartum hemorrhage deaths must have occurred after cesarean delivery. In addition, one case of postpartum hemorrhage after uneventful vaginal birth is described in detail: the woman died several days later at home. That leaves 5 deaths (0.2 per 100,000) that fall in the category of "preventable by AMTSL," although for all we know it was used. To put this into perspective, the maternal death rate with elective repeat cesarean in a large U.S. study was 28 per 100,000.[34]

As for major morbidity, *Saving Mothers' Lives* reports on a 2005-2006 U.K. study of peripartum hysterectomy, which is usually performed as last-ditch effort to control hemorrhage.[23] Overall, 315 women had a peripartum hysterectomy, a rate of 41 per 100,000, but of these, only 53% were related to uterine atony, which drops the rate to 22 per 100,000, and there is no information on what percentage were atony following vaginal birth. Similarly, among all Norwegian women giving birth 1999 to 2004, 3501 experienced blood loss of more than 1500 mL or had transfusions (transfusion is only given for symptomatic blood loss in Norway), of which 757 cases (22%) were due to atony after vaginal birth, or only 0.2% of the population overall.[1, 2] Women with this amount of blood loss experienced higher rates of severe morbidity (sepsis, hysterectomy, renal failure) and mortality than women with lesser amounts, but even so, incidence was low: 7 per 1000 (25/3501) for severe morbidity and 2 per 1000 (7/3501) for mortality. Based on these data, therefore, AMTSL's potential for reducing hemorrhage-related severe morbidity is small.

It could be argued that these low rates reflect the success of prophylaxis, but a study of Norwegian women from 1998 through 2007 proves otherwise.[31] Rates of blood loss of 1000 mL or more in women birthing vaginally rose over the time period. Clinicians began giving 5 IU of oxytocin prophylactically in 2000; midway through 2006, under a national program, AMTSL was intensified to giving 10 IU plus early clamping and uterine massage, and cord traction was added in late 2007, all without returning rates to pre-AMTSL levels. If implementation of AMTSL failed to reduce blood loss of 1000 mL or more, it could not possibly reduce rates of blood loss sufficient to cause maternal morbidity or mortality.

In fact, research fails to provide *any* evidence that universal application of AMTSL results in clinically important improvements in maternal outcomes in developed countries, while documenting that it introduces harms. According to the 2010 Cochrane review, comprising 5 trials and 6486 women, all of which were conducted in high-resource settings, assignment to AMTSL conferred no benefit other than a small absolute reduction in transfusion rates (1-2%), a result whose validity is diminished by the finding that transfusion rate is not an objective measure.[6] Sixteen more women

had a transfusion than had estimated blood loss of 1000 mL or more. Among women at low risk of hemorrhage, even stronger evidence suggests bias affects decision making. In one trial, less than one-third of the women in the AMTSL group had transfusions than had estimated blood loss of 1000 mL or more, but all women estimated to have this much blood loss in the expectant management group had one. Furthermore, a large trial (N = 1429) reported that no woman experienced bleeding greater than 2500 mL or symptoms of extreme blood loss, and similar numbers required uterotonic treatment after 24 hours. (See mini-review 1.) As for harms, the benefit of fewer transfusions with AMTSL was offset by an absolute increase (1.5%) in women returning to the hospital for in- or out-patient treatment of bleeding. Also of concern, newborns in the AMTSL group weighed significantly less, which reviewers attributed to reduction in placental transfusion after early cord clamping. Women were more likely as well to experience postpartum hypertension (diastolic blood pressure > 90 mmHg), an adverse effect of ergot, and to require analgesia. (See mini-review 2 for details.) Differences would almost certainly have been greater had not considerable percentages of women in the expectant management group been given uterotonics. It seems, then, that treating excess bleeding when it occurs works equally well at preventing symptomatic hemorrhage and avoids iatrogenic harms.

Hemorrhage deaths are a severe problem in low-resource countries—99% occur in developing countries, according to the World Health Organization—but even here, AMTSL could have limited benefits.[37] For example, a study in Mexico reported that while hemorrhage was the number one cause of maternal death, two-thirds of the hemorrhage-related deaths would not have been averted by AMTSL because they were associated with placenta accreta, placenta previa, placental abruption, and peripartum hysterectomy.[30] Even among the remaining third, evenly divided between uterine atony and "other," we have no guarantee that AMTSL would have made a difference, nor do we know if AMTSL was practiced and failed. Likewise, in a trial of AMTSL versus expectant management in 3607 Vietnamese women giving birth vaginally, only 21 women had bleeding of 1000 mL or more, of whom 8 were not due to atony.[35]

Moreover, we have no reason to doubt that treating excessive bleeding would work equally well in developing countries as in developed countries. The 2010 Cochrane reviewers warn that their results "cannot, and should not, be extrapolated to other contexts such as low-income countries where access to care is often severely restricted, or those countries with insufficient trained clinicians or inadequate emergency care" (p. 25),[6] but if birth attendants had the training and materials to carry out AMTSL, then they would have the resources and training to manage hemorrhage when it occurs. The Vietnamese trial confirms this.[35] Investigators compared outcomes between one district in which midwives were trained in AMTSL versus other districts in which midwives administered oxytocin as needed. Most women in both groups gave birth in community health centers. Virtually identical percentages experienced measured blood loss of 1000 mL or more

(0.7% AMTSL vs. 0.5% control), despite 97% being given postpartum oxytocin in the AMTSL group compared with 15-30%, depending on comparison district, given oxytocin therapeutically. (See mini-review 3 for more detail.)

How did the earlier Cochrane reviewers reach so different a conclusion on the value of AMTSL? They used surrogate measures—measures believed to be on the pathway to a clinically important outcome—as primary outcomes.[28] Specifically, they used length of third stage and estimated blood loss of 500 mL or more. But surrogate measures often bear little or no relationship to clinically important outcomes, which is the case here. Shorter third-stage duration is clinically meaningless, likewise blood loss of as little as 500 mL. According to *Williams Obstetrics*, healthy parturient women can tolerate blood loss at birth approaching the amount of blood volume expansion in pregnancy: 1500-2000 mL.[10] Using 500 mL inflates the apparent value of AMTSL because the difference in blood loss between trial arms at this level is far greater than differences between arms for blood loss of 1000 mL or more. Indeed, among women at low risk for postpartum hemorrhage, differences in blood loss of 1000 mL or more failed to achieve statistical significance, and, as we have seen, no woman experienced severe blood loss (≥ 2500 mL) or symptoms of severe blood loss in the trial that reported this outcome.

DID EXPECTANT MANAGEMENT GET A FAIR TRIAL?

We contend that expectant management did not get a fair trial because medical-model biases and standard management practices loaded the dice against it. To begin with, conventional obstetric management confounded results by exposing trial participants to modifiable labor practices associated with increased postpartum bleeding. (See mini-review 4.) Only one trial attempted to account for this by excluding women having epidurals and instrumental vaginal deliveries, but even that trial failed to control for others such as induction or episiotomy.[5] Evidence from other studies suggests that iatrogenic inflation of postpartum blood loss is considerable. One study reported that routine administration of oxytocin after birth reduced postpartum blood loss to the same degree that mediolateral episiotomy increased it,[27] that is, simply refraining from mediolateral episiotomy produced the same benefits as prophylactic oxytocin administration. Another study reported that instrumental delivery increased mean postpartum blood loss by 82 mL, (mediolateral) episiotomy by 80 mL, and labor induction by 63 mL.[4]

In addition, trials positioned AMTSL as the treatment and expectant management as the control, but in fact AMTSL was the norm in hospitals and had been for years based on the belief that its practices averted severe hemorrhage. Caregivers, therefore, were likely to be both unfamiliar with and doubtful of the safety of expectant management. One trial reported that 84% of participating midwives were comfortable or very comfortable with AMTSL, while only 1%—one midwife—was not.[29] By contrast, less than half the midwives felt confident about expectant management.

This unfamiliarity and anxiety had consequences. It affected trial design: in Begley (1990), investigators compromised "ideal" expectant management in order to have policies that "would be acceptable to, and therefore more likely to be followed by, the midwives in charge of the deliveries" (p. 6).[5] It affected compliance with expectant management protocol: among the five trials, three reported use of a uterotonic in women assigned to expectant management.[6] Twenty percent of women in one of them were given a uterotonic prophylactically and another 30% received it as treatment, or 50% overall, while in another, percentages were 3% and 21%, or 24% overall. Among the five trials, the umbilical cord was clamped before pulsation ceased 30% to 58% of the time in four of the trials and in all women in the fifth trial. In 12% to 68% of cases, women did not birth the placenta by their own efforts. It affected results as well: Begley (1990) observed that as the trial proceeded and midwives gained confidence, diagnoses of excess blood loss in the expectant management arm fell.[5] And it affected interpretation: Neither those conducting trials nor those reviewing them in the older Cochrane review questioned this high degree of protocol deviation. They should have. Even given labor management that predisposed to excess bleeding, it is highly unlikely that active management was needed in so many cases. The 2010 Cochrane reviewers write of the trial in which 50% of expectant management women were given a uterotonic: "The actual proportion that received the drug appears incompatible with a philosophy of expectant management. In addition, the fact that the administration of the same uterotonic that constitutes the main treatment in AMTSL to half of the "expectant" management group as well, does raise questions as to the usefulness of the findings" (p. 22).[6]

WHAT ABOUT HARMS?

Iatrogenic Norms

One indirect harm of the ubiquity of third-stage management practices and typical labor management practices in general is that we have no true physiologic baselines for length of third stage, maternal blood loss, maternal postpartum hematologic values, or newborn hematologic values. (See chapter 17 for more on newborns.) Similar to using growth charts based on formula-fed infants to evaluate breastfed infants, this has led to making ill-founded assumptions about what is "normal" and what constitutes proper care. Without knowing normal/optimal values, we cannot determine how and when to intervene appropriately. Establishing standards will require studying a pristine population not subjected to the overuse of medical intervention. Such a study doubtless also would expose the harms of medical-model labor management now rendered invisible by their nearly universal use.

The components of AMTSL are not benign. Immediate cord clamping deprives newborns of a substantial percentage of their blood volume (see mini-review 2), with short- and long-term adverse consequences for hematologic values and short-term consequences for cardiac, circulatory, and respiratory function. (See chapter 17.) Immediate cord clamping also retards placental delivery by blocking placental drainage. (See mini-review 2.) Cord traction can result in uterine inversion in untrained or careless hands.* Even with proper technique, is it really a good idea to pull on the umbilical cord when it is impossible to know how well the other end is attached? Traction could snap a weakly attached cord; an abnormally adherent placenta could be partially detached; placental fragments could be left behind. We are now in the process of backtracking on these practices. A trial is underway to see if cord traction can be eliminated in favor of prophylactic oxytocin alone.[17] Immediate cord clamping has been quietly dropped from some third-stage management guidelines,[21] although it remains in others.[26] Doubtless, though, both will be widely practiced for the foreseeable future.

The Real Rationale Behind Early Cord Clamping and Traction

The 2010 Cochrane reviewers write that the reasoning behind early cord clamping and traction is unclear, other than it was thought important to deliver the placenta quickly after administering a uterotonic to prevent it from being trapped.[6] Clamping the cord provided a handle by which to draw out the placenta quickly, accomplishing this goal. We speculate that as time passed, the original motivation was lost and "what is must be right" came into play. Clinicians began to think that truncating third stage and aborting placental blood transfer must be good in themselves, specifically that a rapid third stage would reduce the risk of severe hemorrhage,[28] and minimizing transfused blood volume would prevent neonatal respiratory distress, jaundice, and polycythemia.[20] Evidence supports neither practice. The sole trial of umbilical cord traction versus spontaneous placental delivery we could find—published in 2009—failed to find it reduced bleeding of 1000 mL or more,[3] and late clamping does not increase risk of clinically significant bilirubin levels or other harms (see also chapter 17).[20]

In addition, the distrust of the normal process inherent in the precepts of third-stage management inflicts subtler but no less potent harms. One precept is

* Training does not guarantee due care. H.G. heard a nurse comment from the floor at a conference session on third-stage management that an obstetrician at her hospital blames uterine inversions not on his penchant for vigorous cord traction but on placenta accreta. His patients, she noted dryly, have an extraordinarily high rate of accretas.

"the less postpartum bleeding, the better." This fails to consider that with physiologic processes, "too little" may be as undesirable as "too much." Women need to shed the excess blood supply accumulated over the latter months of pregnancy. Artificially restricting normal blood loss at the time of the birth can cause problems later. As we saw in the Cochrane review, women in the AMTSL arm were more likely to return to the hospital for in- or out-patient treatment for abnormal bleeding. Differences between trial arms might have been even greater had not so many women in the expectant management arm been given uterotonics.

Another precept is that third-stage duration correlates directly with severe hemorrhage, but two studies failed to find a linear correlation. Both found that a spike occurred at about 30 minutes, which makes perfect sense as this is the amount of time most practitioners are willing to wait before undertaking manual removal.[7, 11] Hemorrhage incidence will spike at whatever duration practitioners tolerate before resorting to manual removal either as a consequence of the reason for prolonged third-stage, i.e., abnormally adherent placenta or uterine atony, or consequent to the procedure itself. For example, a study of 3464 women found that among the 6% of women with third stage of 30 minutes or longer, mean blood loss differed by 372 mL from women with shorter duration, but among the 2% who had manual removal, who would largely, if not entirely, be a subset of the prolonged duration group, the mean difference was 921 mL compared with spontaneous placental delivery.[4] The danger of believing that curtailing third stage is beneficial is that it justifies elective manual removals. Investigators in a study of 1052 women having manual placental removal thought some women might be having elective removals because no indication was recorded in over half the cases.[13] Furthermore, placental retention, the indication in one-quarter of the cases, was defined as third stage lasting as little as 20 minutes, and women with epidurals, who would not feel the pain of the procedure, thereby removing a barrier to performing it, were seven times more likely to have manual removal than women with no epidural.

The conviction that AMTSL saves lives also leads to indifference toward the side effects of uterotonic agents. (See mini-review 2.) Ergot compounds can cause hypertension, nausea, and vomiting. Misoprostol can cause fever, diarrhea, and shivering. Oxytocin, like all uterotonics, increases cramping. These side effects can derail early attachment and initiation of breastfeeding, which could have far-reaching and long-term consequences for the mother-baby pair, as well as making the early postpartum period more difficult and unpleasant for the woman.

Finally, the 2010 Cochrane reviewers raise a new concern: as the tide turns against early cord clamping, giving prophylactic uterotonics might force too much blood through the patent umbilical cord, which could disrupt duct closure, lung fluid reabsorption, and cerebral haemodynamic autoregulation,[6] thereby turning an imaginary problem—transfer of too much placental blood—into a real one.

The Cochrane reviewers propose a solution: wait a few minutes before administering a uterotonic. However, every element of AMTSL potentially causes the same problems it is purported to prevent, or it introduces new ones: classic AMTSL mandates cord clamping, which prevents placental drainage, thereby retarding placental delivery. The side effects of uterotonic agents can disrupt attachment and breastfeeding. And while women in low-resource settings are the supposed, although as yet unproven, beneficiaries of AMTSL, they are at greatest risk of the catastrophes that can result from umbilical cord traction and manual placental removal, and their babies are most vulnerable to the harms of immediate cord clamping. Wouldn't it make more sense to avoid the risks of AMTSL by not interfering with a normally functioning physiologic process in the first place?

MEDICAL-MODEL BIAS AND THE TRIUMPH OF COGNITIVE DISSONANCE

The belief that childbirth is inherently risky and therefore routine intervention in the normal process can improve upon it permeates and shapes the medical-model approach to third stage. The very vocabulary used by researchers and clinicians encodes this bias. What medical-model thinkers would "expect" with "expectant management" is trouble. "Expectant" management suggests passively standing by to step in and mop up after the inevitable disasters. "Active" management, by contrast, conveys the strong and positive message of keeping danger at bay. "Controlled" cord traction implies that this procedure is guaranteed safe when performed properly, but as we noted earlier, this cannot possibly be the case, not to mention that it places an unwarranted confidence in the skill and judgment of practitioners. Using "hemorrhage" to describe blood loss of as little as 500 mL, the amount of a blood donation, creates a needless sense of alarm and emergency. Denis Walsh points out that obstetrics is the only medical specialty that defines hemorrhage as loss of a specific blood volume. Anesthesiologists and emergency room physicians "are trusted to institute appropriate resuscitation based on clinical features, observable blood loss and the specific context of illness or injury" (p. 128).[36]

Medical-model biases lead to rationales and practices that make no sense when viewed in the light of reason, but the illogic passes unnoticed by those holding them. Indeed, the internal contradictions are a tip-off that these biases are in play. Why, for example, should as little as 500 mL of blood loss after vaginal birth be considered "hemorrhage," but the definition changes to 1000 mL or more at cesarean surgery? If the worry is diminished blood volume, it should not matter whether the loss occurs during surgery or after vaginal birth. In the randomized controlled trials (RCTs) of placental drainage, investigators clamped and cut the cord immediately, then opened the clamp to let placental blood drain into a bowl.[22, 32, 33] How could it not occur to them that if draining blood from the engorged placenta might be good for the mother, it might also be good to let the

blood go where Mother Nature intended it to go: into the baby? AMTSL is supposed to save women in low resource settings. How can AMTSL proponents not see that once uterotonics, its linchpin, are reliably available and birth attendants are trained to use them, prophylaxis is not needed? Excess bleeding can be treated. Worse yet, how can proponents not see that, where there is no ability to deal with catastrophic bleeding, cord traction and manual placental removal are dangerous or that AMTSL, which causes late problems with bleeding, will be more risky where women lack ready access to skilled care? Why, if it comes to that, conduct all the trials in high-resource settings when the women at risk are in low-resource ones? It makes no more sense than the drunkard searching for his dropped keys under a street lamp because the light is better.

Medical-model biases also blind researchers and clinicians to the harms of injudicious intervention. This has two ill effects: First, AMTSL exemplifies how medical-model thinkers unquestioningly assume that intervention will be required, that harms caused by one intervention should be fixed with yet other interventions, and that if the intervention fails, the answer is even more intensive use. As Denis Walsh (2007) writes: "One inevitably hears of the worst episodes of PPH. This does not cause us to ask the question, 'Why did that occur with an active third stage?' but rather to say 'How much worse it would have been if no oxytocic had been used'" (p. 132).[36] Second, bias prevents medical-model thinkers from seeing that the best way to reduce excess postpartum bleeding is to avoid labor management practices that increase it. So, for example, Norwegian investigators can find that the increased use of induction caused a national rise in blood loss of 1000 mL or more and that introducing prophylactic oxytocin and later increasing the dose and adding early clamping and uterine massage failed to reverse the increase, yet still write:

> Controlled cord traction is also recommended, but this procedure was not implemented until late 2007. One single intervention might not be effective by itself, but when applied in combination with other procedures, interaction may lead to effectiveness. For example, . . . administration of oxytocin within 1 minute after delivery . . . may be more effective. Hopefully, these changes in routines will reduce the increasing tendency for severe hemorrhage (p. 1253).[31]

This blind spot may literally be a killer. The sole maternal death in the Vietnamese trial of AMTSL versus expectant management occurred in the AMTSL arm.[35] The woman had a postpartum hemorrhage due to atony after "an induced labor augmented with oxytocin" (p. 493), which implies that the induction agent was not oxytocin. Could the agent have been misoprostol—especially in light of this passage by G. J. Hofmeyr (2004)?

> Overdosage [of misoprostol] is a major problem needing attention. . . . The author has received reports of health workers in rural hospitals in South Africa using large doses of misoprostol to induce labor without recording it in the chart, or even erasing the record when a complication such as ruptured uterus has occurred. . . . The proportion of fatal postpartum hemorrhages due to ruptured unscarred uterus was more than twice the proportion observed in 1998. Misoprostol was identified as a cause in some cases. Because of health workers' fear of litigation, . . . the frequency of ruptured uterus due to misoprostol is probably under-reported (p. S 64-S65).[19]

We doubt that this opprobrious behavior occurs only in rural South African hospitals—or even only in hospitals in the developing world.

THE CASE FOR A NEW APPROACH

Hastie and Fahy (2009; 2010) argue that Cochrane concepts of expectant management, which essentially consist of refraining from AMTSL, are too limited.[14, 18] True physiologic care encompasses its own set of guidelines, skills, and practices predicated on the degree to which care can hinder or promote the cascade of hormones that optimizes postpartum physiologic and psychological functioning in mother and baby, hormones that include oxytocin, endorphins, prolactin, adrenocorticotrophic hormone (ACTH), and catecholamines. They propose a model of "midwifery guardianship" in which midwife and woman partner in creating a sanctum for birth, "a homelike, private, warm, dimly lit environment that feels physically and emotionally safe" (p. 4),[18] which necessarily requires that all present be familiar to and trusted by the woman. Physiologic care consists of creating that sanctum, ensuring skin-to-skin contact with the newborn, self-attachment breastfeeding, avoiding distracting activities and overstimulation after the birth, and helping the woman remain mindful that the labor is not over until she births the placenta and the uterus contracts. If the placenta fails to deliver within 20 to 30 minutes, remedies include having the woman adopt an upright position or sit on a toilet lined with a plastic bag and quietly giving instructions such as, "Imagine the uterus contracting," or reassurances such as, "Most women like the feeling of the placenta being born" (p. 6).[18] Similar to the U.S. midwifery concept of "optimal birth," the use of medically necessary intervention is not precluded, but because the woman's needs take precedence and she is the ultimate decision maker, their use does not disempower her.

Hastie and Fahy, however, reserve physiologic care for women who have labored without interventions that increase risk of excess postpartum bleeding, including induction, augmentation, epidural, instrumental vaginal delivery, and episiotomy or tear requiring suturing, a requirement that limits physiologic care to precious few women delivering in hospitals. The Cochrane AMTSL reviewers

concur.[6] While we agree that these interventions increase risk of postpartum hemorrhage (see mini-review 4), we disagree on this proscription. Incidence of blood loss of 1000 mL or more with or without AMTSL and with or without risk factors differs little, and there is overlap among studies, all of which have been conducted in women exposed to these predisposing interventions. (See mini-reviews 1 and 3 for details.) Why, then, should any woman be deprived of the benefits of a physiologic care approach?

STRATEGIES FOR OPTIMAL CARE

Unlike AMTSL, physiologic care minimizes the risk of excess bleeding without imposing risks or the possibility of precipitating catastrophic hemorrhage, and it can be applied to low- and high-risk women and in low- or high-resource settings. A physiologic approach would incorporate the following:

- Implement preventive measures in pregnancy such as strategies to improve nutrition or increase iron intake to reduce predisposing factors such as anemia.[2]
- Minimize the use of interventions during labor and birth that increase the risk of excessive blood loss.
- Manage third stage as follows:
  - » no routine interventions,
  - » skin-to-skin contact with newborn,
  - » focus on placental delivery and uterine contraction as the completion of labor.
- Institute upright positioning and bearing down, verbal reassurance and guidance, and putting the baby to breast as first responses to longer-than-usual third stage duration.

Treatment of third-stage abnormalities should minimize potential harms as follows:

- Administer oxytocin. It has the fewest side effects, and neither ergot compounds nor misoprostol are more effective. (See mini-review 2.)
- Decide on when to undertake manual placental removal on a case-by-case basis.
- Unless urgent conditions demand, refrain from manual placental removal in settings not equipped or staffed to handle profuse hemorrhage.
- Supply single-dose oxytocin injection devices at cost and instructions for use to anyone who wants them.[35] No woman should be exposed to a potentially life-threatening complication because she has chosen a birth option disapproved of by mainstream medical practitioners, nor should home birth attendants be subject to prosecution for treating postpartum hemorrhage.

MINI-REVIEWS

Note: Assume differences are statistically significant unless otherwise noted.

1. AMTSL fails to decrease clinically significant maternal morbidity.

The Cochrane systematic review of active vs. expectant management of third stage comprises five trials (6486 women) all taking place in high-resource settings.[6] According to reviewers, trial weaknesses included:

- failure to isolate a group at high risk (high parity, previous postpartum hemorrhage, epidural, long labor, instrumental vaginal delivery) for excessive postpartum bleeding,
- impossibility of blinding clinicians or women as to treatment group,
- estimation of blood loss rather than measurement in four of the five trials, which creates potential for bias,
- clinician unfamiliarity with and lack of confidence in expectant management, which creates potential for bias (see essay for details),
- inclusion of early cord clamping, a practice now established as harmful,
- considerable protocol variation among trials for both AMTSL and expectant management,
- significant protocol deviation in expectant management arms (see essay for details).

To this we add:

- confounding effects of conventional obstetric management on blood loss. (See mini-review 4.)
- insufficient power to detect differences in occurrence of rare severe complications of umbilical cord traction and uterotonic agents, a crucial issue when intervening routinely. (Trials are also underpowered to detect differences in severe consequences of extreme blood loss, but according to a trial in the Cochrane systematic review, expectantly managed women are not more likely to experience extreme blood loss.)

The only clinically significant benefit of AMTSL was a small reduction in transfusions. Among women at low risk of postpartum hemorrhage (3 trials, 3134 women), rates were 0.5% vs. 1.5% (absolute difference 1.0%), while among women overall (4 trials, 4829 women), rates were 1.0% vs. 2.9% (absolute difference 1.9%). However, transfusion rate was subject to bias. Reviewers noted that only 78 women had an estimated blood loss > 1000 mL, but 94 women had a blood transfusion. Among women at low risk of hemorrhage, stronger evidence suggests bias in decision making. In one trial, fewer women in the AMTSL group had transfusions than had estimated blood loss ≥ 1000 mL (4 vs. 13), but all 20 women estimated to have this much blood loss in the expectant management group had transfusions. Moreover, we have no evidence that AMTSL prevented very severe hemorrhage. In the sole trial (1429 women) reporting on estimated bleeding > 2500 mL or symptoms of extreme blood loss, no woman in either group experienced either one, and similar percentages (4 vs. 1 per 1000) required uterotonic treatment for bleeding occurring after 24 h.

2. AMTSL introduces harms.

Meta-analysis in the Cochrane 2010 review found that more women (2.8% vs. 1.3%, absolute increase 1.5%) returned to the hospital for in- or out-patient treatment of bleeding (2 trials, 2941 women).[6] Meta-analysis also found a 77 g mean decrease in birth weight in the AMTSL group (2 trials, 3207 women), which reviewers thought was probably attributable to immediate cord clamping. This equated to roughly an 80 mL reduction in neonatal blood volume with AMTSL, or a 20% increase with expectant management. The deficit probably represents a minimum difference since delayed cord clamping was defined as waiting as little as one minute, insufficient time for complete placental transfusion, and some women in the expectant group had immediate clamping. Women were also more likely (2.5% vs. 0.6%,) to experience postpartum hypertension (diastolic blood pressure > 90 mmHg) (3 trials, 4636 women), an adverse effect of ergot; more likely (3.4% vs. 1.7%) to require oral or rectal analgesia (1 trial, 1429 women); and more likely (1.1% vs. 0.1%) to require narcotic analgesia (1 study, 1429 women). Differences in blood pressure would almost certainly have been greater had not considerable percentages of women in the expectant management group received uterotonics. (Only 14% of women in the expectant group had a uterotonic in the trial reporting on analgesia.)

A Cochrane systematic review comparing immediate clamping with cord drainage reported that cord drainage significantly reduced third-stage duration (1 trial, 147 women) and the incidence of third stages exceeding 30 min (1 trial, 477 women).[33] Two RCTs published subsequent to the review (N = 958, N = 99) also reported shortened duration of third stage.[†22, 32] Clouding the picture is that umbilical cord traction was part of the protocol in both arms of all four trials. We do not know, therefore, how cord drainage alone compares with cord traction, although data certainly suggest that drainage might be beneficial. (For neonatal harms of immediate cord clamping, see chapter 17.) The accumulating evidence supporting late cord clamping raises a new concern: If uterotonics are given while umbilical cord blood vessels are still patent, what adverse effects might a surge in blood volume consequent to a strong, induced contraction have on the neonate?

Systematic reviews of uterotonics provide additional information on their adverse effects. Data on adverse effects of prophylactic oxytocin were extremely limited (one trial of 52 women reporting on nausea),[9] but a systematic review of prophylactic oxytocin alone vs. a mixture of ergometrine and oxytocin found that the addition of ergot increased (1.7% vs. 0.7%) the likelihood of hypertension (4 trials, 7486 women), increased (13.7% vs. 2.4%) vomiting (3 trials, 5458 women), increased (17.9% vs. 4.7%) nausea (3 trials, 5458 women), and increased (23.4% vs. 5.3%) the likelihood of the two combined (4 trials, 7486 women).[25] The review did not report on pain, but, as we have seen, AMTSL increases the use of postpartum analgesia.[6] Ergot offered no compensating advantages, reducing neither rates of blood loss ≥ 1000 mL nor transfusion rates. Similarly, a systematic review of conventional injectable uterotonics (oxytocin alone, ergometrine, oxytocin plus ergometrine) vs. misoprostol reported that oral misoprostol ≥ 600 mcg increased (0.7% vs. 0.2%) the likelihood of diarrhea (6 trials, 20,763 women) and increased (1.7% vs. 0.2%) severe shivering, described according to reviewers in one trial as "teeth chattering for 10 to 20 minutes and no control

† Although these studies took place in India and Thailand, we include them to strengthen the data and because setting was unlikely to affect the outcomes of interest.

over body movements during this period" (p. 8) (3 trials, 19,038 women), although the likelihood of shivering appears to be dose-related.[16] Oral misoprostol also increased (6.6% vs. 1.0%) fever (7 trials, 22,137women), an adverse effect that unrelated to dose. Rectal misoprostol increased (20.7% vs. 8.7%) shivering (4 trials, 2003 women) and increased (7.2% vs. 3.5%) fever (2 trials, 1023 women). Data are insufficient to determine the effect on pain, as this was evaluated in only one small trial (215 women) of rectal misoprostol, which did not find a difference. As with ergot, misoprostol conferred no benefit over other agents. Oral misoprostol *increased* risk of blood loss ≥ 1000 mL (3.3% vs. 2.4%) compared with conventional uterotonics (16 trials, 29,042 women), and rates with rectal misoprostol were similar. All adverse effects of uterotonics would interfere with bonding and initiation of breastfeeding, and make the early postpartum period more unpleasant. Fever is especially concerning because it may lead to suspicion of infection, which could result in separating infants from mothers for observation and lead to unnecessary tests and treatment.

3. Treatment of excessive bleeding produces equally good outcomes as prophylaxis.

A retrospective study of women at ultra-low risk of postpartum hemorrhage (no complications of obstetric history or current pregnancy; first stage < 13 h and second stage < 3 h; no use of oxytocin or regional analgesia; normal, spontaneous vaginal birth) compared care intended to promote optimal psychophysiology during third stage provided in a midwifery-led unit within a community hospital (n = 361) with AMTSL provided in a tertiary care center (staffed and equipped to care for high-risk women and seriously ill and preterm infants) (n = 3075).[14] AMTSL consisted of prophylactic oxytocin, cord traction, and fundal massage after placental delivery. Physiologic care consisted of immediate and sustained skin-to-skin contact with the newborn, encouraging the woman to focus on the newborn and the need to birth the placenta, self-attachment breastfeeding, unobtrusive observation for placental detachment, placenta birthed by maternal effort and gravity, and gentle checking of the fundus for one hour post placental birth for contraction and hemostasis. In the physiologic care group, 13.2% received AMTSL (the authors did not define and the database did not permit distinguishing between prophylactic and therapeutic treatment) while 3.5% of the AMTSL group received physiologic care. In the physiologic care group, 0.9% had estimated blood loss > 1000 mL vs. 2.8% of the AMTSL group. Investigators only calculated statistical significance for blood loss at the > 500 mL level (11.2% AMTSL vs. 2.8% physiologic care, OR 4.4), but clearly physiologic care does as well as AMTSL, if not better, at preventing blood loss > 1000 mL in a population at low risk of excessive bleeding.

The study, however, leaves open whether AMTSL benefits mixed-risk populations and, in particular, mixed-risk populations in low-resource settings. A quasi-randomized Vietnamese trial addresses that question.[35] Outcomes were compared between one district (n = 1236) in which midwives were trained in AMTSL (routine administration of oxytocin, cord traction, uterine massage, and immediate cord clamping) vs. three comparison districts (n = 2371) in which midwives administered oxytocin as needed. In all districts, excessive bleeding was managed first by intramuscular oxytocin followed by bimanual uterine compression with continued bleeding. If necessary, women giving birth out-of-hospital were transferred, and women birthing in-hospital were referred to physician care. Most women in both groups (88% AMTSL vs. 74% expectant) gave birth in community health centers

with all but 1% of the rest, who gave birth at home, giving birth in hospitals. Of the 21 women with measured bleeding of ≥ 1000 mL, 8 (38%) were not attributed to atony. Virtually identical percentages experienced excess postpartum bleeding (≥ 500 mL) related to atony (2.3% AMTSL vs. 3.0% expectant management), and the same was true of blood loss ≥1000 mL from all causes (0.7% AMTSL vs. 0.5% expectant management). This was despite 97% being given postpartum oxytocin in the AMTSL group compared with 15-30%, depending on comparison district, given oxytocin therapeutically. No woman had to be referred to higher level care because of postpartum hemorrhage due to atony, although one woman in a control district required a hysterectomy. The sole maternal death was due to atony despite AMTSL. It occurred "after an induced labor augmented with oxytocin" (p. 493), which suggests that the induction agent was something other than oxytocin, e.g., a prostaglandin agent.

4. Modifiable labor management practices contribute to severe postpartum blood loss.

Note:

- Other factors potentially contributing to excessive blood loss not considered in the studies included here are excessive IV fluids and second-stage fundal pressure. (See chapters 11 and 14.)
- Mediolateral episiotomy would have been the norm in all but the U.S. study.

Seven studies looked at modifiable risk factors associated with severe postpartum blood loss: three in Norway,[1, 2, 31] of which two were of the same population,[1, 2] one in the Netherlands,[4] one in the U.S.,[8] one in France,[12] and one in Australia.[24] Three defined severe hemorrhage as blood loss ≥ 1000 mL;[4, 24, 31] two as blood loss ≥ 1500 mL;[1, 2] one as ≥ 10 point fall in hematocrit from admission to postpartum;[8] and one as ≥ 4 g/dL change in hemoglobin, which authors said was equivalent to ≥ 1000 mL.[12] Results differed because studies varied in what factors investigators chose to examine, how they dealt with correlating and confounding factors, how they defined severe hemorrhage, and because populations and labor management practices differed. Nevertheless, all seven reported independent associations between modifiable practices and severe postpartum hemorrhage.

All seven studies reported an association with induction, although the association remained only in women having cervical ripening in the French study,[12] only in the high-risk population in the Dutch study,[4] and was no longer statistically significant after adjustment for correlating and confounding factors in the U.S. study.[8]

The U.S. study and a study of one of the Norwegian populations reported an association with instrumental vaginal delivery,[2, 8] while in a study of the other Norwegian population and in the Dutch study,[4, 31] the association lost statistical significance after adjustment, probably because both studies adjusted for episiotomy. The French study reported an association but only with instrumental vaginal delivery in conjunction with episiotomy.[12] The Australian study did not evaluate instrumental vaginal delivery per se,[24] but it reported

an association with genital tract trauma, which one of the Norwegian studies reported as strongly correlated with instrumental vaginal delivery.[1]

The U.S. study found both midline and mediolateral episiotomy to be independent factors with mediolateral episiotomy having much the stronger association.[8] The French study reported an association, as did one of the Norwegian studies,[12, 31] and in the other Norwegian study and the Dutch study, episiotomy lost significance after adjustment.[2, 4] As noted, the Australian study reported an association with genital tract trauma,[24] and episiotomy would necessarily cause such trauma. (See also chapter 15.)

Oxytocin augmentation was an independent factor in one of the Norwegian populations and in one of the two adjusted models in the U.S. study but not the other.[8, 31] The Dutch study found an association that lost significance after adjustment;[4] the French study found no significant association before or after adjustment;[12] the Australian study did not distinguish oxytocin use for augmentation from its use for induction so no conclusion can be drawn;[24] and the study of the other Norwegian population did not consider augmentation as a factor.[2]

The Australian study reported that epidural analgesia was an independent factor, and the U.S. and one of the Norwegian studies found an association that lost statistical significance after adjustment.[8, 24, 31] This is probably because controlling for use of instrumental vaginal delivery, episiotomy, or both would adjust for practices whose increased use with epidurals explain the association with excessive blood loss. The French study reported no significance before adjustment and a protective effect after adjustment, which study authors attributed to the rapidity with which clinicians could undertake otherwise painful procedures to address heavy bleeding, such as manual exploration of the uterus or instrumental examination of the cervix.[12] The other studies did not consider epidural analgesia as a factor.[2, 4]

In addition, the Dutch study reported excess mean blood loss associated with:[4]

- instrumental vaginal delivery vs. spontaneous birth: 82 mL
- (mediolateral) episiotomy vs. tear or intact perineum: 80 mL
- induced labor vs. spontaneous onset: 63 mL

Overall mean blood loss with vaginal birth was 369 mL, which makes these procedures substantial contributors to postpartum blood loss.

Finally, investigators conducted a case-control study examining the correlation between oxytocin exposure and risk of severe postpartum hemorrhage (requiring a transfusion) due to atony to test their hypothesis that exposure to oxytocin could desensitize oxytocin receptors.[15] They matched each case (n = 54) to the next delivery of similar age, parity (nulliparous vs. multiparous), and mode of birth (vaginal, planned cesarean, intrapartum cesarean). All women received prophylactic oxytocin at delivery. Cases received more oxytocin (mean 10,054 mU vs. 3762 mU), over a longer mean time period (628 min vs. 294 min), at a higher maximal dose (16.6 mU/min vs. 7.0 mU/min). After adjustment for correlating factors, a 5000 mU increase in total oxytocin dose (equivalent to 4.2 h at 20 mU/min) increased the risk of severe hemorrhage by 60% (OR 1.6).

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Newborn Transition: Don't Just Do Something, Sit There!

"With delivery of the head, either vaginally or by cesarean delivery, the face is immediately wiped and the mouth and nares are suctioned. A soft rubber syringe or its equivalent inserted with care is quite suitable. Before clamping and severing the cord, while the infant is still being held head down, it is beneficial to aspirate the mouth and pharynx again. Once the cord has been divided, the infant is placed supine with the head lowered and turned to the side in a heated unit that has appropriate thermal regulation and is equipped for immediate intensive care."

Cunningham 2001, p. 386[8]

"The role of birth attendants in the hours following birth . . . is to ensure unhurried and undisturbed contact between mother and baby; to adjust the temperature to ensure warmth for mother and baby; to facilitate skin-to-skin contact, mutual gaze, and early breastfeeding and prebreastfeeding behaviour, with no other expectations for mother or baby; and not to remove the baby for any reason. These measures can also include sensitively practiced observations, resuscitation (which can be done next to the mother or . . . on the mother's thigh) and other safety measures."

Buckley 2005, p. 189[2]

When a baby is born, everyone in the birth room awaits the first cry, the signal that the baby has safely completed its journey from fetus to newborn. A remarkable transition occurs in the moments immediately after birth, with the rapid and crucial physiologic shifts necessary for survival culminating in sustained respiration. However, an exclusive focus on initiating breathing imbues a subtle but important bias that overshadows the many other processes that are critical for healthy newborn transition.

Scientists have described a "sensitive period" in the first hour of life, when newborns adapt to the outside world and stabilize their body temperature and respiration, and when mothers and babies begin to attune and attach to each other.[28] How well this early period goes can have far-reaching and long-term effects for good or ill, which is not to say that difficulties cannot be overcome. Optimal outcomes, however, require an alert, undrugged mother and baby, intimate contact

between them, and a peaceful, undisturbed environment. The most striking evidence of the effects of interference comes from studies in which researchers have shown that, when these conditions are met, newborns can make their way up their mothers' bellies, locate the nipple, and begin to suckle by the end of the first hour after birth. When babies are compromised by drugs given in labor, the process is disrupted by delivery room routines, or mother and baby are separated even briefly, the instinctive behavior disappears.[31, 38, 45]

Contrast this with the modern management of babies and mothers in the typical hospital. The infant is subjected to dozens of manipulations and disruptions in the critical first hour after birth. During this "golden hour," a healthy baby may be suctioned repeatedly, cut off from a substantial proportion of its blood supply, stimulated with vigorous touch, placed in a warmer under bright lights, handled by multiple members of the hospital staff, bathed, placed naked on a scale, given one medication that obscures vision and another that is administered by painful intra-muscular injection, wrapped in multiple layers of blankets, and then eventually handed to his or her mother for bonding, attachment, and feeding to begin. In that same interval, the typical healthy mother may have been given exogenous oxytocin, undergone suturing, endured vigorous uterine massage, and been sponge-bathed by staff, all while she is probably recovering from the numbness of an epidural. If she has had a cesarean section, both she and her baby will experience many more interventions and prolonged separation, and the mother will be given a cocktail of opioids—which are excreted in breast milk—to control post-operative pain.

These routines and procedures do not even remotely resemble physiologically normal behavior, and yet nearly 40% of a national sample of babies born in 2005 spent most of the first hour after birth not with their mothers or fathers but in the arms of hospital staff for "routine care."[10] What are the origins and rationales for such routines? Does the research evidence support those rationales? If not, what are the consequences of overriding normal physiology?

ACTIVE MANAGEMENT OF NEWBORN TRANSITION: HOW WE GOT HERE

A number of factors have contributed to the development of newborn routines in hospitals today. Many routine newborn procedures and interventions can be traced back to the twilight-sleep era, when the drugs that induced amnesia in mothers crossed the placenta, inducing respiratory and neurologic depression in some newborns. Forceps deliveries, along with the birth injuries they sometimes caused, were common. In short, many babies were born in poor condition and in need of stimulation, resuscitation, and ongoing observation. To make matters worse, mothers recovering from the prolonged effect of the drugs used in labor were incapable of caring for their babies, so newborns were kept in nurseries for many hours after birth. While we have come a long way since that

era, newborn routines may still be addressing iatrogenic problems that no longer exist, and creating new ones in the process such as hypothermia, respiratory distress, and hypoglycemia.

Current newborn routines also satisfy hospital concepts of efficiency. In most hospitals, mother and baby are transferred to a new room after birth, so protocols require staff to complete postpartum tasks expeditiously to make the room available for the next labor admission. This "processing mentality" (p. 1332) does not allow for the time, privacy, and undisturbed environment required for mother-infant attachment and breastfeeding.[41]

Another factor is the belief that labor is stressful and potentially dangerous for fetuses. Separating mothers and babies after birth, beginning with immediate clamping of the umbilical cord, may be seen as an act of rescue. Only after the babies are evaluated for potential ill effects of the birth process and determined to be medically stable may they be returned to their mothers. Similarly, many consider the immediate postpartum period an intrinsically risky time for mothers, and active management of the third stage, along with frequent assessments of bleeding and vital signs, precedes all other care. Bonding and attachment are seen as niceties to be achieved after the "patients" have been medically "stabilized." (See text box "Stabilizing the Patients.") This belief system does not admit the possibility that the problems seen may be the iatrogenic result of interventions, early separation, or both.

Stabilizing the Patients

Within the medical model, treatments are aimed at stabilizing patients after illness, injury or surgery, and providers rely on vital signs—heart rate, respiration rate, blood pressure, body temperature—to determine whether treatment has succeeded or more is needed. Immediately after childbirth, both mother and newborn experience rapid transitions, but what normally occurs when they remain undisturbed after birth works as a built-in stabilization mechanism. Transfusion of blood from the placenta to the baby provokes respiration in the infant while simultaneously draining the placenta, which facilitates placental detachment.[25, 34] Efficient detachment and delivery stabilizes maternal bleeding. When the mother holds the baby skin-to-skin, the baby's temperature and respiration stabilize, while the movements of the baby's hands, feet, and mouth stimulate a rush of oxytocin in the mother, aiding uterine involution.[22, 28] The baby undergoes an oxytocin surge as well, and, as skin-to-skin and eye-to-eye contact continue, the oxytocin in both mother and baby counteracts high levels of stress hormones, calming both and stabilizing respiration and heart rate.[4]

When providers separate mothers and babies and rely on machines, drugs, and instruments to "stabilize" them, they override the normal, interdependent physiological transition. The result is often to *destabilize* the "patients." Unstable patients require treatment, which in the conventional medical model comes in the form of yet more intervention and separation.

Providers who recognize that childbirth is a normal physiologic process know that the mother and baby stabilize *each other* after birth. As a result, the postpartum care they provide looks very different from what we have come to expect in many American hospitals. Rather than demanding that the mother and baby accommodate institutional routines and treatments, care after birth is arranged to accommodate the mother and baby and support their transition. Birth attendants assess the mother-baby pair without disturbing this process, and often without even touching them. When a mother or baby does deviate from normal—for example, the baby becomes hypothermic or the mother bleeds excessively—treatments, when safe and feasible, incorporate the intrinsic ability of mother and baby to mutually stabilize one another, e.g., the birth attendant may return the baby to skin-to-skin contact or help the baby breastfeed.

WHEN INTERVENING BECOMES THE NORM

Routine interference in newborn transition is now so commonplace that some interventions have become invisible. As recently as the 2000 edition, the authors of *Neonatal Resuscitation*—studied by every perinatal nurse, doctor, and midwife in the United States—erred in describing normal physiologic transition. Among the "changes that take place within seconds after birth, they state that "the umbilical arteries and vein are clamped" (p. 1-5),[17] as if, somehow, cord clamping happened on its own. Such passive language describing actively applied interventions pervades clinical textbooks, as we can see in the quote from *Williams Obstetrics* that introduces this chapter.

This phenomenon is not just a problem of semantics. Researchers repeatedly present refraining from intervening as the experimental arm in trials of safety and effectiveness. Treating interventions as the norm puts the onus on proving that *not* intervening is beneficial. When framed in this way, demonstrating equivalence will not be good enough to bring about change. Even when significant benefit is demonstrated for physiologic care, practice is slow to change and a double standard persists. For example, a commentary accompanying a large systematic review that established the safety and benefits of delayed cord clamping advised,

"Clinicians who are charged with the subsequent care of the newborn should be informed about the delayed cord clamping. This information will increase the awareness of pediatricians, neonatologists, and others who care for the newborn about the need for subsequent observation and management of potential adverse effects" (p. 1258).[29] No warning was given for babies undergoing immediate cord clamping even though the review showed it to be the riskier practice. (See mini-reviews 2-4.)

Despite having the deck stacked against physiology, a growing body of literature consistently concludes that physiologic care *is* beneficial, routine intervention *is* harmful, and optimal transition depends on keeping babies and their moms together. This chapter focuses on three examples of the impact of disrupting normal newborn transition, examining the evidence against suctioning and early umbilical cord clamping and in favor of skin-to-skin contact.

Suctioning

Routinely suctioning the newborn arose from concerns that fluids present at birth—amniotic fluid, blood, and, sometimes, meconium—presented a danger to the infant as it established respiration. Using a bulb syringe or a flexible catheter (e.g., a DeLee catheter) attached to a suction device, a provider may suction the baby's mouth and nose (oronasopharyngeal suctioning) when the head has emerged, after the baby is born, or both. Adopted into widespread practice without evidence supporting it, routine suctioning has only recently been met with emerging research on its effectiveness and potential harms in a series of extremely small trials with a limited number of outcome measures.[5, 14, 15, 42] None of these trials found differences in clinical outcomes between suctioned babies and babies left alone. Because the studies are small, however, they may have lacked the statistical power to detect differences in less common adverse outcomes. If clinically important differences existed, though, they would probably have favored not suctioning: all of the available data showed that suctioned babies took longer to reach full oxygenation after birth, which suggests that, rather than enhancing ventilation, suctioning may actually disrupt it. (See mini-review 1 and text box "Baby's First Breath: How it Happens.")

Babies delivered by cesarean surgery are at higher risk for transient tachypnea (rapid breathing) and have more fluid in their lungs after birth, but neither logic nor evidence support suctioning. It is illogical that excessive fluid in the pulmonary alveoli could be resolved by suctioning the upper or mid-airway. Indeed, the only trial of routine oronasopharyngeal suctioning in babies born by elective cesarean with clear amniotic fluid found that suctioning diminished oxygen saturation compared with babies who were not suctioned.[14] (See mini-review 1.)

The literature on suctioning in the presence of meconium-stained amniotic fluid is much more robust because meconium is believed to be highly caustic to

airways and because meconium aspiration syndrome (MAS) is life-threatening. However, after decades of believing that MAS resulted from events occurring when the infant established respiration, researchers are now exploring other pathologic mechanisms. Consensus is growing that chronic antepartum conditions such as hypoxia or infection are the primary causes of MAS.[37] Suctioning, therefore, cannot prevent it. In support of this, as researchers have begun to evaluate the effectiveness of suctioning in preventing MAS, the recommendations have become less aggressive with each trial. Routine endotracheal intubation and suctioning has given way to suctioning with or without intubation for increasingly selective clinical conditions.[46] No one yet has conducted a randomized controlled trial (RCT) of the only remaining MAS prevention recommendation at birth: endotracheal intubation and deep suctioning of the non-vigorous infant. (See mini-review 1 and appendix "Optimal Practice for Not-So-Optimal Babies.")

The ingrained belief that suctioning is harmless means that studies have not evaluated adverse effects. What little we know, however, suggests that routine suctioning may pose significant risks, as evidenced by the finding of reduced oxygen saturation in suctioned babies. Other potential risks discussed in the literature but not yet studied are apnea, cardiac arrhythmias, delay in resuscitation, and damage of the upper airway.

Absent from the literature, as well, are studies of the impact of suctioning on breastfeeding. Tissue trauma in the upper airway could lead to painful suckling, oral aversion, and difficult latch. A study of gastric suctioning (not a routine practice in most settings today, but similar to oronasopharyngeal suctioning) reports a significant decrease in prefeeding behaviors in suctioned babies.[45] It is possible that suctioning may be responsible for a significant proportion of the early breastfeeding difficulties experienced by so many women and infants today.

If oronasopharyngeal suctioning is not effective and may be harmful, why does the practice persist? National recommendations cannot be blamed. The Neonatal Resuscitations Program Guidelines do not recommend suctioning as a component of routine care in healthy babies nor even in those requiring resuscitation. Likewise, intrapartum suctioning is no longer recommended when meconium is present. However, routine suctioning has become a habit for clinicians, many of whom may continue to assume it is beneficial. Until we have compelling evidence of harm, the double standard that favors intervention will ensure that suctioning remains the norm.

Baby's First Breath: How it Happens

Within seconds after birth, a newborn baby's lungs rapidly change in both structure and function. Before birth, the lungs are filled with fluid, fetal circulation largely bypasses them, and their resistance to blood flow is high. Fetal breathing movements are present but sporadic. As the baby transitions, air must replace fluid in the lungs, resistance to blood flow must drop to allow circulation to the lungs, and the baby must begin regular and continuous breathing movements.

No theory of the physiology of newborn respiratory transition adequately explained the full range of both normal and pathologic outcomes until, in 2002, Mercer and Skovgaard published a seminal paper proposing the Blood Volume Model for newborn transition.[25] Thoroughly analyzing the scientific literature from multiple disciplines, they demonstrated that "successful neonatal transition is dependent upon a newborn having an adequate *blood* volume to recruit the lung for respiratory function through capillary erection and an adequate *red cell* volume to provide enough oxygen delivery to stimulate and maintain respiration" (p. 59, emphasis in original). Key to their model is the hypothesis that the first breath occurs as a *passive* rather than an active process.

The process begins in utero, where strong contractions during second stage propel blood from the placenta into the fetus, which in turn increases perfusion throughout the body, including the lungs. This leads to increased blood-flow to the lung capillaries, which form a scaffolding-like matrix surrounding each alveolus, the sac-like structures where air exchange takes place. If the umbilical cord remains unclamped, perfusion increases further after birth as the placenta rapidly transfuses additional blood volume to the baby. This process causes the capillaries to stiffen, pulling open the alveoli they surround. Meanwhile, lowered resistance routes more and more blood into the pulmonary vasculature. The osmotic pressure in the blood-filled capillaries draws fluid out of the alveoli. As fluid moves out, air passively moves in, gently producing the baby's first breath. Oxygen levels rise, and in response the respiratory center in the brain switches on and stimulates continuous respiration.

Timing of Cord Clamping

At any moment, a substantial proportion of fetal blood supply is circulating through the placenta. After birth, the baby recaptures much of that supply. The umbilical arteries, which deliver deoxygenated blood from the baby to the placenta, constrict reflexively in response to rising oxygen levels, the drop in ambient

temperature, and other stimuli, while the umbilical vein remains open for several minutes. This one-way street results in a net blood flow to the baby after birth that can amount to as much as 40% of the baby's blood volume.[25] (See also mini-review 2 in chapter 16.) As long as the placenta remains attached to the uterine wall, this blood is oxygenated, providing a safety cushion as the newborn transitions to air breathing. Even after placental detachment, deoxygenated blood may continue to flow and augment the baby's blood volume as the contractions of third stage force additional blood out of the placenta.

Immediate cord clamping overrides normal physiology, depriving babies of this placental transfusion. We have known this for decades, yet immediate cord clamping remains standard practice and is fervently defended. Nonetheless, neither logic nor clinical arguments for preventing placental transfusion stand up to scrutiny.

High on the list of purported risks of normal placental transfusion is polycythemia, defined as newborn hematocrit (the percentage of blood volume comprised of red blood cells) exceeding 65%. The real concern is not too many red blood cells but increased blood viscosity. Blood that is too thick can lead to organ damage, but as it is difficult and time-consuming to measure viscosity directly, hematocrit is used as a stand-in. Like so many other surrogate measures, hematocrit correlates poorly with clinical outcomes. In this case, it does not even correlate with viscosity, itself a surrogate outcome. In one study of over 2400 newborns born at 34 or more weeks of gestation, hyperviscosity occurred in fewer than half of infants with polycythemia.[12] Clinical symptoms such as poor perfusion, respiratory problems, irritability, and feeding difficulties are much rarer still and almost always occur in newborns with other serious problems.[25] Evidence suggests that polycythemia may itself be a result of such problems, not the cause,[43] which would mean that clamping the cord cannot prevent it.

So to what extent does timing of cord clamping contribute to the polycythemia "problem"? We have, in fact, no evidence that it contributes at all, at least in babies at low risk. A 2007 systematic review of early vs. delayed cord clamping in term infants revealed that none of the polycythemic infants in any of the seven included trials that evaluated that outcome displayed any symptoms at all.[16] Furthermore, asymptomatic polycythemia occurred in babies who experienced both immediate clamping and delayed clamping, suggesting that timing of umbilical cord clamping is not the only factor determining red blood cell volume. (See mini-review 3.)

Those who defend early clamping also claim that clamping the umbilical cord helps stimulate the baby's first breath, and therefore eases newborn transition. But is sooner necessarily better? The few researchers who have pondered this question have determined that a delay may be normal if not beneficial. Although babies who experience immediate cord clamping take their first breaths sooner than those whose cords are left intact, experimental studies have demonstrated that

the exchange of gas in the newborn's lungs becomes effective only after several breaths.[25] This suggests that, during these first breaths, the baby is still exchanging gases via blood flow through the placenta while physiologic changes occur to enable effective gas exchange in the lungs. (See text box "Baby's First Breath: How it Happens.") Thus, undisturbed blood flow through the umbilical cord creates a margin of safety for adapting to air breathing, a margin removed when clamping the cord prematurely cuts the baby off from its mother. The quick gasp and sharp cry taken to be a sign of newborn well-being may be another iatrogenic norm: not normal at all, but nature's emergency back-up plan to ensure survival.

In addition to physiologic significance, delayed cord clamping has clinical benefits. Studies have consistently found a significant reduction in the risk of anemia and other hematologic deficiencies that persists several months after birth. (See mini-review 2.) Especially in populations where infant anemia is endemic, reduction of anemia has major public health significance. Unfortunately, this has not sufficed to outweigh the clinician's perception of the paramount importance of an immediate first breath.

It is easy to understand such widespread resistance among clinicians. Nursing and medical schools have traditionally taught students to mind their "ABCs"—airway, breathing, circulation, in that order. In marked contrast, everything we know about physiologic newborn transition tells us that, in the moments after birth, babies need CAB—circulation, airway, breathing. (See text box "Baby's First Breath: How It Happens.") As researchers who have studied newborn transition physiology point out, failure to understand normal newborn transition increases "the risk that a single factor, examined out of context, will direct interventions" (p. 59).[25] The real goal is optimal transition to continuous respiration and effective ventilation, but interference with the physiologic process in pursuit of a quick first breath may achieve the opposite.

What about the baby who is born needing resuscitation? The cord is typically clamped immediately and the baby removed to a table for staff to begin resuscitative measures. However, with very few exceptions, babies born not breathing have a pulse and are circulating blood through a still-functioning placenta. Cutting a compromised baby off from its placenta and depriving it of as much as 40% of its blood supply so that staff can mechanically and artificially assume the functions of the placenta affronts common sense. Nevertheless, neonatal resuscitation guidelines that prioritize airway and breathing over circulation dictate doing exactly that.

Similarly, clamping the cord immediately to get a cord blood sample to diagnose acidemia in a compromised baby makes equally little sense. Studies of the effect of timing of cord clamping on blood gas values have involved only healthy babies with blood gas values in the normal range.[9, 19, 44] These studies offer inconsistent evidence regarding to what extent blood gas values are affected by delayed

clamping but suggest that some gas exchange occurs in the minutes after birth. Logic dictates that, by cutting the baby off from the placenta where gas exchange may still be occurring, clinicians may potentially exacerbate the very condition that has raised concern.

A nuchal cord (a cord looped around the baby's neck) is another reason given for clamping and cutting even before birth. The rationale appears to be that severing the cord will speed the delivery, improving newborn outcomes.[33] However, all but the tightest nuchal cords can be unlooped or left alone and the baby guided through the loop. Leaving the cord intact allows placental transfusion after birth to correct acidemia or hypovolemia that might have resulted from cord occlusion during labor.[26] Illogically, in the one RCT of nuchal cord management, the cord was severed either after the birth of the head or immediately after the birth of the body, denying both groups transfusion of placental blood after birth.[33] Not surprisingly, the investigators found no differences in outcomes between groups.

Recently, a new rationale for early cord clamping has emerged: the harvesting and banking of umbilical cord stem cells. Hematopoeitic stem cells are the cornerstone of "regenerative medicine" and umbilical cord blood is a rich source. In laboratory and clinical studies, stem cells derived from umbilical cord blood have shown the ability to regenerate damaged nerves and blood vessels. Research also shows promise that stem cells might someday play a role in treating many different conditions, although current applications are more limited.[27] No one on the stem cell band wagon seems to have considered the potential benefits of stem cells self-administered via an intact umbilical cord after birth. It seems likely, given what we know, that hematopoetic stem cells, immune factors, or other components of cord blood can heal damage from birth injuries or other insults occurring in the perinatal period.[35] Ironically, researchers and cord blood banking companies have begun to tout infusing *banked* cord blood stem cells into babies suffering from the effects of birth asphyxia.[39]

What we think we know about the needs of newborns after birth comes from several generations of clinicians and researchers observing babies whose first task has been to overcome the effects of immediate cord clamping. This means we have been evaluating and measuring not normal physiology but the adaptations the baby must make to accommodate disruption to it. Consequently, technological interventions abound to treat failures of newborn transition with no awareness that such failures may, in many cases, be iatrogenic effects of intervention. By reestablishing physiologic management of newborn transition as the standard of care, starting with delayed cord clamping, we will be able to observe truly normal newborn transition. This will enable us to learn new strategies both for supporting newborns during this time and assisting effectively when transition is compromised.

Skin-to-Skin Contact

In their natural environments, mammal mothers and babies, including humans, normally remain in continuous physical contact after birth. Anyone knowledgeable in animal husbandry knows that separating mothers from their newborn young can have serious consequences for the success of newborn transition, maternal attachment, and lactation. We have no reason to believe that humans are an exception. Nonetheless, in the typical hospital, newborns are routinely separated from their mothers for evaluation and administration of routine treatments to baby and mother. As we shall see, however, failing to apply what we know about mammals to humans causes considerable iatrogenic harm.

The survival of the human infant, the most helpless of all mammalian young, depends on its ability to elicit maternal feelings in its mother so that she will nurture and protect it. The attachment process is mediated largely through oxytocin and catecholamines secreted in both mother and baby and regulated by skin-to-skin contact after the birth.[2] When skin-to-skin contact does not occur, hormone secretion—and thus biological attachment—is disrupted.

At the moment of birth, both the mother and baby are wide-eyed and alert under the influence of very high levels of catecholamines. While being at high alert and protected against stress is optimal at birth, continuing high levels of stress hormones are not. So after birth, mothers and babies who are skin-to-skin experience a surge of oxytocin that sharply down-regulates catecholamines, restoring a calm and stable state.

Separation, therefore, may result in prolonged stress, as oxytocin levels are insufficient to antagonize catecholamines. Babies signal distress by crying, and in randomized trials human babies separated from their mothers cry much more than those held skin to skin.[28] They also exhibit a characteristic "separation distress cry."[6] In other mammals that demonstrate separation distress, compromised health and intelligence in the long term typically follow.[28] (See mini-review 7.) Among mothers, those experiencing skin-to-skin contact with their babies exhibit more affectionate behavior toward their infants,[28, 40] which may result from the anti-stress effects of the contact.[36] (See mini-review 8.)

Oxytocin is also involved in one of the most dramatic benefits of skin-to-skin contact: enhanced breastfeeding. Babies exhibit an inborn "prefeeding behavior" of mouthing and rooting movements, and this physical stimulus is thought to stimulate oxytocin secretion in the mother. Oxytocin, in turn, mobilizes energy for milk production, increases the skin temperature of the mother's breast, and promotes calm, loving behavior in the mother while nursing.[36] As a result, infants who experience early skin-to-skin contact establish effective breastfeeding sooner, are more likely to be breastfeeding at one to four months, and breastfeed longer than infants without such early contact. (See mini-review 5.)

When the mother and infant establish effective breastfeeding, the calming effect seen at birth is likely to persist, thanks again to oxytocin. Studies of humans

and other mammals suggest that repeated exposure to oxytocin induces anti-stress effects and promotes health even well after the exposure ceases.[36] Oxytocin mediates positive social interaction—mother-infant attachment behavior being a notable example—which in turn enhances oxytocin release in a positive feedback loop.[18, 36] A systematic review and subsequent RCT of early skin-to-skin contact showed that differences in some maternal attachment behaviors between groups persisted as long as one year after the contact occurred.[3, 28] (See mini-review 8.)

Despite the clear evidence that separation after birth disrupts attachment and breastfeeding, clinicians often rationalize separation of mothers and babies in the name of ensuring that mother and baby are healthy and stable after the birth. (See text box "Stabilizing the Patients.") What medical model practitioners fail to recognize, however, is that skin-to-skin contact is itself the best means to stabilize both.

To begin with, skin-to-skin contact promotes thermal stability in the newborn. Oxytocin dilates surface blood vessels in the mother's skin, resulting in heat transfer to the baby. This heat transfer rapidly and effectively stabilizes the baby's temperatures within the optimal range. The process is so physiologically precise that mothers of twins have demonstrated the ability to raise the temperature of each breast differentially to meet the thermal needs of the individual babies during shared "kangaroo care."[20] (See mini-review 6.) Babies removed from their mothers are at risk for hypothermia and, when kept under a radiant warmer, the opposite problem: hyperthermia.[47]

Moreover, infants deprived of skin-to-skin contact have to expend extra energy to keep themselves warm. This puts them at risk for hypoglycemia (low blood sugar). The Cochrane systematic review of early skin-to-skin contact showed that babies removed from their mothers have much lower blood sugar, on average, than babies held skin-to-skin.[28] (See mini-review 6.)

In conventional maternity care settings, the need for staff to "do something" overrides the baby's and mother's biological need for undisturbed intimate contact after birth. However, skin-to-skin contact itself does so much of what babies need: it provides warmth and comfort, offers an ideal environment for respiratory, cardiac, and metabolic stabilization, and prepares the infant and mother for effective breastfeeding. Skin to skin with her baby, the mother experiences a surge of calming hormones that also work to decrease her bleeding. The consistent and compelling evidence for the myriad benefits of skin-to-skin contact offer clear guidance to perinatal care providers: doing less is doing more.

FIRST, DO NO HARM

One may ask: if conventional newborn routines are so detrimental, why do we not see the harms? First, otherwise healthy term babies are extremely resilient. Evolution has built in the ability to compensate for insults such as acidemia, hypoxia, and

hypovolemia (low blood volume). Human mothers too can overcome obstacles to attachment and lactation. For this reason, the harms done to most mother-baby pairs will not be severe enough to be noticed.

Second, the universality of newborn routines and procedures renders their adverse effects invisible. Very few hospital-based practitioners have ever seen a completely undisturbed physiologic newborn transition, and even many out-of-hospital practitioners intervene routinely. With no physiologic care comparison group, adverse effects resulting from these routines are presumed to be intrinsic to the newborn period.

Finally, we must face the possibility that perhaps we *are* seeing the negative effects of our cultural habit of meddling with newborns. It would be impossible to isolate the effects of interventions in the newborn period on complex health and behavioral outcomes in infancy and beyond, but for some outcomes the harm is clear. Initiation of breastfeeding, which we know is an innate behavior that can require nothing more than patience and undisturbed contact between the mother and baby, has become the realm of professional lactation specialists. The transition to motherhood is increasingly marked by depression and isolation,[11] yet we know that mothers experiencing skin-to-skin contact with their infants at birth exhibit more attachment and positive parenting behaviors many months after the contact occurred,[28] and longer duration of separation after birth is associated with maternal mood disturbances persisting eight months or more.[32]

Although the amount and scope of literature on newborn practices is limited, studies agree that routine interference with newborn physiologic transition does harm without counterbalancing benefit. Worse yet, as the research currently stands, we do not know what we do not know. The harms we know of to date may be only the tip of the iceberg—hints of the dangers below, on which new mothers and their babies founder every day at the hands of those who thought they were doing them good.

STRATEGIES FOR OPTIMAL CARE

- Abandon routine newborn suctioning whether by bulb syringe or flexible catheter, including of vigorous infants with meconium in the fluid. There is insufficient evidence to determine under what circumstances, if any, suctioning is indicated.
- Delay clamping the umbilical cord until after pulsations cease, and longer if the mother prefers.
- If there is a clinical need to clamp the umbilical cord before pulsations cease, hold the baby below the level of the placenta prior to clamping, if possible. Gravity speeds placental transfusion.
- Initiate resuscitative measures with the umbilical cord intact if pulsations are present.

- If the mother, the newborn, or both may be experiencing severe hemorrhage due to placental abruption, uterine rupture, or other urgent complications, clamp the umbilical cord immediately.
- Maintain continuous skin-to-skin contact between the mother and newborn for at least the first hour after birth. If the mother's condition precludes skin-to-skin contact, place the baby in skin-to-skin contact with the father or another birth companion.
- Perform routine assessments, such as assigning Apgar scores, with the newborn in skin-to-skin contact with the mother.
- Delay all nonurgent treatments or procedures until after the first one to two hours after birth.
- Encourage breastfeeding in the first hour after birth and offer assistance as needed.
- Encourage frequent skin-to-skin contact during the first several days after birth.

MINI-REVIEWS

Notes:

- We have restricted our analysis to the effect of interventions on term infants. While effects on preterm infants are outside of the scope of this review, there is ample evidence that both delayed cord clamping and early skin-to-skin contact are beneficial in this population.[7, 23, 30]
- Assume differences are statistically significant unless otherwise noted.

1. Routine newborn suctioning does not improve newborn outcomes and may be harmful.

Although the practice of oronasopharyngeal (mouth and nose) suctioning is nearly universal, the body of literature on its safety and effectiveness is limited. Moreover, to date, all suctioning trials are small and rely on surrogate outcome measures, hampering our ability to detect clinically important differences between suctioned and unsuctioned newborns. However, while the available evidence is insufficient to adequately evaluate the potential harms of suctioning, surrogate endpoints (lab results and the like) remain a useful tool for ruling out clinically significant benefits. Thus we have included four trials of suctioning vs. no suctioning, all of which evaluate the effect of suctioning on the arterial oxygen saturation (SaO2) of newborns in the first twenty minutes after birth. As the routine practice of suctioning newborns is defended on the basis that it enhances lung ventilation, arterial oxygen saturation is a reasonable outcome to evaluate despite its lack of consistent correlation with clinically important outcomes.

Two RCTs compared outcomes of newborns who underwent suctioning by flexible catheter immediately after vaginal birth with newborns who did not.[5, 15] One trial, conducted

in Uruguay,* enrolled 30 women (15 in each group);[5] the other, conducted in Turkey, involved 140 participants (70 in each group).[15] Both trials used similar methodology and included only babies born to healthy women with no obstetric complications, who gave birth vaginally, and who had clear amniotic fluid. Additionally, the smaller trial excluded women who received any medications in labor while the larger trial excluded those who received medication other than epidural analgesia. In both trials, suctioned babies took longer to reach two clinically important thresholds of oxygen saturation: 86%, below which pulmonary hypertension can occur, and 92%, the lower limit of normal saturation after transition is complete. In the smaller trial, suctioned babies took an average of 8 minutes to reach 86% SaO2 and 10 minutes to reach 92% SaO2, vs. 5 minutes and 7 minutes, respectively, in the no-suction group. In the larger trial, all newborns in the no-suction group had achieved 92% SaO2 by 6 minutes whereas none of the newborns in the suction group reached 92% until 8 minutes, with the longest time being 11 minutes. Additionally, in both trials, minute-to-minute comparisons revealed that SaO2 remained consistently lower in the suctioned group from the first through sixth minute of life. In both trials, all babies were born healthy and had Apgar scores greater than 7, and none experienced respiratory distress.

Babies born by cesarean surgery are known to be more likely to have fluid in their lungs. For this reason, Gungor and colleagues evaluated the effectiveness of suctioning for removing excess fluid in babies born by elective cesarean.[14] Repeating the methodology of their earlier trial of vaginally born infants, the investigators randomly allocated 140 newborns of healthy women to either undergo suctioning with a flexible catheter immediately after birth (n = 70) or receive no suctioning (n = 70). Again, although none of the babies exhibited clinical symptoms of respiratory distress, SaO2 values consistently demonstrated impaired oxygenation in the suctioned group. The mean SaO2 values through minutes 2 and 6 of life were higher in the group not suctioned compared with the suctioned group. Similar to the findings in vaginally born infants, none of the suctioned infants born by cesarean section reached 92% SaO2 before 7 minutes, whereas all of the unsuctioned neonates reached that level by 6 minutes. A similar pattern was seen for the threshold of 86%.

Only one trial could be found that evaluated routine suctioning with a bulb syringe.[42] Although it is methodologically weak, we have included it because it is the sole trial examining this method. This pilot study enrolled only 10 infants in each group. All babies were born vaginally at term to mothers without complications and with clear amniotic fluid. In the suctioned group, doctors suctioned the nose and mouth after the head delivered but before the shoulders emerged (intrapartum suctioning) and suctioning was performed again by a nurse in the first minute after birth. The investigators were unable to obtain accurate oxygen saturation readings until 5 minutes after birth. The suctioned group had lower SaO2 levels at 5 minutes, although the difference did not achieve statistical significance. By 10 minutes after birth, SaO2 levels were similar, and the mean SaO2 in both groups was above 92%. One baby in the no-suction group had mild respiratory distress and received supplemental oxygen for approximately 24 hours after birth. This infant was born at 37 weeks and the investigators believed that the baby's gestational age, rather than suctioning status,

* We included this trial conducted in a developing country because it enrolled only mothers who did not use pharmacologic analgesia, thus removing its potential confounding effect, and because the results are unlikely to have been different in a developed country.

contributed to the respiratory problems. The study authors concluded that a larger study of bulb suctioning is feasible and warranted. Until that trial takes place, no evidence supports routine bulb suctioning, and it should be abandoned on those grounds.

Systematic Reviews of Cord Clamping Timing

Two systematic reviews comparing early with late clamping of the umbilical cord have been published. Hutton and Hassan (2007) included both randomized and quasi-randomized trials while McDonald and colleagues (2008) limited their analysis to RCTs.[16, 24] The included RCTs are the same in both systematic reviews with three exceptions, all of which appeared in McDonald but not Hutton: a 1966 trial involving 379 participants that reports Apgar scores and respiratory distress; a study published after Hutton's cut-off date that reports hematologic outcomes of 105 babies in an area of Zambia where malaria is endemic; and a large, apparently methodologically sound but unpublished study conducted by McDonald herself for her doctoral dissertation. As none of these studies meet our inclusion criteria, we will report outcomes from Hutton (2007), except for the sole clinically significant outcome for which the two reviews provide different results: neonatal jaundice requiring treatment.

2. Immediate cord clamping increases the likelihood of infant anemia and other hematologic deficiencies up to six months after birth.

A 2007 systematic review and meta-analysis revealed that delayed cord clamping was associated with an 80% reduction in the likelihood of newborn anemia at 24-48 hours (1 trial, 179 infants) and half the risk of anemia at 2-3 months (2 trials, 119 infants).[16] Statistically significant differences disappeared by 6 months (1 trial, 356 infants). Results were similar across studies regardless of the level at which the infant was held with respect to the placenta. One large RCT included in the review reported that delayed cord clamping had a greater effect on reducing the likelihood of anemia in infants of anemic mothers than in those of nonanemic mothers.

Consistent with the lower likelihood of anemia, mean hemoglobin and hematocrit levels were higher in the delayed clamping group, a finding that was also demonstrated in a small trial published after the systematic review.[48] In the systematic review, delayed cord clamping also increased mean serum ferritin levels (an indicator of iron deficiency) at two to three months (2 trials, 144 infants) and at six months (1 trial, 315 infants).

3. Immediate cord clamping does not prevent symptomatic polycythemia.

In their meta-analysis, Hutton and Hassan (2007) found an increase in the likelihood of polycythemia at 7 hours (2 trials, 236 neonates) and at 24 to 48 hours (7 trials, 403 neonates) in babies who underwent late (≥ 2 minutes after birth or when pulsation ceased) umbilical cord clamping.[16] However, when the investigators limited their analysis to high quality trials, the differences were no longer significant. Importantly, none of the polycythemic infants in any of the included studies exhibited any clinical symptoms. The reviewers also note that some infants in the immediate clamping group were also polycythemic, which

they suggest may indicate that uncomplicated polycythemia may be a normal finding in the early newborn period that reflects the rapid hematologic shifts occurring during this time.

4. Evidence that immediate clamping reduces the incidence of jaundice requiring treatment is mixed, but if delayed clamping imposes an excess risk, the absolute excess is small.

In the 2007 systematic review, meta-analysis of early and late clamping (8 trials, 1009 infants) found similar rates in the likelihood of jaundice at 24-48 hours and at 3 to 14 days after birth (1 trial, 332 infants).[16] Likewise, the Cochrane systematic review failed to find significant differences in jaundice rates at any point after birth (5 trials, 1828 infants).[24]

The findings related to jaundice requiring treatment differ between the two meta-analyses of early vs. late cord clamping.[16, 24] Hutton and Hassan (2007) found no significant differences between groups in the use of phototherapy to treat elevated bilirubin levels (3 trials, 699 infants). With the addition of McDonald's unpublished data and the Zambian study (in which no babies in either group had phototherapy), the difference reached significance and favored early clamping (5 trials, 1762 infants). The absolute reduction was small: 2 fewer babies per 100 would require phototherapy with early cord clamping.

5. Early skin-to-skin contact after birth results in improved initiation and duration of breastfeeding and a greater likelihood of exclusive breastfeeding.

In the Cochrane systematic review of early skin-to-skin contact in healthy newborns, breastfeeding outcomes were measured in 16 trials (1161 mother-infant pairs).[28] Meta-analysis was performed for most outcomes for which there was data from more than one study. Differences favoring skin-to-skin contact were found for nearly every breastfeeding measure despite variation across studies in the context and timing of skin-to-skin contact and in other clinical or cultural factors that might affect breastfeeding. Babies who experienced early SSC were more likely than control infants to nurse successfully on the first attempt (3 trials, 243 mother-infant pairs), and to be breastfeeding at hospital discharge (2 trials, 149 pairs), at three days postbirth (1 trial, 56 pairs), and at one to four months postbirth (10 trials, 552 pairs). They were less likely to start supplemental feeding before two months of age (1 trial, 92 pairs) and more likely to be breastfeeding exclusively up to four to six months of age (1 trial, 92 pairs).

An RCT published after the Cochrane systematic review involved 274 term babies born vaginally to healthy mothers in a Spanish hospital.[21] Allocation was by pediatrician, such that the pediatrician attending the birth had been assigned to carry out an immediate skin-to-skin protocol or routine care. Infants in the skin-to-skin group were placed immediately on their mother's abdomen after birth, dried, and held skin-to-skin, covered by blankets for two hours, after which routine assessments such as weight and measurement were obtained. Infants in the control group were moved to a radiant warmer for approximately 10 minutes, then wrapped in blankets and returned to their mothers. Infant characteristics were similar in the two groups, except the average birth weight in the skin-to-skin group was lower (3166 g vs. 3300 g). Exclusive breastfeeding at hospital discharge was more common in the skin-to-skin group (85% vs. 70%), although only 65% of both groups were exclusively breastfeeding at 1 month with no significant difference across the two groups.

A prospective, multi-center cohort study of 21,842 healthy mother-baby pairs in 19 California hospitals demonstrates a strong dose-response relationship between the duration

of skin-to-skin contact and exclusive breastfeeding at hospital discharge.[1] Nurses documented the proportion of the first three hours that the mothers and babies spent skin-to-skin. Researchers controlled for feeding intention, education, ethnicity, anesthesia, mode of birth, and other factors. One factor not reported, and apparently not controlled for, was history of prior birth and/or prior breastfeeding experience. This could be a significant confounder, but there is no reason to believe it would negate the strong and consistent findings since the dose-response pattern held up in multiple calculations applying various assumptions.

6. Early skin-to-skin contact prevents hypothermia and improves blood glucose levels.

Of the six trials with newborn thermal outcomes included in the Cochrane systematic review, data from only three could be combined for meta-analysis because of differences in the method and timing of temperature checks.[28] Meta-analysis revealed a nonsignificant increase in axillary temperatures favoring skin-to-skin contact when the contact was maintained for 90-120 minutes after birth. The remaining trials using other measurement techniques uniformly found higher mean temperatures, improved thermal stability, or both in the babies randomized to skin-to-skin contact. While data are inconsistent as to whether skin-to-skin contact is superior to other means of maintaining the newborn's warmth, data consistently confirm that skin-to-skin contact is a safe way to prevent hypothermia in the newborn. Two RCTs published after the Cochrane review address infant temperature. The Spanish study of immediate skin-to-skin contact described in the previous mini-review showed that, while skin-to-skin babies were more likely to be hypothermic in the first minute (22% vs. 8%), 80% of the hypothermic babies in the skin-to-skin group recovered by five minutes compared with only 55% of the hypothermic babies in the routine care group.[21] Moreover, temperature gradually increased over the first two hours in the skin-to-skin group but decreased over the same period in the routine care group. In the other trial, conducted among 34 term babies born after scheduled cesarean surgery to healthy mothers, skin-to-skin contact did not begin until nearly 1 hour post birth, and no differences in infant temperatures were detected.[13]

The Cochrane reviewers meta-analyzed data from two trials (116 healthy, full-term newborns) to determine the effect of skin-to-skin contact on blood glucose. In both studies, blood glucose was measured by two hours with skin-to-skin contact initiated within minutes after birth and maintained continuously until the measurement. The reviewers calculated a weighted mean difference of 11 mg/dl, a finding that is highly significant both statistically and clinically.

7. Early skin-to-skin contact reduces infant crying.

The Cochrane review found a large difference in infant crying between babies experiencing skin-to-skin contact and those separated from their mothers after birth.[28] Heterogeneous outcome measures across studies did not allow for meta-analysis, but a clear and consistent pattern emerged from the literature. In one trial, none of 18 skin-to-skin infants were crying 1 hour after birth while more than half (10 of 18) of infants who were placed in a cot were crying at the 1 hour observation. Another study calculated the total time infants cried during the first 90 minutes after birth. Only 2 of 14 infants who had skin-to-skin contact cried for more than 1 minute during the observation compared with 14 of 15 control infants. A

third trial found babies held skin-to-skin had much less frequent crying episodes and cried for a shorter total duration than those who were separated. Babies who were swaddled and held by their mothers cried more than those held skin-to-skin but less than those in a cot. In all three trials, skin-to-skin contact was continuous for at least an hour and began immediately or soon after birth.

8. Early skin-to-skin contact results in improved mother-infant attachment behavior.

Fifteen of the trials included in the Cochrane systematic review analyzed outcome measures related to mother-infant attachment behaviors.[28] There was marked heterogeneity among the outcomes measured, the context in which investigators observed the behaviors, and other variables. As a result, meta-analysis was possible for only a few outcomes. The reviewers combined data from 4 trials (314 pairs) that assigned summary scores for affectionate contact during breastfeeding between 36 and 48 hours after birth. Meta-analysis revealed that skin-to-skin contact increased the amount of maternal affectionate behavior compared with standard care. An additional trial, excluded from meta-analysis because the data were reported in a manner that did not permit inclusion, reported similar maternal affectionate behavior during breastfeeding between groups.

Other trials support these findings, although the use of different outcome measures and timing of observations precludes direct comparison of the data. One trial found that skin-to-skin contact increased the frequency of maternal contact behaviors during breastfeeding at 2 and 4 days postbirth. Another found that skin-to-skin contact increased maternal holding, touching, and face-to-face behavior during breastfeeding 28-32 days postbirth. A trial conducted among healthy women having scheduled cesarean surgery at term, published after the systematic review, reported that women randomized to immediate skin-to-skin contact spoke to their babies more than women whose babies were randomized to be skin-to-skin with their fathers.[40] The study also demonstrated that newborns respond to vocal interactions from their parents and that those interactions constitute a component of the inborn prefeeding behavior.

Studies that measure the effect of skin-to-skin contact on maternal attachment behavior in the long term have conflicting results. The Cochrane reviewers meta-analyzed data from two trials of maternal kissing and face-to-face behavior during infant play three months after birth and failed to find statistically significant differences, although there were only 60 mother-infant pairs included in the combined analysis, so the meta-analysis may have lacked the statistical power to detect a true difference.[28] Additionally, in one of the trials included in the meta-analysis, babies in the routine care group were swaddled and held for the same amount of time as the skin-to-skin infants, and both groups experienced rooming-in during the day. The intimate contact, though not skin-to-skin, may have decreased differences between groups. On the other hand, another trial included in the review in which the routine care group did not hold their babies at all during the experimental period found that the skin-to-skin group exhibited more affectionate touching and positive holding during an infant physical exam one year after birth. The largest study addressing long-term attachment, published after the Cochrane systematic review, allocated 124 mother-infant pairs to four groups: 1) infants placed skin-to-skin with their mothers after birth and rooming-in with their mothers while in the maternity ward; 2) infants dressed and placed in their mothers'

arms after birth and also rooming-in; 3) infants kept in the nursery both after birth and while their mothers were in the maternity ward; and 4) infants kept in the nursery after birth but rooming-in on the maternity ward.[3] Researchers also documented early suckling, exclusive or near-exclusive breastfeeding, and duration of swaddling. At one year, mothers and infants were videotaped at play and performing a structured task and researchers evaluated multiple variables measuring maternal and child affect, mood, and behavior. Results showed that children who had been clothed or swaddled or who had not nursed in the first hour were more likely to exhibit symptoms of dysregulation (irritability, emotional lability, aggression, impulsivity, or inability to self-regulate) and when researchers observed them at play and performing a structured task, their mothers were more likely to have a flat/constricted affect, lack enthusiasm, or simply seem out of sync with their infants.

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Supportive Care in Labor: Mothering the Mother Versus Serving the Doctor

"Prenatal education . . . should present a realistic picture of the birth experience that is congruent with the philosophy of the birth setting [and] the kind of support that will be available."

Bowers 2002, p. 751[7]

"[Continuous one-to-one support during labor] appears to confer important benefits without attendant risks. . . . Continuous support during labor should be the norm, rather than the exception. . . . Every effort should be made to ensure that women's birth environments are empowering, nonstressful, afford privacy, communicate respect and are not characterized by routine interventions that add risk without clear benefit."

Hodnett 2011, p. 14[31]

There is nothing new about providing laboring women one-on-one continuous supportive care by knowledgeable and skilled women. Historically and traditionally, it has been the norm. According to one anthropological survey cited in a study of doula care, women were accompanied throughout labor by other women in 126 of 127 cultures.[5] Art images as old as a Greek bas relief show women in addition to the birth attendant assisting the laboring woman. With few exceptions, all societies have understood that compassion and humanity demand that women be tended and comforted as they pass through the rigors of childbirth. In recent decades, abundant research has documented the benefits of such care and the harm that can be done by its absence, harm that can last a lifetime.[57] (See mini-review 2.) Research also shows that quality and amount of supportive care, personal relationship with caregivers, and participating in decision-making universally override other factors in determining satisfaction with the birth experience, transcending age, education, socioeconomic status, marital status, culture, and ethnicity. (See mini-review 1.) For these reasons, supportive care is mandated by maternity care authorities, including the World Health Organization,[66] the Society of Obstetricians and Gynecologists of Canada,[23] and the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN).[3]

One would expect, then, that supportive care would be a prominent feature of intrapartum nursing, and, indeed, pregnant women assume this will be so: a survey of pregnant nulliparous women revealed that women expected that half their intrapartum nurse's time would be spent giving them direct supportive care and that all but 5% of the rest would be spent with them in direct clinical care activities.[63] Yet few laboring women in hospitals experience one-on-one continuous supportive care from their intrapartum nurse. Nor, as we will argue, does conventional hospital management enable others to fill the vacuum adequately. We will also contend that the neglect of laboring women's needs for comfort and care is an inevitable byproduct of a failed system. We will tie the reasons why women lack supportive care in labor to a dysfunctional hospital culture and power structure that is inextricably intertwined with medical-model principles and practices and document consequent harms that go far beyond mere dissatisfaction. Finally, we will examine the forces that perpetuate a system that by any standard dismally fails the women and babies it purports to serve.

MISSING IN ACTION: WHY ISN'T SUPPORTIVE CARE PART OF THE PACKAGE?

The Elements of Supportive Labor Care

The labor support research has identified four domains of hospital-based supportive care:[22, 23, 33, 40]

- *Physical support*, including assisting with bathing or shower, position change for comfort, and walking; using a cold face cloth; applying warm compresses; supplying a warmed blanket; massage; reassuring touch; giving ice chips or fluids; reducing environmental stimuli such as dimming lights; and changing linen or gowns for comfort.
- *Emotional support*, including reassurance, encouragement, and praise; keeping company with the woman; joking and social chit chat; encouraging verbalization of fears or concerns.
- *Instruction/information*, including coaching, suggesting techniques to promote relaxation or increase comfort, providing information about progress or fetal status, explaining procedures, and interpreting clinical findings.
- *Advocacy*, including soliciting the woman's requests, interpreting her needs to other staff members, acting on her behalf, and supporting her decisions.

Few women laboring in hospitals receive one-on-one supportive care from a qualified person. Intrapartum nurses, the designated providers, spend only a small fraction of their time in supportive care activities, of which the major portion consists in giving instructions or information. What little supportive care they provide falls woefully short in quality and quantity. (See mini-reviews 4 and 5.)

Conventional obstetric management allots labor support to the woman's male partner or possibly a female family member. Studies show, however, that asking fathers to "mother" often boxes men into a role for which they are unsuited. (See mini-reviews 7 and 8.) Female relatives (or friends) would be more innately suited to "mother the mother,"[38] but few women today have the requisite knowledge or experience, and while minimal training is effective,[8, 9] both they and fathers still lack the specialized skills and experience needed to assist women in the hospital environment.

Doulas, women trained in the art of labor support, could fill the gap. Doulas meet the woman's need for physical and emotional supportive care, and they can provide the instruction/information component, which partners and family members usually cannot, and the guidance and support needed by partners and other loved ones. (See mini-review 3.) Few families, however, have access to doula care. According to Listening to Mothers II,[16] a national survey of women giving birth in the U.S. in 2005, only 3% of women were attended by doulas. The cost of hiring a doula is a likely impediment, but the system often does not welcome independent doulas and rarely integrates doulas as employees or contractors. (See mini-review 6.)

Yet, if everyone agrees on the value of supportive care, why the vacuum? Why, indeed, the active resistance to incorporating it? To answer these questions, let us begin by describing the characteristics of a system prioritizing supportive labor care along with the barriers to its provision.

An optimal system would provide an infrastructure conducive to supportive care. It would include structural accommodations such as deep tubs and showers in each room, an inviting place to walk, a lounge area for women in early labor and their families, and a kitchen with microwave and refrigerator. It would have comfortable labor room furniture that would adapt to sleeping, rocking chairs, birth balls, squatting bars, and a blanket warmer. Intrapartum units would be organized to decentralize nursing tasks so that nurses spent more time in the laboring women's rooms. Supplies would be stored in labor rooms, and monitoring and charting would be set up to be done from labor rooms as well. But converting conventional labor and delivery units would increase costs, and if conversion reduced epidural use, which would be likely, revenues would decline.

Having the infrastructure, however, would not mean women under the strictures of conventional management could take advantage of it. An optimal system would practice physiologic care. Physiologic care promotes and facilitates the

natural process, minimizes use of medical intervention, and attends to psychological as well as physical health. Physiologic care is, therefore, supportive care by definition, but the practices and policies of medical-model management—such as frequent use of labor induction, labor augmentation, and epidural analgesia; confining women to bed; imposing arbitrary time limits; directed pushing; and routine use of continuous electronic fetal monitoring (EFM), IVs, and blood pressure monitoring—are potent antagonists. (See mini-reviews 3 and 4.) A doula describes the difficulties thus engendered:

> Here I was trying to help this one client—you know, you want skin-to-skin contact to stroke and comfort. . . . You can't rub her back because she's got two monitors, the contraction monitor and the baby's monitor. And this particular hospital puts leg cuffs on anyone confined to bed, so her legs are covered from the top of the thigh to the ankle. So I spend the whole time rubbing her shoulders—that was all I could get to (p. 156).[6]

An optimal system would offer one-on-one care throughout labor by a knowledgeable and experienced woman, but providing nursing staff at this level would increase cost without increasing revenue. In addition, supportive nursing care would be valued and rewarded. That it is not is made clear in this plea for reform: "The caring dimensions of nursing practice need to be better articulated and more visible in notations on patient charts, workload measurement systems, performance appraisals, and patient satisfaction surveys. They need to be seen as a routine function of the daily care nurses provide" (p. 54).[15] Medical-model, high-tech management demands that nurses focus on assisting at procedures, recording data, and monitoring and tending equipment, not attending to women's physical and emotional needs. For example, in a video made to analyze social interactions during labor, the nurse glanced at the fetal monitor 19 times to monitor maternal/fetal status during an arbitrarily selected 5-minute segment, including during moments of the woman's greatest distress.[35] Indeed, the Cochrane review of continuous support in labor posits that one reason doulas improve outcomes may be that they counteract some of the stresses of conventional management:

> During labour women may be uniquely vulnerable to environmental influences; modern obstetric care frequently subjects women to institutional routines, high rates of intervention, unfamiliar personnel, lack of privacy and other conditions that may be experienced as harsh. These conditions may have an adverse effect on the progress of labour and on the development of feelings of competence and confidence; this may in turn impair adjustment to parenthood and establishment of breastfeeding, and increase the risk of

depression. This provision of support and companionship during labour may to some extent buffer such stressors (p. 3).*[31]

Still, economic disincentives and medical-model management are not the whole story. Workplace culture plays a role. Although nurses list understaffing as a major obstacle to providing labor support, one work sampling study noted that the minimal amount of time spent providing supportive care did not increase during quiet times,[40] and another found that understaffing rarely occurred.[23] A third work sampling study stands apart from similar studies in that nurses spent a much higher percentage of their time in the labor room and a much higher percentage of their time giving supportive care.[42] But this was no success story: closer examination reveals that the likely reason was that the computerized record system required documentation to be done in the rooms. In other studies, it was rare for the nurse to be engaged in another activity during the limited time they gave supportive care, but in this study, most supportive care consisted of verbal reassurance, and women only had the nurse's undivided attention 14% of the time. In other words, even if the barriers perceived by those within the system suddenly disappeared, the entrenched culture would continue to pose a potent obstacle to change.

WHY ISN'T SUPPORTIVE CARE PART OF THE PACKAGE? EFFECTS OF THE MEDICAL MODEL

Ingrained medical-model beliefs create a mismatch between what medical staff perceive to be appropriate supportive care and the actual needs of laboring women. They also may limit understanding of what constitutes supportive care. For example, nurses may define nursing tasks such as catheterizing women or emptying the Foley bag as "supportive care."[42] (See mini-review 4.) Even when nurses are designated and trained to provide one-on-one supportive care and are assigned to do so, they do not achieve the results of providers who are not hospital employees.[32] (See mini-review 3.)

Medical-model beliefs can also lead nurses to think they are meeting women's needs,[15] while according to objective standards—including what women themselves want and value—they are not. For example, nurses often believe that providing pain medication is an essential component of supportive care,[23] but studies show that pain relief has little effect on women's satisfaction with the birth experience. (See mini-review 1.) Writes Hodnett (2002) in her systematic review of studies of pain management and women's satisfaction:[30]

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* Some labor support studies have looked at postpartum psycho-social effects such as reduced depression or enhanced self-esteem, but none have looked at trauma, an important omission because failure of supportive care is an important factor in the development of posttraumatic stress disorder (PTSD) symptoms and the full-blown syndrome. (See appendix "Optimal Practice for Protecting Maternal Mental Health.")

> Four factors—personal expectations, the amount of support from caregivers, the quality of the caregiver-patient relationship, and involvement in decision making—appear to be so important that they override the influences of age, socioeconomic status, ethnicity, childbirth preparation, the physical birth environment, pain, immobility, medical interventions, and continuity of care, when women evaluate their childbirth experiences (p. S171).

Furthermore, epidurals, a cornerstone of medical-model management, make life easier on nurses, which provides a powerful incentive to encourage their use (see mini-review 5):[10]

> Caring for an unmedicated mother requires one-on-one care. We don't always have that luxury. With an epidural you have a lot more leeway because they're comfortable. There's a lot less you have to do immediately. When an unmedicated woman is ready to push, she's ready to push and you've got to be there. It's just more time intensive and more emotional. It kind of drains you, especially if they're not handling it well (p. 54).

Medical-model culture will hinder efforts at reform no matter what women want or what the evidence supports. (See mini-review 5.) Writes Hodnett (1997):

> [E]very year when we discuss the evidence about labor support, the students tell me the same story. . . . [W]hen . . . they try to spend as much time as possible with their patients, their colleagues exert considerable pressure on them to conform to the norm, which seems to involve frequent, brief visits to their patients, arranging the epidural analgesic as soon as possible, and spending substantial periods of time with one's colleagues at the nurses' station. Nurses who deviate from this norm risk being shunned, set apart, and even ridiculed by their peers. Patients come and go, but nurses must work with the same colleagues for many years (p. 79).[29]

As the quotation that opens this chapter makes clear, medical-model thinkers do not see a problem with the system. Women should just give up their unrealistic expectations of care. In response to this, Tumblin and Simkin (2001) ask, "How can [realistic preparation of pregnant women] be achieved without making the hospital system look uncaring or suggesting that a nurse may be unable to give effective and supportive care?" (p. 55).[63] The answer, of course, is that it cannot. The problem is not women's expectations of labor support. It is not unreasonable for women to want an experienced woman by their side; to be treated kindly and sensitively; to be made comfortable; to be praised, encouraged, and reassured; and to receive care that promotes the best outcome with the least use of medical

intervention. The problem is that many women do not receive humane—let alone optimal—care in labor because the system does not permit it.

WHY ISN'T SUPPORTIVE CARE PART OF THE PACKAGE? EFFECTS OF THE INSTITUTIONAL SOCIAL STRUCTURE

Medical-model culture is but one underpinning of our current system. Hand-in-glove with it goes a dysfunctional social structure. An optimal system would put the laboring woman at the center. It would be designed to promote the best physical and psychological health and well-being of an inseparable mother-baby dyad. An optimal system's social structure would be egalitarian and collaborative. It would be characterized by open and honest communication; mutual trust and respect among doctors, midwives, nurses, and doulas and between caregivers and women; and the woman would have the ultimate say over what happens to her and her baby. The current system is organized as a rigid, authoritarian hierarchy that puts the physician at the pinnacle. After the physician, the interests of the administration are served, followed by those of nurses and other staff, and finally—a long way last, and provided it can be marketed to women (hotel-like amenities, designer hospital gowns)[21, 55] and does not require any meaningful change in practices or policies—women's preferences. Signs, symptoms, and effects of the power imbalance permeate the literature.

To begin with, a hierarchical social structure fosters intra-staff behaviors that degrade quality of care. Investigators analyzing the comments of nurses responding to a survey cite "hierarchy, fear of and intimidation by physician colleagues, and lack of administrative support when conflict occurs" (p. 35) as reasons why clinical practice was not evidence based.[58] They continue, "Physicians had higher social status and were afforded more power [by hospital administrators which] created a power gradient that nurses found intimidating [and which] allowed some physicians to engage in explicitly intimidating and bullying behaviors" (p. 36). Such behavior is both common and tolerated. A survey of U.S. intrapartum units revealed that disruptive behavior ("angry outbursts; rudeness or verbal attacks; physical threats; intimidation; noncompliance with existing policies; sexual harassment; idiosyncratic, inconsistent, or passive aggressive orders; derogatory comments about the organization; or disruption of smooth function of the healthcare team" [p. e1]), occurred in the majority of units.[64] Obstetricians and anesthesiologists were the most common offenders, but "horizontal hostility" (p. e4) between nurses occurred as well; indeed, bullying among nurses of all specialties is so common that it has been called nursing's "silent epidemic."[61]

We also see the effects of hierarchical structure in the watered-down approach to advocacy, the fourth pillar of supportive care. The word *advocate*, in its classical sense *advocare*, means "to summon to one's assistance, to defend, to call to one's aid" (p. 30).[2] Nurses generally advocate for the hospital, not the woman. Their job

is to persuade her to comply with hospital policies and clinician orders.[23] Even nurse researchers conceive of patient advocacy merely as "negotiating women's wishes" with "team members" around such issues as "desire for natural childbirth, for epidural, for no episiotomy" (p. 267),[23] decisions that should be the woman's prerogative, not matters for "negotiation." Advocacy only takes on its true meaning when the nurse interacts with those who are lower down in the hierarchy, e.g., when "asking visitors to leave at patient's request, etc." (p. 267).

Other signs of the power imbalance can be seen in interactions between those lower and those higher on the ladder. Interactions with those higher in the power hierarchy are characterized, as we just saw, by the need to "negotiate" what should be the woman's right to decide. Those in a position of weakness must employ tactics such as placation: "I try to be tactful with the doctors so they always feel in control" (p. 43);[60] subversion: "There were times when I had a doc who would throw a fit if I didn't up the pitocin, so I would pacify him by agreeing to, but never would" (p. 35);[58] and collusion: "Doulas and their clients often work out code words and signals in advance. Somehow the doula has to bring what's going on to the woman's attention" (p. 158).[6] Passive-aggressive behavior, another strategy of the disempowered, also occurs: "Next shift undoes the work I did in avoiding epidurals or interventions" (p. 208).[59] By contrast, interactions down the hierarchy include giving orders and expecting obedience, as with this nurse speaking to a woman who is desperately trying not to push while waiting for the doctor to arrive and give permission: "I know it won't be long [and] it'll feel better for you to push, but in the meantime, I don't want you to, okay (emphatic)?" (p. 162).[35] Those more powerful may also treat those less powerful insensitively and disrespectfully with impunity, as these examples illustrate: "If I encourage or permit a woman to push in any other way than 10-second valsalva, the physician would question my abilities in front of the patient" (p. 207);[59] "At the height of the drama when she is in great pain and barely able to control the pushing urge, the nurse and the medical student have a little chat, engage in a little private chuckle" (p. 165);[35] "[During the cesarean surgery,] the two docs were discussing golf handicaps . . . . And then, . . . to add insult to injury, as they were rolling me out of the OR, Doc says to Nurse, 'You know, contrary to popular belief, I do sometimes have vaginal deliveries'" (p. 9).[54]

Yet another symptom of the power imbalance is exemplified by R. D. Laing's statement, "To allow is to exercise as much, if not more power, than to forbid" (p. xvii).[46] Women may be "allowed" labor companions at hospital births, but they have no control over who they may be (children may be forbidden, for example), how many they may have, or when they may be separated from their companions despite their wishes. Writes the obstetrician author of a popular book for pregnant women, "If you and your partner choose to have a doula present during labor and the birth, talk to your doctor about your decision. He or she may find her presence intrusive and veto the idea" (p. 187).[14] Hospital policy or doctor's

preference often deprives women of their labor companions at times of greatest distress such as during initiation of an epidural or preparation for surgery. No one questions hospital staff's right to do this, but imagine a midwife telling her home birth clients who they could have with them and under what circumstances, and the degree of control over women's choices becomes apparent.

The authoritarian, hierarchical social structure has many ill effects relevant to supportive care. It denies women an advocate. It almost guarantees that they will not be given complete and accurate information on which to make decisions and that their choices will not be respected. It deprives women of physical and emotional supportive care, and last, but certainly not least, it exposes women to the possibility of unkind and insensitive treatment at a supremely vulnerable time in their lives.

WHY ISN'T SUPPORTIVE CARE PART OF THE PACKAGE? THE DOULA PARADOX

One would think medical staff would welcome doulas, as they take on a useful set of tasks generally at no cost to the system. Yet doulas frequently are regarded with suspicion and unease if not outright hostility. (See mini-review 6.) Why should this be?

To those entrenched in the system, the independent doula is a "loose cannon" because her allegiance is to the laboring woman, not the doctor or institution. But even if she is utterly self-effacing and confines herself to physical and emotional support, she is still a threat because she is an independent witness to how the woman is treated and a visible reminder of the kind of care the woman should be getting but is not. Her presence alone embodies a disconfirmation of the system. Moreover, while doulas do not act as advocates, they are—at least according to the oldest of the U.S. doula organizations—charged with helping women advocate for themselves: "[The doula] assists families to gather information about the course of their labor *and their options*" (emphasis ours).[18] In a hierarchical system in which everyone must give way to those higher on the ladder, even the mildest, most diplomatic attempts to assert the woman's right to make choices can be sufficient to trigger resentment and antagonism from medical staff. Those socialized into the authoritarian model will view the doula as competing for control of the woman, who should properly be controlled by those above her in the power structure:

> "Most are great," [says a Canadian nurse of doulas], "but maybe they've questioned something in their doula-like way—you know, granola-ish, where they will say, 'Well, why don't we let Mary think about this for awhile.' And I'm thinking, 'Oh sure, absolutely, no one is rushing anybody here,' but it's not me and it's not the doula who is having the pain, it's the patient."[28]

Medical staff fear that a woman with a doula will not do what they want her to do, which is the definition of a "difficult patient." Should too many women accompanied by doulas resist staff direction, the solution is either to impose draconian restrictions on doulas or forbid them altogether. Says a nurse at a Virginia hospital that bans doulas, "From a nursing standpoint, too many crossed the line and interfered with my job."[48] Likewise, an obstetrician, relating the incident that led her clinic to begin firing pregnant women who intend to have a doula, says, "I was spending hours trying to explain that [oxytocin augmentation] was for the baby's health, and it was just 'no, no, no.'"[34] The obstetrician's evidence for the doula's culpability was that, before refusing, the woman asked staff to leave so she could consider the recommendation in private.

An article published in *JOGNN* attempting to sell doulas to nurses gives an idea of what a doula acceptable to the system would be like. The author positions doulas as useful members of the "team" (p. 762).[24] In that role, doulas serve as a "bridge between mothers and caregivers, often spanning different philosophies and perspectives about normal birth," helping "mothers, nurses, and medical caregivers feel comfortable with one another in unfamiliar territory" (p. 762). The bridge, however, is unidirectional. The good doula, although her actions are not framed as such, compensates for harsh treatment by medical staff, as in this case where the baby of a teenager was showing signs of distress late in second stage:

> There was no opportunity to change her position [presumably to one more effective], and Janey repeatedly said she was pushing as hard as she could. Her sensitive and caring physician told her to "Push harder!" . . . Her doula leaned forward and said, "Janey, I know you're pushing as hard as you can. But your baby really needs to be born, so you've got to get him out NOW." . . . Progress was swift with Janey's renewed efforts, and baby Jason emerged less than 2 minutes later. (p. 764)

The good doula also assists with gaining cooperation:

> Sometimes physicians or midwives who are not accustomed to being asked questions or who have a more autocratic style may feel their authority is being questioned. Yet patients are simply trying to enhance their understanding and lower their anxiety. . . . By enhancing communication and encouraging dialogue between caregivers, nursing staff, and the patient, doulas are helping to secure informed consent. (p. 767)

And she helps couples feel better about how they were treated, as in this example where a father recalled his "intense disappointment" four years later at having his baby "whisked away to the warming table" and kept there despite asking to have his baby put skin-to-skin with the new mother:

> The doula gently probed and discovered that the mother had received a requested analgesic within half an hour of the baby's birth. After more questioning, the doula suspected that the baby had required resuscitation and possibly Narcan. [The doula relates this possibility to the parents, reassuring them that neither father or doula could have made a difference under these circumstances.] It is likely that the staff explained their baby's needs to them at the time or right afterward, but they may not have retained that information. (p. 768)

And, of course, the doula supplies supportive care, the missing component of intrapartum nursing. Into this reminder, the author tucks a face-saving explanation as to why nurses themselves are not providing it and sometimes resent the doula's doing so:

> [A] nurse may feel uncomfortable because she wants to do what the doula is doing: connecting on a personal level with the laboring woman. The dynamic between the doula and mother may preclude the nurse's involvement or her other responsibilities may keep her too busy. . . (p. 765).

Conflict between nurse and doula is ascribed to doulas who may be "new and overeager" or have so much "enthusiasm to help the new mother" that she "may seem to be challenging the rest of the health care team" (p. 765). Conflict may also arise where there is "pressure [on the] caregiver to work entirely outside of his or her comfort zone" (p. 767), but its resolutions are that the nurse be patient with the doula or that women should choose care providers more in line with their philosophies. Never is there the least suggestion that the woman has the right to make decisions, that her preferences should be honored, or that care practices should be improved. To point out that the problems lie not with the doula but with the system would defeat the article's purpose, which is to convince nurses that doulas pose no threat. In their proper role, doulas help maintain the status quo.

In short, the institutional power structure in most hospitals will not permit doulas to provide effective supportive care. It presents them with a no-win choice: To promote a positive birth experience, they can soften and reinterpret neglectful, insensitive, and disrespectful treatment by medical staff and work covertly, often unsuccessfully, to avert unnecessary medical interventions or counteract their adverse effects. This forces doulas into complicity with a system that deprives their clients of the care to which they are rightfully entitled and makes them partners in the conspiracy of silence surrounding what really happened. Alternatively, they can try to assist women in obtaining safe and effective care, accurate information on which to base decisions, and respect for those decisions. All of these run the risk of generating unpleasant conflict around their clients. This, again, harms their clients, often to no purpose since the doula's efforts are likely to fail. Without a

doubt, women are better off with doulas than not, but whichever path doulas take, all too often they and the women they serve lose.

HARMS OF THE SYSTEM: "POWER CORRUPTS; ABSOLUTE POWER CORRUPTS ABSOLUTELY"

Researchers have looked for benefits of supportive care and found many, but adding supportive care merely spreads anesthetic salve over a gaping wound. To truly understand the benefits of supportive care, we must look at the harms done by a system that fails to provide it.

Centering care around the woman ensures that the system serves her and her baby's best interests. With the typical hierarchical power structure, administrative and medical staff's interests override not only women's wishes, but what best promotes their and their baby's health and well-being. Explains the nurse subject of a qualitative study:

> So I push that Pit. I try everything I can so she'll hurry up and deliver, even though ethically, I feel horrible about it. And I can't tell her, 'Your doctor's got a golf game and he said if you don't deliver by noon you're going to have a c-section' (p. 42).[60]

Furthermore, equal to or perhaps worse than the potential for physical harm is the psychological damage the system inflicts: depression, failure of attachment, and symptoms of, if not full-blown, PTSD. (See appendix "Optimal Practice for Protecting Maternal Mental Health.")

The goals of traditional woman-centered care as well as physiologic care today are to help women safely birth their babies and, addressing the "rite of passage" aspect of childbirth, meet the challenges of labor so that they emerge from the experience feeling strong, confident, competent, resilient, and ready to take on the challenges of motherhood. The goal of a doctor-centered system is to assist the doctor in delivering the baby, which means creating the illusion that doctors have the starring role. This requires impressing on women that they are weak, helpless, incompetent, and must rely on medical staff. Those messages are reinforced by comments that undermine the woman's goals: "The nurse told me that I was not going to be able to do it without an epidural. That was like the first crack in my confidence" (p. 149)[11] or rebuke her for having goals at all, as in the classic: "After all, the most important thing is a healthy baby." Little wonder that many mothers struggle with feelings of inadequacy and failure. Despite efforts to convince them otherwise, women instinctively realize that they were, in fact, engaged in a test, but they attribute any failure to themselves, not to a system that rigged the test. Nor does it matter whether women are pleased with their care. They have internalized the negative messages just the same.

In an authoritarian system, overt attempts to contravene the will of those higher up are not tolerated. This holds true here as well: "Women . . . plan on an unmedicated birth, but the doctor either wants to give them cytotec, or pitocin, and wants it turned up 6 mU every 15 minutes until the woman is begging for an epidural" (p. 208);[59] or, "We're admitting another one of those hypnobirthers. Make her stay on the monitor so she can't get out of bed, and she'll agree to the epidural by the time she's three centimeters."[1] Because a doula signals potential resistance to the program, merely having one can be sufficient to trigger retaliation: in a survey of nurse attitudes, among nine women accompanied by doulas in labor, one wrote, "[The nurse]. . . seemed to want me to suffer because I wasn't doing things her way," and another described her nurse's attitude as "out to get me" (p. 16).[47] A commentary on a doula trial observes that women allocated to the doula arm were more likely to be induced or augmented despite being admitted at greater dilation than control women. The commentator attributed this to doulas being perceived as intruders.[56] A more colloquial example of retaliation is this statement posted to a doula list: "I ran into a nurse yesterday at the mall. . . . She said the general opinion at [her hospital] is when they see a Doula that they say 'get the C-Section Table ready!'"[19]

Finally, because those lower in the hierarchy have no power to call those higher to account, inhumane care can descend into outright emotional, physical, or sexual abuse.[25] For example, an intrapartum nurse writes that 8 to 10 times in four years at two different hospitals she has seen doctors ignore an inadequate epidural during cesarean surgery: "Despite her crying out, 'Ouch, I can feel that, that feels sharp! That hurts!' she is told, 'No, it's just pressure,' 'I'm not even doing anything that should hurt' . . . or 'I'm almost done.'"[45] She also writes: "I have witnessed many physicians say degrading things to women in natural labor, as if punishing them for not getting pain control in order to be more passive patients, including 'I don't want to hear any noise from you,' [or] 'Come on, you need to open your legs, obviously you didn't mind that nine months ago.'"

These cases are not, as would be more comfortable to believe, aberrations. They may be at the far end of the spectrum, but when a social system allows some individuals unrestrained dominance over others, mistreatment and abuse will inevitably follow. Stepping onto the labor and delivery unit, women all too often find themselves in an environment where society accords them no protection from what would be considered inhumane treatment if not criminal acts outside its doors. Once over the threshold, women depend solely on the kindness of strangers, and if that fails, in an authoritarian system, they have no redress.

WHAT PERPETUATES THIS DYSFUNCTIONAL SYSTEM?

System outsiders—fathers and doulas—cannot effect reforms. As Coleman Romalis (1981) writes: "The husband is usually willingly coopted to manage the wife's

behavior. In this way she is prevented from succumbing to 'female' or 'pregnant' irrationality, . . . or lack of faith in the doctor and medical routines. But it is like a fly assisting a spider, . . . the father himself is rendered silent and captive" (p. 103),[52] while doulas, writes Jennifer Block (2007), quoting Christine Morton, "cannot afford to piss off the people in power."[6]

Insiders—nurses (and midwives)—could instigate change, but so long as they rank lower in the hierarchical order and the administration will not back them up, fighting for change is a battle they will lose possibly along with their jobs. Knowing this, nurses find ways to reconcile the conflict between what they know they should be doing and what they feel compelled to do. Nurses speak of taking "baby steps" when making change, which enables them to feel satisfied with minimal accomplishments despite enormous efforts. They engage in cognitive dissonance: nurses in a study of work activities talked about the importance of ambulation, but only 2 of the 75 observed laboring women were "allowed" to do so.[42] They resort to euphemisms: one nurse researcher framed the "unwilling partnership" in supporting and delivering unethical treatment as an "ethical dilemma" (p. 40).[60] This is no dilemma, as a commentary on the study makes clear:

> Beauchamp and Childress describe moral dilemmas in the following way: "In a moral dilemma, an agent morally ought to do X and morally ought to do Y, but the agent is precluded by circumstances from doing both." . . . Being an unwilling partner in care that is focused, not on the patient's best interests, but on the physician's, does not have the elements of a moral dilemma. . . . [It is] just substandard care (p. 46).[50]

Nurses may also burn out and cease to care altogether.

Doctors have the authority to change the system, but they rarely act to rein in their own kind. For one thing, doctors trained in authoritarian systems are likely to internalize as normative a model of interaction with underlings and patients that desensitizes them to problem behaviors and may socialize them into becoming abusers themselves. For another, doctors, as will members of any group, will close ranks against a perceived attack by outsiders.

A dysfunctional institutional social system replicates a dysfunctional family dynamic on a larger scale, which also hinders reform. Virginia Satir (1988) describes two types of family systems: open and closed.[53] In the closed system, organizing principles include: "There is one right way, and the person with most power has it," and "There is always someone who knows what is best for you" (p. 132). Closed family systems set rules according to these principles, i.e. "Self-worth is secondary to power and performance. Actions are subject to the whims of the boss. Change is resisted" (p. 132). As a result, in closed family systems, self-esteem is low; communication is indirect and incongruent; styles of interaction are blaming,

placating, and distracting; rules are unspoken and outdated, and when the rules are inhumane, people adapt rather than change the rules. As happens with those within closed family systems, those within closed institutional systems are likely to perceive them as normative, especially, we would speculate, if they were reared in closed family systems themselves. Those who perceive them as problematic still understand that if they are in the minority, they must "go along to get along" or move on.

For laboring women, a protective mechanism may kick in. Experts offer theories to explain women's high satisfaction ratings of their treatment in childbirth despite the chasm between what elements of care studies find to be associated with satisfaction and between what women describe as good care—and objective standards agree—and typical treatment.[16, 17] Experts speak of the "halo effect," the joy that surrounds having a healthy baby overwhelming all other considerations and "what is must be right," the internal justification for not getting what was reasonably expected. These explanations, though, amount to deflection of an anger women cannot afford to feel during a time of vulnerability and dependency and when trying to cope with the stresses of new motherhood, often while recovering from major surgery.

Female physiology may be at work as well. Taylor and colleagues (2000) dispute the notion that "fight or flight" is the predominant response to stress in women and conclude that belief in its being so originates in almost all studies having been done in males.[62] They argue that "fight or flight" will not be evolutionarily beneficial in mammalian species who bear young who have limited or no mobility. They propose an alternative: "tend and befriend." In support of their hypothesis, they cite numerous studies in animals, primates, and humans showing that stressful events trigger nurturing behavior in females. When directed toward offspring, tending calms and soothes, promoting health and wellbeing. Tending behaviors also reduce stress in the ones doing the tending, not just the recipient, and tending behaviors are not solely directed toward young. Tending facilitates the formation of social networks among females, which ensures mutual assistance when a member is threatened. Unlike "fight or flight," which is mediated by the sympathetic nervous system, evidence suggests that "tend and befriend" is mediated by the parasympathetic nervous system, primarily by oxytocin. "Tend and befriend" could explain why normally assertive women in labor submit without protest to treatment that would provoke outrage under other circumstances. It also could explain why nurses and doulas often believe, despite abundant experience to the contrary, that conflicts arising from fundamental systemic differences between them and those more powerful will be resolved by "tending and befriending" their opponents. As a friend of ours, often in trouble with obstetricians, responded to her nurse manager's plea to be nicer to them, "I had an abusive husband, and so did you. Did you ever find that being nice made a difference?"

There is hope. Not all hospital social systems are rigid, authoritarian hierarchies. Some nurses report working in egalitarian environments where care centers around the laboring woman, birth is understood to be a normal process, nurses are respected, and doulas are welcomed as colleagues.[59] Nurses also write of the joys and rewards of helping women meet the challenges of labor.[10] But reform will not be achieved by converting individuals to a better model, but by radical restructuring of the culture that drives our care delivery system. Until such time as the guide for intrapartum care universally becomes, as a bumper sticker proclaimed, "Honor labor," the driving force will remain in most institutions, as another bumper sticker orders, "Get in, shut up, and hold on!"

MINI-REVIEWS

Note: Assume differences are statistically significant unless otherwise noted.

1. Women universally want the same elements of supportive care, and inadequate supportive care negatively affects perception of the birth experience.
A review of the qualitative literature determined which elements of professional labor care positively influenced women's perception of their childbirth experiences.[7] The review's methodology is weak—no information is given on predetermined inclusion or exclusion factors, nor are studies evaluated for quality—but we include it because of the consistency of its findings across cultures and because these weaknesses are not likely to compromise the review's results. The reviewer's search strategy yielded 17 qualitative studies published between 1990 and 2001 encompassing 533 women and taking place in 8 countries. Labor support providers were nurses, midwives, and doulas. Data were analyzed according to the four domains of supportive care used in studies of labor support: physical comfort, emotional support, informational support, and advocacy, as well as three additional domains that emerged from the data synthesis: prenatal expectations, caregiver's interpersonal communication style, and professional competence (analysis of professional competence is not included here because it is not related to supportive care).

- Expectations prior to labor. Women thought their nurse would help them be comfortable, reassure them, assist them with labor coping techniques, stay with them continuously, keep them informed, answer questions, and help them achieve their personal goals and preferences. Expectations of care prior to labor were congruent with what women viewed positively during labor. (See following bullet points.) Failure to receive these elements of supportive care from their professional caregivers decreased satisfaction with the birth experience.
- Physical comfort. Women valued physical contact, such as hand holding or massage and comfort measures, such as supplying cool cloths, drinks, pillows, and blankets. Also important was assistance with pain coping techniques, such as breathing, walking, position changes, using a rocking chair, massage, and hydrotherapy.

- Emotional support. Women valued professional caregivers who were friendly and calming, who treated them respectfully, who praised and encouraged them, and who spent time getting to know them as individuals.
- Interpersonal communications. Women valued an interpersonal communication style that was "cheerful, positive, and trustworthy, as well as understanding and considerate" (p.748).
- Informational support. Women valued being given detailed, accurate, and understandable information, explanations, and advice.
- Advocacy. The reviewer defines advocacy by quoting a study participant: "The nurses are supportive of what you want, who you are, and how you want to do things" (p. 749). Women valued having real options and being involved in decision-making.

Since publication of the review, seven additional studies have explored the relationship between satisfaction and elements of supportive care. Conducted in Australia, Belgium, Finland, the Netherlands, Sweden, and the U.S., all agree with the findings of the review.[4, 13, 26, 41, 43, 51, 65]

One study performed a qualitative analysis of interviews with 24 pregnant Finnish women experiencing both normal and complicated pregnancies (antenatal hospital admission).[41] Women defined a "good" birth as one in which medical staff were kind, encouraging, nonjudgmental, and trustworthy; where they individualized care; where they kept women informed; where they assisted women in making informed decisions; and where they were present to the degree the women wished. Expectations did not differ between women anticipating normal birth and those with antenatal complications.

In the second study, investigators administered antenatal and postpartum (within 2 w of birth) questionnaires to 605 Belgian and Dutch women intended to evaluate satisfaction, experience of pain, personal control (components: self-control and self-efficacy), and fulfillment of expectations.[13] Fulfillment of expectations bore the strongest relationship with satisfaction, which in turn depended on feeling in control and experiencing self-efficacy. A painful labor did not result in dissatisfaction provided women felt empowered. Results did not differ between the two countries despite a medical management model in Belgium and a physiologic care model in the Netherlands.

A third study, a qualitative analysis of descriptions of the birth experiences of 141 Australian women written 6 to 14 w postpartum, concluded that the experience was enhanced by feeling "safe, secure, supported, respected, confident, and in control" and diminished "by feeling their options were limited and being treated unkindly and disrespectfully."[4] A birth that did not go as planned was not perceived negatively provided care providers involved women in decision-making.

A fourth study surveyed 60 U.S. women prior to discharge who had had normal vaginal births of healthy full-term infants to determine how labor pain and personal control related to satisfaction.[26] Having personal control (a global measurement encompassing feeling in charge of events and behavior) was the only variable that achieved statistical significance in explaining the variation in total childbirth satisfaction ratings. Personal control was also significantly associated with satisfaction with care providers. Study authors suggest that the probable link between the two is having caregivers "who facilitate the woman's control over her environment" (p. 217), i.e., caregivers who provide good supportive care.

Three studies examined factors associated with extreme dissatisfaction with care. In two of them investigators explicitly noted that this outcome had been chosen because a negative experience can have far-reaching effects, including whether to have more children or to have elective cesarean surgery for future deliveries.[51, 65] In the first study, investigators analyzed interviews with 10 U.S. women who were angry after having vaginal delivery of healthy term or near-term infants (timing of interview not reported).[43] Common themes explaining anger were failure to meet expectations that caregivers would be "competent, truthful, and caring" and that "their wishes/desires to be in control of their labor would be respected" (p. 344). In the second study, Swedish investigators surveyed 2541 women at 1 y postpartum to determine factors associated with a negative rating of the birth experience.[65] Among intrapartum factors were disagreement with the statement that "the midwife was attentive to my needs," was "encouraging," and that she was "competent in psychological matters" (p. 22). Likewise, respondents having negative birth experiences were more likely to be dissatisfied with "information about the progress of labor," "involvement in decision-making," "support by midwife," and "support by doctor" (p. 22). They were also more likely to feel lack of control nearly all or all of the time, which study authors explain relates to fear and feeling unsupported in addition to feeling overwhelmed by pain—although in fact, feeling out of control was only weakly related to degree of pain. After adjustment for correlating factors, dissatisfaction with involvement in decisions (OR 2.2), lack of control (OR 3.4), and lack of support from midwife (OR 1.7) and doctor (OR 2.7) were significantly associated with negative birth experience (no percentages reported). Finally, Dutch investigators surveyed 1309 women 3 y postpartum.[51] Women with negative recall of their births were more likely to choose "rushed," "insensitive," "bossy," "rude," "off-hand," "inconsiderate," "condescending," and "unhelpful" (p. 111) to describe their caregivers. Women with a negative experience were less likely to describe their caregiver positively (10.8% vs. 89.2%). After adjustment for correlating factors, describing caregivers negatively tripled the odds (OR 2.9) of negative recall of the birth experience.

2. Continuous one-to-one female labor support confers benefits on women laboring in hospitals without introducing harms.

A Cochrane systematic review of RCTs of continuous (female) labor support vs. usual care included 21 trials taking place in 15 countries and comprised 15,061 women.[31] Reviewers evaluated use of any analgesia, use of regional analgesia, oxytocin use, labor length, spontaneous vaginal birth, instrumental vaginal delivery, cesarean delivery, perineal trauma, low 5-min Apgar scores, admission to special care nursery, prolonged neonatal hospital stay, postpartum report of severe labor pain, negative rating of birth experience, difficulty mothering, breastfeeding at 1-2 months postpartum, postpartum depression, low postpartum self-esteem. (No trial evaluated posttraumatic stress symptoms.) Results for all measured maternal and neonatal outcomes (not all of which are reported here) were either similar or improved with continuous female labor support. Meta-analyses found that women receiving continuous labor support are less likely (73% vs. 76%, RR 0.9) to have any intrapartum analgesia (13 trials, 12,169 women), less likely (66% vs. 69%, RR 0.9) to have regional analgesia (9 trials, 11,444 women), more likely (71% vs. 68%, RR 1.1) to have spontaneous vaginal birth (18 trials, 14,005 women), less likely (12% vs. 14%, RR 0.8) to have cesarean delivery (21 trials, 15,061 women), less likely (18% vs. 20%, RR 0.9) to have instrumental

vaginal delivery, and less likely (12% vs. 18%, RR 0.7) to report dissatisfaction or a negative birth experience (11 trials, 11,133 women). (See also mini-reviews 1 and 3.)

3. Stronger beneficial effects of continuous one-to-one female labor support are seen with providers who are not hospital staff members and in environments more conducive to physiologic care.

The Cochrane reviewers (see mini-review 2) also evaluated the influences of whether the woman was allowed her choice of labor companions; the availability of epidural analgesia; the use of continuous EFM (cardiotocography); and whether the labor support provider was a hospital staff member, a member of the woman's social network, or neither, by comparing the pooled results of trials with and without these elements.[31] The effects of continuous support on any use of analgesia appeared to be stronger in settings where women were denied labor companions of choice but did not appear to be influenced by availability of epidural, use of routine EFM, or type of labor support provider. The effects of continuous support on spontaneous vaginal birth and cesarean rate appeared to be stronger where women were denied labor companions of choice, where epidurals were not routinely available, where EFM was not routine, and where the provider was neither a hospital staff member nor a member of the woman's social network. The effects of continuous support on reducing likelihood of admission to special care nursery appeared to be stronger in settings where epidurals were not routinely available but did not appear to be influenced by availability of labor companions, use of routine EFM, or type of labor support provider. The effects of continuous support on reducing likelihood of dissatisfaction or negative birth experience appeared to be stronger in settings where epidurals were not routinely available and when the provider was neither a member of the woman's social network nor a hospital staff member but did not appear to be influenced by availability of labor companions or use of routine EFM.

The reviewers warn that these subgroup analyses should be interpreted with caution but state that the consistent pattern argues nonetheless that the effectiveness of continuous female labor support is moderated by hospital policies and practices. It produces greater benefits where women are denied support from family or friends. Routine EFM and ready availability of epidurals impede its effects which, reviewers write, raises "questions about the ability of labour support to act as a buffer against adverse aspects of routine medical interventions" (p. 14). Labor support is also more effective when provided by a support person who is not a staff member, which reviewers speculate may be explained by "divided loyalties, additional duties besides labour support, self-selection and the constraints of institutional policies and routine practices" (p. 14). We note that the effect of labor support provider is all the more remarkable in that in one of the "not staff person, not family" trials, the labor support providers were retired nurses. Retired nurses presumably would be more likely to align culturally with former colleagues than would system outsiders.

Some data suggest that the provider effect may also explain failure to find psychosocial benefits and higher breastfeeding rates. The Cochrane review failed to find a benefit for continuous support in the meta-analysis of three trials reporting on difficulty mothering (29% vs. 31%). However, in by far the largest trial—5601 women vs. 707 in the other two combined—the labor support provider was a staff nurse, whereas in the other two, providers were, respectively, doulas and a specially trained female friend or family member. In the

nurse trial, rates of difficulty mothering in both arms were identical at 31%, but in the other two trials combined, rates were 31% with usual care vs. only 14% with continuous support by a non-staff member. The postpartum depression analysis includes only the nurse provider trial, and the sole trial evaluating postpartum self-esteem used retired nurses as providers. Neither analysis reported a significant difference, but was this because continuous labor support is ineffective or because medical staff, current or retired, are ineffective? Arguing for the latter, yet one more trial (314 women) in which community-based doulas supplied labor support reported that supported women were more likely to feel that they coped well with labor and to have positive perceptions of themselves as a woman and of their physical strength and performance.[27] (This trial was excluded from the Cochrane review because of inadequate information on postrandomization exclusions.)

The Cochrane review reported similar breastfeeding rates at one to two months postpartum (60% in both groups) in three trials, of which, again, one was the large, staff nurse trial, and the other two were smaller trials (combined N = 804) in one of which providers were doulas and in the other retired nurses. If the staff nurse trial is excluded, rates in the other two trials combined favored continuous support (79% vs. 75%), although we do not know whether this difference would be statistically significant or whether differences would be even greater with non-nurse providers. Data were not included from a fourth trial in which specially trained friends or family members provided support because it did not report breastfeeding rates at one to two months postpartum. It did, however, report that 55% of the labor support group breastfed at some point vs. 42% of the usual care group.[8] We have in addition a non-randomized study of the effects of doula care (intrapartum support plus two home follow-up visits) on breastfeeding in low-income nulliparous women who either planned to breastfeed or were undecided.[44] Investigators compared outcomes in eligible women admitted when a doula was available vs. when she was not. Investigators calculated that 100 women would be needed in each group for adequate power, but for reasons such as one of the two program doulas being unable to participate, ultimately 44 women received doula care vs. 97 in the usual care group. At 6 w, two-thirds of the doula group were breastfeeding vs. half the usual care group, a difference that nearly achieved statistical significance (adjusted OR 2.6 CI 1.0 – 7.0), which suggests that statistical significance likely would have been achieved had the study reached full enrollment. Moreover, in the subgroup of women with additional stressors such as depression or chronic health condition (41% doula care, 36% usual care), doula care markedly increased likelihood of breastfeeding at 6 w (89% vs. 40%, OR 23.8). Results may also have been affected by the high cesarean rate (12/44). Among the 32 women with vaginal births, doulas assisted 30 (94%) with early skin-to-skin contact and 25 (78%) with first breastfeed vs. 2 (17%) and 4 (33%), respectively, of the 12 women delivered by cesarean.

4. Intrapartum nurses provide minimal supportive care.

Researchers have examined the amount of supportive care provided by labor and delivery nurses by conducting work sampling studies. With this method, investigators observe workers, recording their activities using a checklist in order to quantitatively measure the amount of time spent in various categories of work. Three studies all concluded that nurses spent only a small percentage of their time providing supportive care. The first of these was conducted in a Canadian teaching hospital with a one-to-one nurse-to-patient ratio in

active labor.[40] Direct care categories were categorized as physical comfort measures, emotional support, instruction/information, and advocacy occurring in the woman's presence. Other activities were categorized as "all other direct care activities" such as assessments or assisting at procedures, "indirect care activities" such as documenting care or attending meetings, and "all other activities" such as meal breaks. A total of 616 observations of 17 nurses were made. Nurses spent 9.9% of their time engaged in supportive care, which broke down to 6.6% giving instruction or information, 2.6% giving emotional support, 0.3% providing physical comfort, and 0.3% in advocacy. Half of the time the nurse was not with the woman. The amount of supportive care did not increase during quiet times compared with busy times.

The second study, also a work sampling study, took place in a different Canadian tertiary care center where staffing ratios were generally one nurse to two laboring women.[22] This study covered all times of the day and days of the week during a single week and consisted of 3367 observations. The number of nurses observed was not reported. If the nurse was talking while performing another activity, the only instance of simultaneously engaging in two activities, and the activity was supportive, it was recorded as such. Overlap was rare. As with the earlier study, supportive care nursing activities were categorized into physical comfort, emotional support, instruction/information, and advocacy, although in this study, advocacy need not take place in the woman's presence. Other categories were "direct care not related to support" such as taking vital signs or performing procedures, "indirect care taking place in the room" such as assisting with procedures or charting, postpartum care of mother or baby, "indirect care not in the room" such as charting out of the woman's room or making reports, and "off the unit" activities such as meetings or meal breaks. In this study, nurses spent 6.1% of their time offering supportive care, of which 50.5% was spent giving instruction/information, 26.7% was spent giving physical support, 17.0% was spent giving emotional support, and 5.8% was spent in advocacy. Seventy-five percent of the time the nurse was not with the woman.

The third study also took place in a large Canadian teaching hospital with a one-to-one nurse-to-patient ratio in active labor.[23] Work was sampled over a 3 w period and consisted of 404 observations of 12 nurses during the day shift. As with the previous studies, activities were categorized as supportive care according to the same subcategories used previously, direct care not in the supportive category, indirect care in the room, indirect care not in the room, and all other activities. When overlap occurred, such as when nurses gave reassurance while administering medication, the activity was counted as supportive. Overlap was rare. Overall, nurses spent 12.4% of their time in supportive care activities, of which 70% was spent giving instruction/information. No details are provided on percentages spent on other components of supportive care. The amount of time spent giving supportive care ranged among nurses from 0 to 37%. Seventy-two percent of the time the nurse was not with the woman.

Two other studies took a qualitative approach and interviewed postpartum women. As part of a randomized controlled trial (RCT) of supportive care by a monitrice (a term used for women who do assessments as well as provide supportive care), participants were surveyed 2-4 w postpartum regarding supportive care in labor from partners, monitrices in the supportive care arm, and nurses in the usual care arm.[33] (See also mini-review 8 for information on support by fathers.) Trial participants were 103 nulliparous women having

vaginal births of healthy newborns. Loss to follow up, if any, is not reported. Supportive care was categorized according to the same categories as the three work sampling studies, and the survey covered 20 specific actions among the categories. The average number of supportive actions by a monitrice was 15.1 vs. 8.6 by a nurse in the usual care group. Most nursing supportive care actions fell in the category of information/instruction. Fewer than one-third of the women in the usual care group reported receiving any physical comfort or advocacy actions from a nurse.

Another qualitative study surveyed 9 U.S. women who had hired doulas to assist them in labor and who gave birth vaginally.[47] Among other questions, the women were asked what support measures were provided by their nurse and their doula. Women listed four physical measures supplied by the nurse, only one of which related to comfort or physical assistance (holding legs) while the others were nonsupportive direct care measures (vital signs, IV insertion, cervical exams). In contrast, women listed 11 physical support activities supplied by their doula (massage, counter pressure, assistance with bath or shower, coached breathing, positioning, walking, swaying, homeopathic measures, ice chips, birthing ball, warm compress). Under psychosocial measures, women listed only one (verbal encouragement) supplied by a nurse vs. seven supplied by a doula (verbal encouragement, music, calm environment, reassurance, presence, focus, love).

In contrast to the remarkable consistency in the three work sampling studies, a fourth work sampling study conducted in the U.S. appears on the surface to have quite different results.[42] This study sampled the work activities of 24 nurses during first-stage labor. Seventy-five two-hour episodes of care were observed. Nurses spent 59% of their time in the labor room, and 32% of their time providing a supportive intervention. During an episode of care, nurses provided a mean of 79.5 supportive care interventions, of which the most common was emotional support (42.3), the next most common informational support (21.8), and the least common physical support (13.9). This is in marked contrast to the other studies in which the majority of time was spent outside of the labor room, little supportive care was provided, and supportive care mainly consisted of information/instruction. What might explain the differences? First and foremost, the computerized record-keeping system in this hospital required that documentation be completed in the labor room, which necessarily increased greatly the amount of time nurses spent there. This difference also appears to have shifted interaction between nurse and laboring woman in other ways. In contrast to the other two studies, where overlap was rare, supportive care in this study was provided simultaneously with nonsupportive activities 86% of the time. In addition, emotional support activities, primarily consisting of encouragement/reassurance, were more common than information/instruction, another difference. Indeed, encouragement/reassurance was the second most common activity (mean of 11.1 per observation episode) after documentation of care (mean of 21.8). This suggests that supportive care in this study was likely to mean brief reassurances while inputting data at a computer terminal. Moreover, this investigator adopted the same terminology as used in the labor support research but defined it differently. She developed her activities list from a nursing-profession-generated checklist and from asking intrapartum nurses, a group established as generally lacking both knowledge of supportive care and experience in providing it, what activities they identified as effective at improving outcomes. This resulted in an idiosyncratic interpretation of supportive care. For example, the second most common physical comfort measure (mean

of 2.3 per observation episode) was "ensuring adequate urinary elimination," which could include offering a bedpan, catheterization, or emptying a Foley bag. None of the supportive care activities that all other work sampling studies included, such as reassuring touch, massage, keeping company with the woman, or suggesting labor coping techniques, were on the checklist in this study, and advocacy was not even a category. Taking these differences into account, it is not remarkable that nurses performed more supportive care activities they self-identified as being important. What is surprising is that given the high rankings nurses themselves assigned, they performed so few of them.

5. Systemic and cultural factors hinder nurse provision of supportive care.

Five studies have looked at barriers to nurses providing supportive care in labor. One study examined whether lack of self-efficacy ("people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" [p. 49]) explained the gap between recommendations for labor support and actual practice.[15] Investigators developed a questionnaire to evaluate self-efficacy in the provision of supportive care in labor and surveyed 207 nurses at 5 Canadian hospitals. Mean self-efficacy scores at the five hospitals were high, ranging from 86 to 92 out of a maximum of 98. Respondents identified obstacles to providing supportive care, most commonly inadequate staffing (staffing ratios were either one-to-one or one-to-two laboring women), an unconducive physical environment, lack of management support, and negative staff attitudes.

In the second, six randomly selected nurses who participated in a Canadian work sampling study were interviewed to explore their perceptions of what facilitated or hindered nurses giving supportive care to laboring women.[23] The major barrier mentioned by all six was having too many patients, but, in fact, staffing ratios were one-to-one in active labor and direct observation of nursing care showed that understaffing rarely occurred. Similarly, an earlier work sampling study reported that the amount of time spent in supportive care did not vary between busy times and quiet times.[40] These findings raise the possibility of a difference between perception and reality. Analysis of participant comments revealed another obstacle: nurses defined their role as one of control, not support, as exerted by securing acquiescence to medical interventions and restrictions and compliance with institutional policies, doctor's orders, and the nurse's instructions. The study's authors speculated that the physical layout of the unit (central area for charting and EFM display) and the time taken up in providing highly technological, medically interventive management could interfere with the provision of supportive care.

The third, a qualitative study, explored 18 nurses' perceptions of caring for laboring women.[10] Nurses were employed in four hospitals with yearly birth censuses ranging from 1500 to 4500. Reported systems barriers were institutional policies and protocols (continuous EFM, applying high-risk protocols to all women), unit culture (preference that women have epidurals because they need less attention and second stage goes more slowly and predictably), and staffing ratios (inability to provide quality care).

The fourth study surveyed 97 intrapartum nurses at a single institution regarding factors affecting intention to provide continuous labor support (CLS) under two identical scenarios (healthy, nulliparous woman in early active labor who is knowledgeable, coping well, and accompanied by her partner and adequate staff for one-to-one care) in which, in one, the woman wants natural childbirth and, in the other, she wants and gets an epidural.[49] Survey

questions were based on the Theory of Planned Behavior, which holds that intent to perform a behavior is the central determinant of actual behavior and that intention (e.g. "I plan to provide CLS to this patient") is influenced by attitudes (e.g. labor support would be "unhelpful/helpful" or "not satisfying/satisfying"), subjective norms (e.g. "other nurses on this unit would provide CLS to this patient"), and perceived behavior control (e.g. "I am confident that I have the skills" or "providing CLS to this patient would be difficult/ easy") (p. 408). Nurses rated agreement or disagreement with survey items using a Likert scale. In addition, nurses were asked to rate agreement with a list of organizational barriers. Nurses gave the highest scores to four organizational barriers in both scenarios: unit acuity, method of patient assignment, need to cover other nurses on break, and ratio of nurses to patients. Perceived behavior control scores did not differ between scenarios. Mean and median scores of intent to provide continuous labor support were higher in the no-epidural scenario. Multiple regression analysis determined that subjective norms played the greatest role in determining intention in both scenarios; however, in the no-epidural scenario, subjective norms, perceived behavioral control, and having taken labor support courses explained 55% of the variance in intention, while in the epidural scenario, subjective norms and attitudes explained 88% of the variance. Informal discussion revealed an expectation that nurses not stay with women with epidurals but make themselves available for other nonnursing duties or covering nurses on break.

The fifth study analyzed and synthesized the responses given by 416 nurses to open-ended questions in a U.S. national survey of intrapartum care.[59] Overall, 755 participants were recruited via professional electronic mailing lists, attendees at a conference, and professional contacts. Comments were transcribed and coded into three main categories with subsidiary themes within each category by the primary researcher. The panel of researchers then reached consensus on the various themes based on the amount and quality of evidence supporting each one. As a check back, the panel then asked seven nurses and a nurse midwife with a background in qualitative research to match representative quotations with identified themes. Overall agreement was 94%. The three main categories were barriers or obstacles to intrapartum care, factors that facilitated intrapartum care, and strategies used to reduce cesarean surgeries, enhance labor, and promote good outcomes. Six themes emerged under the category of barriers or obstacles to optimal intrapartum nursing care:

- "Hastening, controlling, and mechanizing birth." The largest number of comments fell under this heading. Respondents indicted inducing or augmenting labor to suit doctors' convenience and the use of technologies such as EFM and epidural analgesia that tied women to their beds. Women themselves were sometimes complicit. They wanted inductions, epidurals, or cesareans, believing that these were the easy way out, and refused to try alternatives. Respondents observed nurses manipulating the decision to perform cesarean surgery as a means of getting a break or avoiding working with a difficult woman.
- "Facility culture and resources." Respondents named an assembly-line mentality and the orientation around doctors' preferences as cultural elements interfering with the provision of supportive care. In teaching hospitals, the residents' perceived learning needs were an obstacle. Resource limitations included lack of whirlpool baths, showers, rocking chairs, or birth balls that would facilitate supportive care. Overcrowding also contributed to assembly-line management. Managerial attitudes played a role in chronic understaffing and overemphasis on paperwork.

- "Mothers' knowledge, language and medical status." Barriers to supportive care were high-risk status, limited or no ability to speak English, lack of knowledge about childbirth or how to cope with labor, and passivity in the belief that the obstetrician would take care of everything.
- "Outdated practices." Nonevidence-based practices by doctors and nurses such as insistence on EFM, *non per os* (nothing by mouth), confinement to bed, and directed pushing prevented provision of supportive care.
- "Conflict." Respondents listed the need to carry out doctors' orders that they knew were not evidence based and having to bargain for more time or negotiate for the use of alternatives such as walking instead of oxytocin augmentation. Nurses had to keep quiet when they could not support what doctors told women. Doctors, by contrast, would openly question the nurse's care in front of the woman. Nurses also reported having their efforts to avoid an epidural or medical intervention undermined by other nurses and observing nurses criticize colleagues for spending too much time with the laboring women.
- "Ethical/professional decline." Respondents wrote about nurses failing in their nursing responsibilities by avoiding spending time with laboring women even when they had time to do so or by treating women coldly and insensitively. Many respondents complained of questionable or unethical physician practices such as failing to inform women of the risks of treatment, convenience prevailing over safety in treatment decisions, and ignoring or sabotaging women's wishes, as, for example, when ordering high-dose oxytocin for a woman who wanted to avoid an epidural, and pressuring women to agree to unwanted procedures.

6. Doulas may meet with resistance from medical staff.

The attitudes and beliefs of medical and nursing staff can negatively impact doulas' perceived ability to support laboring women. A national U.S. survey of 626 doulas certified by various U.S. national organizations and doulas in the process of certification reported that 30% of respondents disagreed with the statement, "My role as a doula/labor assistant is respected by physicians who also provide care to my clients," and 24% disagreed with the statement, "My role as a doula/labor assistant is respected by nurses who provide labor/delivery care."[37] Taken together, 42% of survey participants cited lack of support or disrespect from medical care providers, making it the most frequently cited challenge to doula work. A national Canadian survey of 212 DONA International members reported that substantial percentages rated their acceptance by obstetricians (47%), nurses (38%), and family practitioners (30%) below "well" or "very well."[20] Sixty-eight percent agreed that better recognition by providers and 39% that greater respect could convince doulas to continue practice, and 15% agreed that lack of support and respect from maternity care providers and 7% that provider conflicts were reasons to discontinue practice. One-third had experienced conflict with hospital staff, and half of those doulas did not feel that satisfactory resolution was achieved. Nearly half (47%) reported that regulations had excluded them from a birth and one-third (32%) had been asked by staff to leave, including during vaginal exams, epidural administration, or in the operating room. Some doulas had been excluded by their clients, usually because hospital rules limited the client to one support person, forcing a choice between a family member and the doula. Nine respondents would not accept clients who planned delivery at certain hospitals because of perceived staff disrespect of doulas.

A survey of nine U.S. women regarding perceptions of nurse attitudes toward their doula reported that four respondents described the nurse in terms indicative of resentment and animosity, including "hostile," "confrontational," "seemed to feel threatened," "bad attitude," "close-minded" (p. 16).[47] Two women who reported a positive relationship between their doula and the nurse attributed it to being admitted to the hospital late in labor so that little time elapsed before the birth. None of the respondents reported that doula care interfered with nursing care. Conflicts with nurses arose around the use of EFM, failure to adhere to a previously agreed upon birth plan, pushing position, oral fluids, and nipple shields for breastfeeding. Conflict and perception of antipathy toward the doula had a negative impact on the woman's experience of the birth. Researchers asked the women for recommendations for improving relationships between doulas and nurses. All advice was directed toward the nurse.

7. Fathers may not be able to provide adequate labor support.

In a U.S. doula trial in which 388 middle- to upper-income, nulliparous, low-risk women were supported by their male partners in both control and doula groups, having a doula for additional support substantially reduced the cesarean rate compared with the control group (14% vs. 26%).[39] Another study compared 14 fathers' labor support activities at labors where doulas were not present with those of 3 doulas attending 27 women as part of a RCT of doula care in a hospital where labor companions were not permitted.[5, 36] All women were healthy, first-time mothers. Activities were recorded only when the mother was physically uncomfortable. In both early and late labor, during contractions doulas spent 85% of their time within a foot of the mother's body vs. less than one-third of the time for fathers in early labor dropping to one-quarter of the time in late labor. In early labor, during contractions doulas were actually holding the mother 18% of the time vs. none of the time for fathers. In late labor, this rose to one-quarter of the time for doulas and remained at < 1% for fathers. Researchers broke down touching into subcategories of handholding, rubbing/stroking/clutching/holding, other touching, and physical comfort. With the sole exception of hand-holding in early labor, doulas exceeded fathers in all categories. The difference was especially marked for rubbing/stroking/clutching/holding. Doulas spent three-quarters of their time in this activity in both early and late labor vs. about 15% of the time for fathers.

Turning to a qualitative study, the investigator observed and interviewed 20 couples in 5 U.S. hospitals. Couples varied in race, years married or living as a couple, age, educational attainment, whether the men had previously attended a birth, whether they had taken childbirth preparation classes, and whether the care provider was an obstetrician or a midwife.[12] Men fell into one of three categories: coach, teammate, or witness. Coaches (n = 4) led or directed their partners through the birth experience; teammates (n = 4) acted as helpers or followers; and witnesses (n = 12), the majority, were there primarily to see the birth of the child. While coaches maintained high engagement throughout the labor, teammates varied depending on the amount of information and direction they received from their partner or a nurse, and witnesses maintained a low level of engagement until the pushing phase. Lack of guidance could result in a struggle the investigator termed "searching for place" and could lead to disengagement. This study suggests that some men may either fail to provide adequate supportive care in labor or may flounder for lack of someone to guide them.

8. Adding a doula complements and enhances labor support by fathers and is viewed positively by them.

One concern is that having a doula might interfere with the father's caretaking role during labor, but the only trial to explore this issue suggests that doulas enhance supportive care by the father. Researchers randomly assigned 103 first-time mothers to be accompanied by a doula or not. All women were accompanied by their male partner.[33] Researchers broke down labor support activities into physical comfort measures such as cool cloths or massage, emotional support such as reassurance or encouragement, information/instruction actions such as coaching breathing or suggesting relaxation or comfort techniques, and advocacy actions such as interpreting the woman's needs to staff members or supporting her decisions. Researchers periodically made observations and compared the average number of actions in each category as offered by the doula and father in the doula group and the nurse and the father in the control group. Fathers in the doula group averaged more different physical comfort actions than the control group fathers: four vs. a little over three. They averaged about the same number of emotional support actions and advocacy activities in both groups. The only reduction was in giving information/instruction. The average number of activities fell from three in the control group to slightly over one in the doula group. This is not necessarily a drawback. As can be seen in mini-review 7, having someone more knowledgeable and experienced present may relieve pressure on fathers to take on a role unsuited to them. The trial also showed that fathers appreciate doula care. Fathers uniformly responded positively to open ended questions about the effect of the doula on their role during the labor.[33]

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Midwife-Led Care: Organizing an Optimal Maternity Care System

"Delivering a baby is a major medical procedure. It's potentially dangerous, and it hurts like hell. Who do you want to be on the receiving end—a trained doctor backed up by modern life-saving machines and painkillers, or some woman with a Guatemalan hat?"

Anonymous doctor, The National Post, 2006[32]

"Midwife-led care confers benefits and shows no adverse outcomes. It should be the norm for women classified at low and high risk of complications. . . . Policy makers who wish to achieve clinically important improvements in maternity care, particularly around normalizing and humanizing birth, should consider midwife-led models of care."

Hatem 2008, p. 17[25]

In this chapter, we turn our attention to the optimal organization of a system to produce the best outcomes at the population level. We define the appropriate goals for an optimal maternity care system and explore how midwives, who are experts in the provision of physiologic care, can form the backbone of an integrated, woman-centered system that maximizes safety, efficiency, quality, and satisfaction.

WHAT CONSTITUTES AN OPTIMAL MATERNITY CARE SYSTEM?

Throughout this book, we have considered what general practices are most likely to produce a healthy baby and a healthy, satisfied mother with the least use of potentially harmful interventions. But an optimal *system* of care must ensure that each woman has access to the "package" of care that will provide the most benefit with the least harm given her individual circumstances, risk factors, health status, and preferences; in other words, each woman must receive "the right care in the right place at the right time given by the right people."[10] The right combination of these elements, i.e., the package of care, will vary across the population of women receiving care and may even vary for an individual if her health status or preferences change. So, from a public health perspective, the architects of an optimal

system of care must match the maximum number of women to the optimal package of care and minimize the likelihood that women will get the wrong care, in the wrong place, at the wrong time, or from the wrong provider.

The right care in birth can be sub-divided into care that meets basic needs and care that meets condition-specific needs. Basic needs are shared by all women regardless of their health status. These include comfort and emotional support, culturally competent care, avoidance of errors and iatrogenic injury, information and autonomy to make informed choices, and guidance on how to maintain their own and their infants' health and wellbeing. Beyond meeting basic needs, the right care depends on whether the woman or fetus has any conditions that warrant close monitoring, intervention, or both. An optimal system must therefore provide access to tests and treatments for women and babies who are likely to benefit from them and minimize their use in women and babies unlikely to benefit. When women do need high-tech care in order to give birth safely, they must still have their basic care needs met and access to low-tech approaches to treatment when these are sufficient. It follows that the system should ensure widespread access to care providers who are proficient in low-technology, supportive care. These providers must also be able to diagnose problems and either treat them or access appropriate treatment in a timely manner on the woman's behalf. Clinicians caring for women with complicated pregnancies must be skilled as well in meeting women's basic needs or ensure access to such care from another, collaborating provider.

The right place and the right time for intrapartum care go hand in hand, because, as the next two chapters will show, women are much more likely to experience physiologic care in low-tech environments, such as homes and freestanding birth centers. However, these settings are safest when integrated into a system that provides for timely hospitalization of women who develop complications. This means complications must be identified in a timely manner, swift transport must be available, and care in the receiving facility should not be delayed. Thus, the optimal care provider in community-based settings must be able to diagnose problems without relying on sophisticated technology and assist with the smooth transition to a setting with higher-tech resources when necessary.

Who, then, are the right people to provide care to childbearing women? Our discussion has shown us the qualifications of the optimal frontline care provider for the childbearing population:

- proficient in the delivery of physiologic care
- skilled at providing physical comfort, emotional support, and health education/promotion
- culturally competent
- able to identify problems with or without sophisticated diagnostic technology
- skilled at managing or stabilizing common problems that present in pregnancy, labor, birth, or the postpartum period

- aware of the limits of her/his scope of practice, and willing to engage specialists and other clinicians as indicated based on the health status of the individual woman or baby

These skills are the hallmarks of midwifery. However, given that obstetric management practices—some of which can and should only be provided by obstetric specialists—are necessary for some childbearing women, the challenge becomes ensuring that the maximum number of women and infants realize the benefits of midwifery care and avoid unnecessary intervention while having access to specialist care when needed. Historical and contemporary evidence supports a primary care model as the best way to achieve this.[2] The Institute of Medicine (IOM) defines primary care as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community" (p. 15).[20] Primary care models best serve populations in which the majority are healthy, there are opportunities for health promotion and disease prevention, and there is a need to efficiently identify and treat pathology, all of which apply to childbearing women. As we will see, putting midwives at the helm of the maternity care system produces the best outcomes, and systems that deemphasize or marginalize midwives do so at the expense of injuries to women and infants, stress to families and communities, and great economic cost.

What is a Midwife?

According to the definition endorsed by the International Confederation of Midwives,

> The midwife is recognised as a responsible and accountable professional who works in partnership with women to give the necessary support, care and advice during pregnancy, labour and the postpartum period, to conduct births on the midwife's own responsibility and to provide care for the newborn and the infant. This care includes preventive measures, the promotion of normal birth, the detection of complications in mother and child, the accessing of medical or other appropriate assistance and the carrying out of emergency measures.[27]

There is ample literature on the essence of midwifery and the benefits of midwifery-style care, and we will review some, although not all, of it here. We refer readers interested in a more robust discussion of midwifery care to Rooks (1999) and Kennedy (2000).[33, 42]

MIDWIVES: THE OPTIMAL PRIMARY CARE PROVIDERS

Many contemporary maternity care systems rely on midwives to provide care to the majority of childbearing women, in some cases restricting access to obstetricians without a referral from a midwife. These midwife-led systems presuppose that all women and fetuses/newborns benefit from holistic, supportive care during pregnancy, labor, birth, newborn transition, and breastfeeding, and only a minority will require medical or surgical management. In midwife-led models of care, the midwife consults, collaborates, or refers to specialist (obstetrician, perinatologist, neonatologist) care in those cases when an aspect of care falls outside of the midwife's independent scope of practice.

When compared with physician-led or team-led models, midwife-led care produces better health outcomes for mothers and babies with less reliance on surgical and medical intervention. (See mini-reviews.) When the Cochrane Collaboration conducted a systematic review of midwife-led models of care, the authors concluded decisively, "Midwife-led care confers benefits and shows no adverse outcomes. It should be the norm for women classified at low and high risk of complications" (p. 17).[25]

The insistence that obstetricians must lead care is based on the belief that obstetrics encompasses the skills of midwifery with the added bonus of specialist surgical and medical expertise. However, while midwives lack some of the skills and knowledge of obstetricians, obstetricians lack some of the skills and knowledge of midwives. The bulk of medical training emphasizes the medical and surgical management of all reproductive health problems from adolescence to menopause and beyond. Obstetricians learn "normal" mostly as a benchmark against which to recognize pathology and measure the effectiveness of treatments. Even here, though, physicians-in-training lack knowledge of truly physiologic birth, much less how to facilitate and support it, because they likely never see one. Midwifery training, on the other hand, emphasizes *maintaining* normalcy with health promotion, individualized education, and judicious use of mostly low-tech interventions. In addition, unlike obstetrics, midwifery encompasses the primary care of newborns as well as breastfeeding support and promotion of healthy adaptation to parenthood.[42]

As the authors of *Effective Care in Pregnancy and Childbirth* (2000) conclude, "It is inherently unwise, and perhaps unsafe, for women with normal pregnancies to be cared for by obstetric specialists" (p. 21).[21] To have obstetricians care for all pregnant women wastes the specialists' skills and mismatches women's needs with what obstetricians best provide. Midwives are experts in physiologic care and aim to support and facilitate the normal processes while keeping a watchful eye on deviations from normal. Obstetricians are experts in pathology and have the specialized knowledge and skills to manage medically complicated pregnancies and births. An optimal system will recognize the complementary roles of midwives and physicians and integrate their services accordingly.

IS MIDWIFE-LED CARE ONLY FOR LOW-RISK WOMEN?

A 2008 Cochrane systematic review concluded that midwife-led care is superior to other models of care regardless of whether women are low- or high-risk.[25] How is this possible?

To begin with, we must distinguish "midwifery care" from "midwife-led care." Midwifery care can be defined simply as care actually delivered by midwives. Midwife-led care, on the other hand, is care coordinated by midwives, in which the midwife may consult, collaborate, or refer to a physician or other specialist. In midwife-led care, the midwife may not oversee every aspect of the woman's care directly, nor even "catch" the baby, but she retains responsibility for care to the extent possible given the woman's condition and the midwife's scope of practice. Midwife-led care can and should engage obstetricians along with other specialists as indicated to address needs and concerns that cannot be addressed solely by the midwife. In other words, while *midwifery care* alone may be insufficient for women with medically complex pregnancies or significant risk factors for poor outcomes, *midwife-led care* remains best practice.

We must also distinguish "at risk" from actual pathology, a line that has become increasingly blurred in conventional obstetric concepts of risk screening. As Rooks (2008) argues:

> Physicians have expanded the proportion of pregnancies considered abnormal or pathologic by using monitoring devices that over-diagnose complications . . . , basing diagnoses on overly narrow definitions of normal, and treating variation from those definitions as evidence of pathology. . . . The desire to identify complications early has led to use of a sequence of preemptive interventions (to prevent complications or treat them before there is evidence that they exist) and a focus on "risk factors" (conditions that are not pathologic but are associated with an increased incidence of complications). In many instances, the distinction between risk factors and actual pathology has been lost, and women with "high risk factors" are treated as though they have actual complications (p. 371).[43]

Midwife-led care relies on ongoing assessment and monitoring for deviations from normal, but midwives tend to use lower-technology assessment methods and have broader definitions of normal. While some claim that this approach will lead to poor health outcomes, there is no evidence that this is true. Nor is there evidence that physicians do any better at sorting out which women need aggressive monitoring and treatment. In fact, as sociologist and bioethicist Raymond DeVries argues, obstetricians "are convinced that even with all of their advanced monitoring equipment, they cannot prospectively separate normal pregnancies from pathological ones" (p. 196).[19] Midwives assume that the woman is healthy

and her pregnancy is normal until proven otherwise, and care is organized to keep her healthy. In stark contrast, many physicians believe that labor is only normal in retrospect and the focus is on identifying and treating pathology.[19] In this paradigm, a woman cannot "pass all of the tests" and prove herself worthy of low-intervention care (e.g., midwifery care) until after the baby is born, when, of course, it is too late.

If we start with midwife-led physiologic care as the foundation, we can incorporate technology when necessary while preserving the benefits of midwifery care. Indeed, when medical or surgical intervention becomes necessary, the personalized and hands-on approach that characterizes midwifery care may be more important than ever, helping to counteract the emotional trauma, pain, and stress that can accompany medically complex births. But when systems are built on a foundation of high-tech pathology-oriented care, the basic needs for comfort and emotional support, culturally competent care, and self-determination often become "niceties," attended to only as an afterthought if at all.

OBSTACLES TO CHANGE

Many challenges confront a conversion to a midwife-led primary care system. In the U.S., for example, obstetricians outnumber midwives eight to one,[19] and over 4 million women give birth annually. Shifting to a midwife-led system would require a major commitment to training more midwives and fewer obstetric specialists. Efforts to achieve midwife-led care must also overcome perverse economic incentives and entrenched professional power dynamics as well as reverse troubling trends in midwifery training and practice. In addition, advocates for midwife-led systems must transform deep-rooted cultural beliefs about what constitutes safe and effective maternity care.

Market-driven health care systems such as the U.S.'s create incentives that are antithetical to the best interests of the systems' supposed beneficiaries—women, newborns, and society. As Perkins (2004) points out, "The 'market' for obstetricians is inherently finite, limited by the number of births in any given region. Thus, the only way to generate more revenue on the same number of births is to perform more procedures" (p. 105).[40] Cutting costs can also help the bottom line, and this is most often achieved by artificially controlling when, whether, and for how long women are in labor. Scheduling inductions and cesarean surgery and artificially speeding spontaneous labor allows providers and hospitals to predict staffing needs and earn the same, and in some cases more, revenue while avoiding staff overtime or night and weekend premium pay.

Overlaid on this market-based system for providing care is a similarly dysfunctional system for compensating women and families in cases of alleged malpractice. A full discussion of these problems is outside of the scope of this book (see Childbirth Connection's *Blueprint for Action: Steps Toward a High-Quality,*

High-Value Maternity Care System for a good summary[2]), but, in short, the current obstetric system has responded to the ongoing malpractice crisis by intensifying the use of interventions, in particular cesarean surgery, in the belief that it helps defend against claims. In addition, malpractice concerns are often cited by physicians who refuse to collaborate with midwives, especially in states where midwifery licensing implies or mandates a supervisory relationship between obstetricians and midwives. Where this is the case, it exposes physicians and sometimes hospitals to vicarious liability for care performed by midwives, a potent disincentive.

When midwives are independent practitioners, however, as is the case in truly midwife-led systems, vicarious liability disappears,[5] and it would thus seem logical that doctors would welcome independent midwifery and transform the relationship from supervisory to collaborative. Yet independent midwives are also economic competitors, diverting business from obstetricians. To get the "best of both worlds," some hospitals and physician group practices have incorporated midwives but imposed rigid hierarchical structures within which midwives give up most, if not all, of their autonomy. Midwives are assigned to "labor sit" or triage patients, which frees up physicians to perform more revenue-generating procedures, such as scheduled surgeries. These arrangements have created more opportunities for midwives to work within the existing physician-led system, but midwives often practice under physician or hospital protocols that do not value or even tolerate hallmarks of midwifery care, such as patience for individual variation, one-to-one care, and non-intervention in the absence of complications. Even the midwife who has her own caseload of clients may be expected to conform to medical model protocols and keep up with "productivity" standards set by hospitals.

In a physician-controlled, market-based system, the alternative to co-optation is marginalization. In most areas of the U.S., midwives wanting to practice physiologic care cannot do so in hospitals because of power dynamics that reward conformity with conventional obstetric management principles. Freestanding birth centers offer an alternative venue for "midwifery model" care, but these facilities face constant economic threat as a result of low reimbursement, high fixed costs (including unjustifiably expensive malpractice insurance premiums), and their dependence on their competition—physicians and hospitals—in order for the birth center business model to function. If birth center midwives cannot find a willing physician and hospital to accept clients requiring transfer of care, the house of cards comes tumbling down: the facility may lose its license, insurance companies may no longer reimburse for services, and the volume of clients will plummet. To avoid collapse, many birth centers organize as hospital-owned but midwife-operated. This offers some potential economic benefits, such as access to hospital billing contracts or malpractice insurance. But trade-offs can be severe. In 2008, a hospital-owned birth center in Massachusetts was threatened with closure. Public outcry led the hospital's corporate board of trustees to vote against the proposed

closure, but with one stipulation: women laboring at the birth center would be required to undergo periodic electronic fetal monitoring that would be interpreted remotely by physicians at the hospital. Based on these fetal monitoring tracings, the physicians—not the midwives—would determine whether the woman could remain at the birth center.[7]

These power dynamics ensure the dominance of the conventional obstetric management model and give rise to another obstacle to midwife-led physiologic care: midwifery training. Although there is no reason a midwife must first become a nurse or that accredited midwifery schools should train midwives in tertiary care centers, this is, unlike in most other countries, the only legally sanctioned route to midwifery in much of the U.S. This route ensures socialization into the medical model and promotes the loss of some, and sometimes all, of the philosophy and knowledge that distinguish midwifery from obstetrics. While nurse-midwives can overcome this socialization or "work the system" to provide physiologic care, they enter a system that imposes significant barriers to doing so while rewarding assimilation. Aspiring midwives wanting to avoid this socialization can choose the certified professional midwife (CPM) credential, which may involve apprenticeship and self-study, a more formal institution-based education, or a combination thereof. However, because about half of states still do not recognize or license CPMs, almost all of whom work in home birth or birth center settings and are excluded from hospitals, training may lack opportunities for learning how to practice midwife-led care within the integrated system that evidence supports as optimal.

The final and perhaps most significant obstacle to change is deep-rooted cultural beliefs about what constitutes safe and effective maternity care—beliefs that have been shaped by a hegemonic medical-model system for many generations. In the early 20th century, obstetricians rose to dominance in the U.S. by waging a disinformation campaign discrediting midwifery. They provided no evidence to support their argument (then or since), yet managed to convince the public that their skills were superior and would produce better outcomes.[15] As a result, midwives became seen as "second class" providers, inferior to the physician "experts" who could offer the benefits of modern technology.

BEACONS OF HOPE?

In the early 1990s, the United Kingdom undertook a national "Changing Childbirth" initiative, which culminated in the government's commitment to restructure the maternity care system as a midwife-led model with widespread access to planned home and birth center birth. Declercq (1998) reviewed public documents and conducted dozens of interviews with stakeholders to analyze the factors that led to this shift in policy, with the aim of drawing out the lessons for U.S. health policy making.[16] Although he cautions that fundamental differences between the culture and politics of the U.K. and the U.S. make the direct exportation of policy

nearly impossible, the lessons offer a useful framework for determining the feasibility of meaningful reform toward a midwife-led system in the U.S.

Lesson: "The medical model is vulnerable to attack on clinical as well as financial grounds" (p. 850).

In the U.K., a major impetus for reform was the development and publication of the landmark book *Effective Care in Pregnancy and Childbirth*, which reported the findings of a rigorous systematic review of a variety of perinatal practices.[21] The report called into serious question the safety and effectiveness of the prevailing package of maternity care. According to Declercq, this government-sponsored research justified the need for a national inquiry into maternity care and became the foundation of the work of the national committee charged with conducting that inquiry. Efforts to reform maternity care in the U.K. also coincided with larger reforms affecting the entire National Health System (NHS). These reform efforts focused on restructuring care to improve both quality and cost-effectiveness. The climate of health policy reform, though not directly responsible for instigating national maternity care reform efforts, set the stage for politicians and grassroots advocates to challenge the safety, effectiveness, and cost of medical-model maternity care.

Conventional obstetric management is no less vulnerable to attack in the U.S., but to date the U.S. government has not sponsored any inquiry into the working of the maternity care system. Fortunately, nongovernmental entities have stepped in, collecting, codifying, and synthesizing the evidence favoring physiologic care in general and care by midwives in particular. The most notable examples are the 2008 Cochrane systematic review of midwife-led care,[25] *The Evidence Basis for the 10 Steps of the Mother-Friendly Childbirth Initiative,* published in 2007,[11] and the 2008 report, *Evidence-Based Maternity Care: What It Is and What It Can Achieve.*[45]

In recent years, a "climate of reform" in health care has emerged in the U.S. as well. Skyrocketing costs, lack of accountability, and outcome disparities have brought health care reform to the top of the agenda. This creates an opportunity for transformation of the maternity care system, and reformers have pointed out the significant economic burden of maternity care in the U.S. as a justification for focusing health care reform efforts on maternity care specifically. However, although pregnancy and childbirth are responsible for far more hospital charges than any other condition in the U.S.,[45] the health care reform conversation—in the media, at the policy level, and among the public—has been slow to take on maternity care. Maternity care consumer advocates and other stakeholders are organizing to lobby for change, but with many well-funded interest groups also clamoring for reform in other health care sectors, whether maternity care reform efforts will be effective remains to be seen.

Lesson: "Research can directly influence policy" (p. 851).

Declercq argues that the demand for evidence to guide policy making successfully led to calls for reform because policy makers insisted that evidence guide policy making and put the onus on obstetricians to produce evidence to justify restricting choice or intervening in the normal process, which, of course, they could not do. Writes Declercq:

> The existence of a body of systematic data at [a government-sponsored agency] challenging current practice . . . changed the debate from "science versus women's feelings" as it had been characterized in the past, to "my evidence versus your 'consensus opinion.'" In some cases, such as home births, where there was little systematic evidence on either side, the burden of proof shifted from those advocating home births to those wanting to impede women's right to choose them (p 851).[16]

The lack of evidence for or against home birth refuted the mainstream claim that "childbirth is made so much safer by the application of high technology that only this option should be provided" (p. 55)[49] and provided an impetus both to ensure access to planned home birth and to study systematically how to optimize its safety and effectiveness.

Advocates for reform in the U.S. maternity care system must likewise demand that care be based on the medical evidence, but new challenges have arisen. In the years since Changing Childbirth, a glut of poor quality studies have been published and widely disseminated as evidence bolstering the medical management model. The argument has become not "your opinion versus my evidence" but "your evidence versus mine." Moreover, power differentials have ensured that midwifery research is subjected to more scrutiny and receives less publicity, while medical-model research is disseminated and adopted widely even when significantly limited or flawed. Reform advocates must, therefore, expand their repertoires. In addition to becoming sophisticated in discerning good studies from bad (we hope we have been of assistance here), they must insist on greater investment in midwife-led research, transparent review mechanisms, and equitable access to publication of research findings relevant to physiologic care and midwifery practice.

Reform advocates must also insist on ground rules for the incorporation of new evidence into practice, some of which must be modified from those generally accepted in determining medical care. The use of comparative effectiveness research to define safe and effective care has become a major priority in national healthcare policy. As a general rule, this is good policy because testing new treatments against the community standard, rather than against no treatment, tells us whether the new treatment will improve outcomes over what we already have. It presents a danger, however, in evaluating maternity care policies. As we have argued elsewhere, maternity care is a special case

because obstetric standard management has never been shown to be superior to "no treatment," i.e., letting the normal process unfold with no or minimal intervention. In addition, we know that the overuse of many high-technology obstetric interventions has led to a mounting burden of preventable cost and injury. In contrast, physiologic care provides a valid, optimal standard against which to benchmark the effectiveness of other approaches. In systems committed to delivering safe and effective maternity care, physiologic care should be the default, and comparative effectiveness research and maternal preferences should guide management in the presence of pathology.

Finally, reform advocates must recognize that limiting research to comparative measurement of morbidity and mortality will necessarily tell only part of the story. Women and infants almost always come through birth alive and relatively well no matter what kind of care they receive because they are mostly healthy and resilient to begin with. In addition to being rare, adverse outcome rates alone cannot tell us which approach to care optimizes health and wellbeing, promotes satisfaction, strengthens families and communities, or is more cost effective, among other important but rarely measured "outcomes."

To what extent midwifery research will directly influence policy in the U.S. depends on the success of maternity care reformers in reframing concepts of "evidence-based care," curbing the conduct and dissemination of flawed research, and removing barriers to the conduct and dissemination of high-quality research on normal physiologic birth and midwifery practice.

Lesson: "Interest groups, even poorly funded public interest groups, can influence policy agendas, particularly if they have a place to lobby" (p. 852).

In the U.K., "an established and diverse childbirth consumer movement . . . advocated change at the same time that more sophisticated political awareness developed in a major provider group, the Royal College of Midwives" (p. 839). This movement served as a major impetus for elevating maternity care reform to national agenda status and helped maintain the Commission's focus on normality, women's rights, and evidence-based policy. According to many of Declercq's respondents, a particularly helpful factor was a "good cop/bad cop" approach. The National Childbirth Trust and Royal College of Midwives took the more sympathetic, conciliatory stance while organizations such as the Alliance for Improvements in the Maternity Service and the Association of Radical Midwives agitated more aggressively for more radical transformation. Yet while these groups adopted differing public roles, they viewed their roles as complementary, not oppositional.

When Declercq published his findings in 1998, he lamented that the U.S. was far behind the U.K. with respect to organization and status of advocacy groups. At the time, the most established consumer-oriented groups, Lamaze International and the International Childbirth Education Association (ICEA), focused on education, the Coalition for Improving Maternity Services (CIMS) was a fledgling

organization that emphasized provision of "mother-friendly" care at individual birth services (hospitals, birth centers, and home birth services), and Childbirth Connection, formerly Maternity Center Association, concentrated on provider and consumer education and demonstration projects. In the decade since, the collective call for systemic U.S. maternity care reform has grown significantly. Lamaze, ICEA, and CIMS have organized around this issue, and Childbirth Connection has risen to the forefront with their publication of several landmark reports about maternity care in the U.S.,[8, 18, 45] including, in 2010, its "Blueprint for Action," the result of a multi-year collaboration with leaders from across the healthcare system.[2] New efforts have also sprung up. Grassroots community advocates have come together in organized "birth networks" with national leadership, and CPMs have launched a coordinated campaign to achieve licensure in all 50 states.

Unfortunately, divisiveness among activists, inadequate numbers and resources, and fragmented healthcare policy making continue to impede reform. For example, midwives have failed to unify over a common agenda. Some subgroups are advocating for emancipation from the dominant system, while others are pushing for greater acceptance within it, and only a few are advocating for conversion to a system of midwife-led primary care that provides widespread access to physiologic care. Moreover, unlike countries with nationally organized healthcare systems, "places to lobby" are minimal. Midwifery advocates wanting a seat at the table are up against the much better-funded American Congress of Obstetricians and Gynecologists (ACOG) and the American Medical Association—both of which have waged vigorous campaigns against independent midwifery.*

Policy makers' current emphasis on health care quality and safety has provided some opportunities for midwifery advocates to influence policy and public discourse, but progress will be slow and changes minor until such time as policy makers can be brought to recognize that the foundational beliefs underpinning our maternity care system, namely, that universal hospitalization and obstetrician-led care improve outcomes, are false.

Lesson: "Individuals still profoundly shape the policy-making process, particularly in the early stages, and, in health care, their personal experiences with the system matter" (p. 853).

Declercq cites several instances when a policy maker's own experiences with childbirth influenced attitudes toward policy decisions, including one instance when a conservative committee member proudly acknowledged being born at home. In the U.S., more women are in power than ever before, and many male lawmakers will have been with their wives' during labor and birth. These demographic

* Although in 2011 ACOG for the first time recognized certified nurse-midwives and certified midwives as independent providers,[1] they maintain vigorous opposition to CPMs, who practice almost exclusively in the home and birth center settings.

and cultural shifts mean more policy makers have personal experience with maternity care. Thus, the potential exists for a high-profile maternity reform champion to appear and take a leading role in instituting reforms. Experience, however, is a double-edged sword. In a culture that values and normalizes medicalized management and fails to recognize its iatrogenic harms, the experience of politicians and policy makers can also lead to calls for yet more intensive use of the same.

Lesson: "Focusing health care reforms on how we live instead of how and why we die restructures the debate and forces decision makers to address a public health model as well as (or in place of) a medical model" (p. 854).

Early in the process of developing what became "Changing Childbirth," participants decided to focus on promoting "normal birth," that is, women free of medical or obstetric complications at onset of labor having vaginal births without significant medical or surgical intervention. This decision was a major departure from previous inquiries. Writes Declercq:

> Studying normal birth put emphasis on the overwhelming majority of births that result in no harm to mother or infant and led to questions about the nature of care and support provided to these women. Attention therefore began to turn to issues that physicians are less likely to control, such as economic and social conditions, access to care, and nutrition. A broader, more integrated, and cost-effective public health model becomes the natural solution rather than providing more neonatal intensive care units (p. 854).[16]

Policy makers pushing for health care reform in the U.S. have emphasized access to affordable health care, cost containment, and patient safety. Currently, preventive care gets lip service, but the U.S. system remains one that provides incentives for treating illness but few for avoiding it. Ongoing health care reform efforts may mean new opportunities, however, and maternity care advocates should seize the chance to reframe the conversation.

Lesson: "Change, even change in one sector of the health care system, is breathtakingly slow in coming about, despite the powerful forces that advocate for it" (p. 849).

Declercq cautions that:

> In the United Kingdom, where there is relatively centralized control of the delivery of health services, simply agreeing to alter one small part of that system took over four years of discussion, and that did not include implementation. In the United States, with a decentralized, privatized system based on medical regulation in fifty states, determining how even the British maternity reforms might be applied is difficult to comprehend (p. 849-850).[16]

Indeed, in the years since "Changing Childbirth" became policy, the U.K. government has fallen far short of implementing all of its recommendations, and public health impact has therefore not been fully realized.[17]

In the U.S. the fundamental changes in policy needed to achieve a midwife-led maternity care system grounded in physiologic care face substantial bureaucratic, cultural, and economic hurdles that may take decades or even generations to overcome. Attitudes will linger and power is not relinquished easily. Even with a national commitment and appropriate policies, care would almost certainly continue to be suboptimal for the foreseeable future because of institutional inertia and the time and effort it would take to re-train and reallocate staff and educate the media and the public to the dangers of medical management and the benefits of physiologic care. It will not be easy to turn the ship around, but we cannot in good conscience fail to make the attempt. The health and wellbeing of women, infants, families, and communities depend on it.

MINI-REVIEWS

Notes:

- Midwifery training, regulation, and scope of practice differ markedly across industrialized countries. Even within individual countries, such as the U.S., routes to becoming a midwife and regional regulations affecting midwifery practice may vary. For the purposes of this analysis, we have excluded studies involving unregulated midwives or traditional birth attendants.
- Evaluating the safety and efficacy of midwives presents us with two questions: "What is the relative safety and effectiveness of *midwifery care*?" that is, care actually delivered by a midwife, and "What model for delivering maternity care will reap the most benefits of midwifery care for the most women?" We will answer the first question by comparing the process and outcomes of care by midwives vs. physicians and the second by comparing midwife-led models of care with other models of maternity care in which midwives share their caseload with, or are supervised by, physicians.
- A significant barrier to studying midwifery care outcomes is the potential for selection bias. Women seeking midwifery care are likely to differ from women opting for physician care in ways that may not be easy to measure. Random allocation can eliminate this source of bias, but it is difficult to require women to use a certain type of provider, and women who have no preference for provider type may differ from the childbearing population at large. We have only two randomized controlled trials (RCTs) comparing midwifery care with physician management. One was conducted without the informed consent of participants,[9] and

the other was conducted in a region where midwifery had previously been unavailable and was introduced on a pilot basis.[24] (Far more RCTs compare midwife-led care with other models of maternity care, but women in those trials typically had access to midwives in both arms of the trial. [See mini-review 8.]) This dearth of "Level 1" evidence for the safety and effectiveness of midwifery care requires that we look to other types of evidence. We have therefore included high-quality observational studies that used statistical methods to control for confounding variables.

- Unless otherwise specified, women in the midwife groups were analyzed in that group even if they were transferred to an obstetrician before or during labor ("intent to treat" analysis).
- We have restricted our analysis to care and outcomes occurring in the intrapartum and immediate postpartum periods. Antepartum care practices are outside the scope of this book, but differences in the approach to and content of antepartum care exist, and some evidence suggests that these differences may result in lower rates of low birth weight and preterm birth with midwifery care.[41]
- Studies of midwifery care are heterogeneous, which affects the applicability of their findings to other populations or settings. Factors that may influence the presence and magnitude of observed differences across provider groups include the following:
  - » Birth setting: In some studies, midwifery care took place in a hospital unit,[4, 6, 24, 26, 31, 38, 44, 46, 48] while in others care was provided in a freestanding or hospital-based alternative birth center.[9, 22, 29]
  - » Provider mix: Family physicians constituted all or some of the physician group in five studies.[24, 26, 31, 36, 44] Another study compared physician care with a joint-provider practice in which most, but not all, low-risk women were attended in labor by midwives.[46]
  - » Timing of study enrollment: Some studies enrolled participants early in their pregnancies,[22, 24, 29, 38, 44, 46] while others enrolled participants in late pregnancy or in labor.[4, 9, 13, 14, 26, 31, 37]
  - » Risk-level of participants: Some studies included women with moderate- or high-risk factors for poor pregnancy outcome.[13, 22, 36, 46]
  - » Exclusion of operative deliveries (instrumental vaginal and cesarean).[4, 6, 36, 47, 48]
- Differences can be assumed to be statistically significant unless otherwise noted.

1. Midwifery care in labor and birth reduces the likelihood of operative delivery. Two RCTs compared midwifery care with physician management and yielded somewhat different results, probably because their recruitment strategies and methods were dissimilar. A Canadian trial evaluated outcomes in a pilot nurse-midwifery service in a large city located

in a province where midwifery had previously been unregulated and unsupported.[24] The pilot service was the only hospital-based midwifery option in the community. Both the experimental and control groups were drawn from a population of low-risk women who had sought out midwifery care in response to a campaign publicizing the pilot program. The trial excluded nulliparous women younger than 17 or older than 37 and all women with prior cesareans. Of the194 participants, 101 were assigned to receive antepartum, intrapartum, and postpartum care from a team of 7 midwives who practiced independently according to midwifery protocols. (Antenatal care included two visits with an obstetrician to confirm low-risk status but no other routine involvement of physicians.) The 93 women assigned to the control group were free to use any family physician or obstetrician and gave birth at any of several local hospitals. All women met low-risk criteria on entry to the study, and antenatal complication rates did not differ between the two groups. Fewer women had cesareans (4% vs. 15%, absolute difference 11%) in the midwife group, and similar percentages had instrumental vaginal deliveries (5.9% vs. 7.6%). The other RCT was conducted in a California hospital where midwives and obstetricians had worked side-by-side for 10 years.[9] In this trial, women were randomly allocated during labor, and no information was given about who provided prenatal care. Low-risk women were assigned to an in-hospital birth center with a midwife (n = 234) or a typical hospital room with the resident obstetrician (n = 253). Exclusion factors were estimated large (> 4000 g) or small (< 2500 g) baby, > 1 prior cesarean, meconium-stained amniotic fluid, prelabor rupture of membranes, maternal fever, fetal station > -3, or significant maternal or fetal complications. The cesarean rate was low and similar in both groups (0.4% physician vs. 2% midwives), but the rate among obstetricians was extraordinarily low, especially considering that some women had a prior cesarean. By contrast, instrumental vaginal delivery was more common among obstetricians (7% vs. 0%, absolute difference 7%).

Among prospective cohort studies, one study stands out for the diligence with which investigators controlled for confounders.[39] The study compared processes of care and use of technology in 471 women cared for by midwives and 710 similar women cared for by obstetricians. The 8 midwives and 22 doctors, all in private practice, practiced in the same facilities with the same support staff and under the same fee structure. All women met medical eligibility requirements for midwifery care at prenatal enrollment. Investigators reviewed medical records to determine processes of care and use of technological interventions. After calculating unadjusted differences, they constructed models to control for maternal preferences and characteristics (determined via prenatal questionnaires about demographics, past experiences of abuse or major stress, expectations for their care in labor and birth, and fears/anxieties), prenatal and intrapartum medical problems, and length of labor. In unadjusted analysis, forceps use (11% vs. 4%, absolute difference 7%) and cesarean surgery (19% vs. 13%, absolute difference 6%) were increased in the obstetrician group while vacuum extraction rates were similar (3% midwives vs. 5% obstetricians). These three variables were combined with 14 others for a composite score of "technology-based care processes" and results were adjusted for this score. The provider type (obstetrician or midwife) explained 8% of the variation in the use of technology-based care. Prenatal and intrapartum medical problems and maternal characteristics each explained 14% of the variation, while women's preferences explained less than 2%.

A secondary analysis of data from a prospective study of planned home birth that included two hospital cohorts tracked outcomes of all women planning midwife-attended hospital births in the Canadian province of British Columbia in 1998 or 1999 who were

of sufficiently low-risk status to be eligible for home birth (n = 488).[31] The comparison group included women meeting the same eligibility requirements but planning physician-attended birth in hospitals where midwives also practiced (n = 572). In unadjusted analysis, instrumental vaginal delivery rates were similar (12% both groups), as were cesarean rates in nulliparous women (14% midwife vs. 17% doctor) and multiparous women with no prior cesarean (3% both groups). However, the spontaneous vaginal birth rate was higher in the midwife group (78% vs. 72%), a difference explained by a higher proportion of women in the midwife group planning vaginal birth after cesarean (VBAC) (93% midwife vs. 42% physician). About 80% of women who planned VBACs gave birth vaginally in both groups. After controlling for maternal age, parity, height, smoking status, and previous cesarean delivery, midwife-attended birth was associated with a lower risk of cesarean section (OR 0.6).

A third prospective study compared outcomes among 1808 low-risk, low-income women enrolled in a midwife-led collaborative care model with 1149 similar women enrolled for traditional obstetrician-led care.[29] In the collaborative care model, women who remained low-risk at the onset of labor were admitted to a freestanding birth center for labor and birth while women who developed complications or became high-risk were cared for by obstetricians in the hospital, thus observed differences between provider groups may be confounded by the different birth settings. All women in both groups were eligible for birth center care at the first prenatal visit. Mode of birth was adjusted for race/ethnicity, parity and cesarean history, education, age, marital status, country of origin, height, and smoking during pregnancy. After adjustment, differences in spontaneous vaginal birth (81% vs. 63%, absolute difference 15%), instrumental vaginal delivery (8% vs. 18%, absolute difference 10%), and cesarean surgery (11% vs. 19%, absolute difference 5%) all favored collaborative care. Excluding women from the collaborative care group who had specifically sought out midwifery care or birth center birth (leaving those who had chosen collaborative care for other reasons such as convenience or financial factors) did not affect outcomes.

In a subsequent analysis of the same study, researchers looked at the subset of the women with singleton, vertex fetuses who were admitted in spontaneous labor to their birth settings to explore whether cervical dilation at time of admission to the birth setting explained differences in mode of birth between provider types.[28] Admission to the labor setting prior to 4 cm dilation is itself a risk factor for cesarean surgery, and it is possible that obstetricians are more likely to admit women in early labor, which might explain higher cesarean rates in obstetrician-managed labors. Researchers compared this subset of 1413 women in the "collaborative care" group with 783 similar women in a subset of the obstetrician management group. Researchers investigated individual and joint effects of provider group (collaborative or obstetrician-only care) on spontaneous vaginal birth and cervical dilation at admission to the labor and birth setting (< 4 cm or ≥ 4 cm). Unadjusted data stratified by parity showed absolute differences favoring collaborative care for nulliparous women (absolute difference 22%), multiparous women without prior cesarean (absolute difference 13%), and multiparous women with prior cesarean (absolute difference 23%). More women in the obstetrician group were admitted prior to 4 cm dilation, but this did not explain differences in the likelihood of operative delivery across provider groups for any subpopulation. In fact, joint effects analysis suggested that early labor admission and obstetrician provider worked synergistically to increase risk of operative delivery above and beyond the sum of the excess risk for either early labor admission or obstetrician provider individually.

The fourth prospective cohort study compared outcomes across three provider types.[44] Researchers randomly sampled practicing obstetricians (n = 54), family physicians (n = 54), and midwives (n = 43), then randomly selected 11 low-risk women from each provider's caseload, for a total of 1322 women. Women were retained in their original provider group regardless of what type of provider actually attended the birth. Eighty-four percent of women initiating care with nurse-midwives had spontaneous vaginal births compared with 70% of women in the family physician group (absolute difference 14%) and 65% of those in the obstetrician group (absolute difference 19%). Likewise, women initiating care with midwives were less likely to have a cesarean (9% midwife vs. 15% family physician vs. 14% obstetrician, absolute difference 5-6%) or a forceps-assisted delivery (1% midwife vs. 7% family physician vs. 12% obstetrician, absolute difference 6-11%). Rates of vacuum extraction were similar (7% midwife vs. 8% family physician vs. 10% obstetrician). Researchers explored the effect of parity by separately analyzing nulliparous women, women with parity of one, women with parity of two, women with parity greater than two, and all multiparous women. In every analysis, women initiating care with nurse-midwives were more likely to give birth spontaneously. The difference in cesarean rate was most pronounced in nulliparous women (12% midwife vs. 26% family physician vs. 23% obstetrician, absolute difference 9-14%). Finally, to explore the effect of selection bias, the researchers analyzed a homogenous group of white, married, multiparous, privately insured women. Differences across provider types remained unchanged.

A fifth prospective cohort study compared outcomes of a joint midwife/physician practice (n = 749) with those of a physician-only (family physician or obstetrician) practice (n = 885).[46] In the joint practice, all publicly insured women had midwifery care unless they developed complications while privately insured women could choose midwifery or obstetrician care, and those who chose midwifery care gave birth with a midwife unless complications occurred. Overall, 12% selected a physician provider and 13% risked out of midwifery care before or during labor, with the remaining 75% having all of their intrapartum and postpartum care provided by midwives. Researchers analyzed outcomes of singleton births beyond 20 weeks using data from the community hospital's birth log. The joint practice had a higher rate of spontaneous vaginal birth (89% vs. 70%, absolute difference 19%) and less use of instrumental (1.5% vs. 12%, absolute difference 10.5%) and cesarean delivery (9% vs. 18%, absolute difference 9%). After controlling for confounding factors, practice type remained an independent determinant of cesarean surgery.

A sixth prospective cohort study analyzed outcomes of 1022 women matched for parity, age, and risk status (low, moderate, or high).[22] Women in the midwifery group were admitted to a freestanding birth center in labor unless complications arose in pregnancy. Women in the midwifery group were more likely to have spontaneous vaginal births (90% vs. 71%, absolute difference 19%) and less likely to have cesarean surgery (6% vs. 13%, absolute difference 7%). Differences remained significant when researchers restricted their analysis to nulliparous women and to multiparous women and when they excluded women who had had prior cesarean surgery.

A final prospective cohort study evaluated process and outcomes of care in 375 moderate-risk women enrolled for care with midwives (n = 196) or obstetricians (n = 179).[13] Women in the obstetrician group were more likely to use nontherapeutic drugs or alcohol before or during the pregnancy and had to have chronic medical problems. Other

background characteristics were similar between groups. In unadjusted analysis, women in the obstetrician group were 1.7 times more likely to have cesarean surgery (34% vs. 13%, absolute difference 21%). When investigators made the two groups more similar by excluding women with preexisting chronic conditions and filtering to include only women with one or more prenatal complications (n = 135 in obstetrician group; n = 162 in midwife group), the cesarean rate remained higher in the obstetrician group (16% vs. 6%, absolute difference 10%), and the spontaneous vaginal birth rate lower (63% vs. 80%, absolute difference 17%).

2. Midwifery care in labor and birth reduces the likelihood of genital tract trauma. Studies report strikingly lower use of episiotomy, an important source of perineal trauma, by midwives compared with physicians. This holds true in RCTs as well as observational studies, whether studies included all vaginal births or restricted analysis to spontaneous births, after controlling for various risk factors, in settings with high and low baseline episiotomy rates, and in both multiparous and nulliparous women. Beginning with the only two RCTs of midwifery care vs. physician care in low-risk women, both the U.S. (11% vs. 35%, absolute difference 24%) and the Canadian trials (16% vs. 33%, absolute difference 17%) reported lower episiotomy rates.[9, 24] Seven observational studies found episiotomy rates ranging from 3-30% among midwives and from 15-60% among physicians, with absolute differences ranging from 13-30%.[4, 22, 26, 39, 44, 46, 47] One retrospective study comparing midwives with family practice physicians found a difference in episiotomy rates only in multiparous women (11% vs. 20%, absolute difference 9%).[26] The most recent study provides the only instance we could find of physicians using episiotomy less frequently than midwives.[48] Researchers retrospectively analyzed all 8927 spontaneous vaginal births of term, singleton, vertex infants occurring between 2000 and 2004 in a large U.S. teaching hospital. They compared perineal outcomes of all births attended by midwives with those of private-practice physicians and obstetric residents separately. The residents had the lowest episiotomy rate (6%) compared with midwives (16%) and private-practice physicians (30%). The low rate among residents may reflect a trend toward teaching conservative use of episiotomy in medical training programs in light of current evidence. A similar pattern may exist among midwives—midwives trained more recently cut fewer episiotomies—but the study design did not allow us to measure practice variation across midwives. Combining the incidence of episiotomy performed by residents and private-practice obstetricians yields a rate of 21%, which is higher than midwife-attended births, although we do not know if this difference is statistically significant.

Among studies that reported perineal outcomes on all vaginal births (instrumental and spontaneous), midwifery is consistently associated with fewer anal sphincter tears (third- and fourth-degree perineal lacerations). The U.S. RCT reported that 8% of women in the physician group and 1% of women in the midwifery group experienced third- or fourth-degree tears (absolute difference 7%).[9] The Canadian RCT (N = 176) reported no incidence of anal sphincter tear in either group, but investigators excluded all births with episiotomies, which were twice as common in physician-attended births, from their analysis of perineal outcomes.[24] Median episiotomy, the norm in the U.S. and Canada, promotes anal sphincter tears. (See chapter 15.) Three prospective cohort studies found higher rates of anal sphincter tears in women cared for in labor by doctors. Rates ranged from 6-23%

in the physician groups and 1-7% in the midwife groups, with absolute differences ranging from 4-16%.[22, 38, 46] In a fourth study, all physician care was provided by family practice doctors.[26] Anal tear rates in nulliparous women were similar between provider groups (9% midwives vs. 11% family physicians), but more common in multiparous women cared for by family physicians (5% vs. 1%). The only study that failed to find a difference in incidence of anal sphincter lacerations was a Canadian prospective study in which the physician group was comprised mostly of family physicians and rates of both instrumental delivery and episiotomy were similar between groups.[31] This suggests that excess anal sphincter tears in physician-attended births arise from excess use of episiotomy, instrumental delivery, or the combination of both.

Studies that exclude instrumental vaginal deliveries, not surprisingly, find smaller or even nonsignificant differences in severe lacerations. An Austrian study reported similar incidence of third-degree lacerations (0.3% midwives vs. 0.4% physicians);[4] however, episiotomy rates were low and would have been mediolateral, which does not predispose to anal extension. A U.S. study comparing midwives with obstetric residents and private-practice physicians reported anal sphincter tears in 2% of midwife-attended births, which was similar to the incidence in resident-attended births (also 2%) but significantly lower than the rate in births attended by private-practice physicians (4%).[48] The likelihood of an anal sphincter tear in spontaneous vaginal births with an episiotomy was similar across groups (7.5% midwives vs. 7% private-practice physicians vs. 13% residents). However, anal sphincter tear in spontaneous vaginal deliveries without an episiotomy were significantly more common in births attended by private-practice physicians compared with midwives or residents (1.1% midwives vs. 3.1% private-practice physicians vs. 1.3% resident physicians). In another U.S. study conducted among 2819 nulliparous women, researchers compared rates of genital tract trauma occurring with spontaneous vaginal birth, and controlled for known demographic and labor management factors that affect perineal outcomes. Women attended by obstetricians were more likely to experience first- or second-degree lacerations (adjusted OR 1.8), episiotomy without extension (adjusted OR 4.9), episiotomy with or without extension (adjusted OR 2.9), and spontaneous anal sphincter laceration (adjusted OR 2.3).[6]

3. Midwifery care in labor and birth reduces the use of pharmacologic pain management methods.

> **Note:** Because desire to avoid pain medications may motivate women to seek out midwifery care, rates of analgesia and anesthesia use in observational studies may be particularly vulnerable to selection bias, and results of non-randomized studies should therefore be interpreted with caution.

Two RCTs comparing midwifery care with standard obstetrician management report use of pharmacological pain relief methods. In the larger trial, women were randomly assigned upon admission in labor.[9] Those allocated to midwifery care (n = 234) labored in a hospital-based alternative birthing center while those allocated to physician management (n = 253) labored in a typical hospital unit. Analgesia use (type not specified) was low in both groups

but was less common in the midwifery group (10% vs. 23%, absolute difference 13%). In a second, smaller, trial, women seeking midwifery care were assigned to care from midwives (n = 101) or obstetricians or family physicians (n = 93).[24] Women assigned to midwifery care were less likely to use nitrous oxide (23% vs. 33%, absolute difference 10%), narcotic analgesia (16% vs. 18%, absolute difference 2%), or epidural anesthesia (13% vs. 24%, absolute difference 9%), although none of these differences achieved statistical significance. This may be because the sample size was too small to detect a difference or because having family doctors in the physician group may have resulted in lower use of analgesia/anesthesia than with obstetricians alone, or both.

Two observational studies comparing midwifery care with care by family doctors support this hypothesis. In a prospective cohort study, local (e.g., pudendal) or epidural anesthesia use by family physicians fell between that of obstetricians and midwives. Researchers randomly sampled practicing obstetricians (n = 54), family physicians (n = 54) and certified nurse-midwives (n = 43) and randomly selected 11 low-risk women from each provider's caseload, for a total of 1322 women.[44] They then calculated the percentage of participants who had vaginal births in each provider group receiving various pharmacological pain relief methods as well as the proportion having vaginal births with no analgesia. Women cared for by midwives were less likely to have an epidural than both the obstetrician group and the family physician group (18% vs. 42% and 31%, respectively, absolute differences 24% and 13%, respectively). The difference between the obstetrician group and the family physician group also was significant. Likewise, midwifery clients were more likely to use no anesthesia than both other groups (36% vs. 12% and 20%, respectively, absolute differences 24% and 16%, respectively). No differences were seen in the use of pudendal, local, or "other" anesthesia across care provider groups. Narcotic analgesia use was not reported. In another prospective study comparing 488 midwife-attended births with 572 physician-attended births, in which most of the physician were family practice doctors, epidural rates were nearly identical (26% midwife vs. 25% physician) but narcotic use was much lower in the midwife group (12% vs. 31%).[30] In a third prospective cohort study, researchers analyzed outcomes in 850 women in a midwife/family physician group practice with shared call. The women who gave birth with nurse-midwives (n = 400) and those who gave birth with family physicians (n = 450) had similar rates of intrapartum narcotic or epidural use.[26]

Five additional observational studies compared obstetricians with midwives and all found less use of pharmacologic pain relief with care by midwives. Rates of epidural use in the five studies ranged from 11% to 31% in the midwife groups compared with 45% to 69% in the physician groups, and absolute differences ranged from 20% to 42%.[13, 14, 22, 29, 39] Differences in narcotic analgesia use, reported in four of the studies, were more modest and did not achieve significance in two of the studies.[22, 29] A large retrospective study reported rates of 20% vs. 25% (absolute difference 5%) favoring midwives,[14] and a prospective study reported rates of 31% vs. 42% (absolute difference 11%), also favoring midwives.[39] The fifth study did not report narcotic use but did report use of any pharmacologic method. Rates were 82% in the physician group vs. 64% in the midwife group (absolute difference 16%).[13] Two of the studies used different methods to determine whether women's preferences confounded findings. A Michigan study of 471 midwife-attended and 710 obstetrician-attended births reported lower narcotic (31% vs. 42%) and epidural (20% vs. 45%) rates with midwifery care.[39] The researchers constructed a statistical model to determine how

much of the difference could be attributed to differences in maternal characteristics, such as anxiety level, and preferences, such as stated desire for various technological procedures. The findings are difficult to interpret because pain medications were lumped together with other technologies in the analysis. However, provider type remained a significant, though modest, predictor of the amount of "technology-based care," explaining 8% of the overall difference. In another study, Jackson and colleagues (2003) asked women in the midwifery group why they selected midwifery care.[29] Although data were not presented, the researchers reported that outcomes of women who sought out midwifery or birth center care were no different from women who chose the collaborative practice for financial, convenience, or other reasons.

4. Women cared for by midwives in labor are more likely to use nonpharmacologic pain relief methods.

> **Note:** Because desire to avoid pain medications may motivate women to seek out midwifery care, rates and types of nonpharmacologic use in observational studies may be particularly vulnerable to selection bias. Results of nonrandomized studies should therefore be interpreted with caution.

Reduced use of pharmacological pain management does not mean there is no pain management, but that a variety of no-risk nonpharmacologic strategies are employed. A pilot trial of a newly introduced midwifery service reported more use of several non-pharmacological methods in the group randomized to midwifery care compared with obstetrician or family physician care.[24] All women in both groups had sought midwifery care, which may indicate an increased willingness to avoid pharmacologic pain relief methods. The group allocated to midwifery care was more likely to use massage (46% vs. 19%, absolute difference 27%), a bath (28% vs. 8%, absolute difference 20%), or a shower (72% vs. 42%, absolute difference 30%). Few women in either group used a jacuzzi or hypnosis, and equal numbers (about 7%) used transcutaneous electrical nerve stimulation.

Turning to observational studies, one prospective study reported that, compared with women in the care of obstetricians, similar women who enrolled for midwifery care were more likely to use position changes (65% vs. 53%, absolute difference 8%), relaxation techniques (42% vs. 36%, absolute difference 6%), massage (37% vs. 30%, absolute difference 7%), walking (37% vs. 29%, absolute difference 8%), a shower (29% vs. 11%, absolute difference 18%), and music (16% vs. 9%, absolute difference 7%) for pain relief.[39] The use of breathing techniques, hypnosis, and visualization did not differ between groups. Although the researchers surveyed women prenatally about their preferences for pain management, they did not control for maternal preference in analyses of method use. Therefore, these results likely reflect some degree of selection bias.

A more recent study compared 1808 low-income women receiving midwifery care in collaboration with physicians with 1149 receiving physician-only care.[29] Low-risk women in the collaborative care group gave birth in a freestanding birth center with midwives or with physicians in the hospital if they developed antenatal or intrapartum complications.

Among women in the collaborative care group, 37% used a tub or shower in labor vs. 3% in the physician group (adjusted difference 32%). No other non-pharmacologic methods were reported.

Finally, a prospective cohort study compared the process and outcomes of care in moderate-risk women attended by midwives and doctors.[13] The researchers analyzed a subset of women who had no chronic medical conditions but at least one prenatal complication (n = 279). Those attended by midwives were more likely to use nonpharmacologic pain relief methods in labor (88% vs. 51%, absolute difference 37%).

5. Midwives rely less on restrictive or invasive intrapartum procedures.

Two studies evaluated the overall intensity of intervention use across provider groups. One study calculated an "Optimality Index Score."[13] The index comprises 40 yes/no items that measure use of supportive care techniques (e.g., continuous support or freedom of movement), avoidance of interventions (e.g., intravenous fluids, continuous electronic fetal monitoring), and favorable outcomes (e.g., vaginal birth, no resuscitation). Because the instrument measures care processes and outcomes together, a higher (more optimal) score reflects both desirable health outcomes and no or minimal reliance on technology to produce those outcomes. Lower scores can reflect either a poor outcome, use of many interventions, or both. Using data from 375 births occurring among women at moderate-risk of poor outcomes, analysis revealed that type of provider (midwife or obstetrician) explained 13% of the variance in Optimality Index Score. Women's background characteristics and medical/obstetrical history explained only 7%. In the second study, researchers administered a survey at 32 weeks asking women their preferences regarding pharmacologic induction, pain medication, intravenous fluids, electronic fetal monitoring, stirrups for delivery, and episiotomy.[39] A score was assigned for the number of procedures the women said they "definitely wanted." The results of this survey, clinical data from medical records, and the results of another survey that collected information about background demographic and personal characteristics were analyzed to establish which variables predicted how many of 17 intrapartum interventions would be used. Provider type (obstetrician or midwife) explained 8% of the variation. Prenatal and intrapartum medical problems and maternal characteristics each explained 14% of the variation, while women's preferences explained less than 2%.

Turning to individual interventions, study results consistently favor midwives:

- *Pharmacologic induction:* In studies that reported induction in mixed-parity populations, use ranged from 6% to 15% among midwives vs. 15% to 24% among physicians. Absolute differences ranged from non-significant to 18%.[14, 22, 24, 29, 39] Only one study controlled for other factors.[29] After adjustment, provider type remained independently associated with pharmacologic induction. Induction rates in one retrospective study were reported separately in nulliparous and mulitparous women.[26] The study also separated "prostaglandin ripening" from "labor induced." Differences across provider types were not significant for either category of labor induction in nulliparous or mulitparous women, which may be because control-group women were cared for by family physicians, who tend toward a less interventive style of care.
- *Oxytocin augmentation:* In studies that reported augmentation in mixed-parity

populations, use ranged from 6% to 53% among midwives vs. 11% to 57% among physicians. Absolute differences ranged from nonsignificant to 32%.[4, 9, 23, 24, 29, 39] In another study, augmentation was less common in the midwife group only in mulitparous women (9% vs. 17%).[26] In this study, the control group was cared for by family physicians, which may result in smaller differences. Only one study controlled for other factors.[29] After adjustment, provider type remained independently associated with oxytocin augmentation.

- *Induction or augmentation:* One prospective observational study reported combined rates of induction and augmentation and measured differences among midwives, obstetricians, and family practice physicians.[44] Low-risk women cared for by midwives were much less likely to experience induction or augmentation (26%) compared with similar women cared for by obstetricians (42%) or family practice doctors (40%).
- *Amniotomy:* In studies that reported amniotomy in mixed-parity populations, use ranged from 14% to 43% among midwives vs. 15% to 53% among physicians. Absolute differences ranged from nonsignificant to 25%.[4, 22, 24, 29, 39] In another study, amniotomy use was higher in the midwife group among nulliparous women (59% vs. 46%).[26] Women in the control group were cared for by family physicians. Only two studies controlled for confounding factors.[29] Provider type remained independently associated with amniotomy.
- *Continuous electronic fetal monitoring:* Use ranged from 22% to 51% among midwives vs. 46% to 94% among physicians. Absolute differences ranged from 11% to 68%.[29, 31, 39, 44] In all three studies in which investigators controlled for confounding variables, provider type remained an independent predictor of electronic fetal monitoring use.[29, 31, 39]
- *Prohibition of eating and drinking in labor:* Prohibition rates ranged from 20% to 50% among midwives and 90% to 95% among physicians. Absolute differences ranged from 15% to 40%.[13, 29] Both studies controlled for confounding factors.
- *Routine intravenous fluids:* Use rates ranged from 27% to 67% among midwives and 43% to 97% among physicians. Absolute differences ranged from to 16% to 35%.[13, 24, 29, 39] In both studies in which investigators controlled for confounding variables, provider type remained an independent predictor of whether a woman had an IV.[29, 39]
- *Mobility in labor:* A prospective study reported that 75% of the midwife group vs. 67% in the physician group used ambulation (absolute difference 8%), a difference that did not change after adjusting for other factors.[29] A larger prospective study reported the proportion that walked (68% midwife group vs. 28% physician group) or changed position (65% vs. 53%).[39] A third prospective study combined ambulation and frequent position changes. Rates for midwives and physicians were 68% and 28%, respectively.[13]
- *Position for birth:* One study reported that women attended by midwives were significantly more likely to give birth nonsupine (33% vs. 12%, absolute difference 19%).[4]

6. With one exception, which may be explained by systemic factors, midwife-

ry care results in equivalent or superior newborn outcomes compared with physician management.

No study big enough to detect significant differences reported rates of intrapartum fetal death, but one large epidemiological analysis investigated differences in neonatal mortality (live birth, death within 28 d) and infant mortality (death in the first year).[36] Using linked birth and infant death certificate data for all babies born in the U.S. in 1991, the researchers compared outcomes of midwife-attended and physician-attended vaginal births. Using birth certificate data posed two problems. First, birth certificate data do not allow us to determine with confidence which women attended by physicians would have been eligible for care by midwives. Second, midwives' clients who develop risk factors or complications antenatally or intrapartum would likely be transferred to obstetrician management, and those women would be more likely to experience an adverse neonatal outcome. In these cases, the physician would be listed as the birth attendant despite midwife care during pregnancy, labor, or both. To address these problems, researchers constructed a physician group similar to the typical midwifery caseload by limiting their analysis to vaginal births of singleton babies born between 35 and 43 weeks gestation. They then applied statistical models to control for the medical and sociodemographic risk factors and obstetrical complications that would increase likelihood of a poor outcome, a transfer from midwifery care to physician management, or both. The most stringent model controlled for maternal age, race, education, marital status, infant birth order, month of pregnancy prenatal care began, gestational age, excessive or insufficient amniotic fluid, placental abruption, breech or other malpresentation, fetal distress, precipitous labor, prolonged rupture of the membranes (defined as > 12 hours), and seizures in labor. All eligible midwife-attended births occurring during the study year (n = 153,194) and a 25% random sample of eligible physician-attended births (n = 686,644) were included. Infant mortality was reduced in the midwife-attended births in all three models. In the most stringent model, infant mortality was 19% lower in the midwife-attended births. When researchers limited analysis to neonatal deaths, the magnitude of the difference increased. In the most stringent model, babies born under the care of a midwife were 33% less likely to die in the first 28 days compared with those born under the care of a physician.

Two studies reported the incidence of serious newborn morbidity. The first, of 2957 births, reported similar rates (4.5% midwife group vs. 6.4% physician group) of newborns having one or more of 17 major neonatal complications, including, among others, seizures, sepsis, cardiac failure, and respiratory distress syndrome.[29] The researchers also evaluated the proportion of babies undergoing evaluation and treatment for sepsis. While culture-confirmed sepsis rates were similar (0.6% midwife group vs. 0.5% physician group), more newborns in the physician group underwent sepsis evaluation and 1-3 days of treatment (5.4% vs. 1.8%, adjusted difference 3.8%) This more aggressive approach is problematic because it separates newborns from mothers unnecessarily, interfering with attachment and breastfeeding. The second study, a prospective cohort study with matched controls, used a weighted score adapted from a previously validated index of neonatal morbidity.[22] It reported similar percentages of babies exceeding a score of 300 (2.4% midwives vs. 3.2% physicians), the threshold for clinically significant morbidity. The seizure incidence was also similar between groups (0.6% midwives vs. 0.4% physicians). The same study, however, reported that more babies in the midwife group

required resuscitation (20% vs. 13%). Increased rates held for all categories of resuscitation (oxygen only 12.6% vs. 7.8%; ventilation < 5 min 6.4% vs. 4.6%; ventilation ≥ 5 min 1.5% vs. 0.7%). The investigators note that babies needing prolonged ventilation were also in worse condition in the midwife group. Among the 14 babies in the midwife group needing ventilation for more than 5 minutes, 6 had seizures and 9 had decreased muscle tone. Among the 7 babies having ventilation for greater than 5 minutes in the physician group, none had seizures and only 2 had decreased muscle tone. This pilot study suffered from major problems in the design and conduct of the study and occurred in the context of intense animosity and distrust between obstetricians and midwives. Possible effects of these problems are reviewed in the text box, "Do Outcomes Suffer When Midwives Are Poorly Integrated into the Maternity Care System?"

One RCT[24] and five prospective cohort studies[13, 22, 29, 38, 46] reported the proportion of newborns admitted to special or intensive neonatal care units. The trial reported increased rates of admission to special or intensive care nurseries in the physician group (9.4% vs. 7.9%), and the cohort studies, all of which adjusted to ensure similar populations, reported similar rates. Finally, a study comprising 2957 births reported no difference in the rate of neonatal readmissions within the first 28 days (1.4% midwife group vs. 2.2% physician group).[29]

Do Outcomes Suffer When Midwives Are Poorly Integrated into the Maternity Care System?

As we have seen, most studies report equivalent or better outcomes for babies and mothers with midwifery care compared with obstetric management. One study comparing hospital-based physicians with birth center-based midwives, however, provides the lone exception, with newborn outcomes favoring doctors in hospitals. Fraser and colleagues (2000) reported outcomes of a pilot program to introduce midwives into the Canadian province of Quebec,[22] where virtually all maternity care had previously been provided by obstetricians and general practitioners along with obstetrical nurses. The participating midwives had been trained in other countries, were perinatal nurses who had undergone additional training, or had learned through apprenticeship and independent study. Some had previously practiced in Quebec as unlicensed, unregulated home birth midwives. Research evaluating the safety and effectiveness of the pilot midwife-staffed birth centers was "commissioned by the Quebec government as a necessary pre-condition for the legalization of midwifery" (p. 5).[34]

The legislation establishing the pilot project required researchers to identify "the professional and organizational factors, as well as the mode of integrating midwives into the maternity care system, that would promote the best outcomes and the autonomy of midwives" (p. I-16).[12] Data from interviews, focus groups, site visits, and written documents revealed poor integration of midwives and exposed gaps and conflicts that may have contributed to adverse outcomes. Collin and colleagues (2000) write:

> Overall results indicate that midwives were poorly integrated into the health care system during the evaluation. Although causal relationships cannot be established, this probably created situations that were detrimental to the midwives' clients, such as difficult access to consultants and technology (e.g., resuscitation expertise, lab tests, medication), delay in the referral and transfer of women to hospitals and physicians, and the lukewarm if not cold reception of midwives' clients transferred to hospitals. These situations were far from ideal, but specific outcomes on mothers and babies cannot be definitely linked to particular events (p. I-17).[12]

The researchers point to resentment by obstetricians, family physicians, and obstetrical nurses as a source of much of the marginalization of midwives. "The degree or absence of cooperation experienced by midwives during the evaluation were largely dependent on these dynamics," they observe, "which were aimed at protecting, conquering and redefining the territory of each professional group" (p. I-18).[13] In fact, that the government sponsored a pilot study, rather than legalizing and regulating midwives outright, was a result of fierce opposition to legalization of midwifery from organized medicine.[34] Lack of mutual trust and effective communication among providers may have in turn influenced the poor articulation of the participating facilities. Several of the birth centers and referral hospitals lacked any formal agreement or established protocols for handling urgent transfers.

How might integration problems have affected newborn outcomes? Professional resentment and lack of familiarity with midwifery prejudiced hospital staff against midwives. Midwives would have perceived mistrust or animosity during interactions with hospital staff, and probably held their own prejudices of the dominant health care system given their lack of familiarity with it, having neither trained nor worked within it. Resulting delays in diagnosing complications, initiating referrals, or receiving appropriate care in the referral facilities could have compromised the wellbeing of women and babies participating in the pilot program.

Midwives in other settings have produced excellent outcomes despite less-than-optimal relationships with the dominant medical system. However, the simultaneous introduction in Quebec of a "new" category of autonomous maternity-care providers lacking professional standards along with a new type of maternity care facility with which neither the midwives themselves nor the doctors were familiar probably posed much greater challenges than are typical in other communities.

7. Midwifery care reduces the likelihood of maternal morbidity.

Because maternal morbidity is rare in populations of healthy women, combining maternal complications into an index or composite score increases a study's power to detect significant differences. Two prospective cohort studies combined various maternal complications and compared the likelihood of any complication or the average number of complications across provider groups. The first compared 1808 women who planned to give birth with midwives in a birth center with similar women planning hospital births with obstetricians (n = 1149).[29] After adjusting for confounding factors, there were no differences in the likelihood of ex-

periencing major intrapartum complications (20% in both groups) or major postpartum complications (0.8% vs. 0.4%). However, women in the physician group were more likely to be hospitalized longer than 72 h (16% vs. 10%, adjusted difference 6%). The second study, of 1181 low-risk women having hospital births, found that obstetrician management was associated with an increase in the average number of serious maternal complications, although in both groups the average number was less than one per woman: 0.67 obstetrician vs. 0.37 midwife.[38] This difference remained statistically significant after adjustment for medical and obstetrical risk factors and maternal preferences. In addition, more women in the nurse-midwife group gave birth without complications (74% vs. 54%).

Turning to specific maternal complications, five studies reported outcomes related to postpartum infection. Unfortunately, the study that provided the most detailed evaluation of infection excluded cesarean and instrumental vaginal deliveries, which carry a much greater infection risk.[4] The study found no difference in the occurrence of clinical signs or of positive results for either of two common blood tests for infection. Because operative delivery is more common in obstetrician-attended births, their exclusion may have obscured true differences between provider groups. The only RCT to report outcomes related to infection, a study of 194 low-risk women, found similar likelihood of postpartum temperature > 38 degrees C (1% midwife group vs. 2.2% physician group).[24] A prospective study of 1191 women that used more stringent criteria to diagnose infection (temperature > 100 degrees F for 4 consecutive h plus antibiotics prescribed) reported similar rates (3.6% midwife vs. 5.9%) as well.[38] Another prospective cohort study comparing 488 women receiving hospital-based midwifery care with 572 similar women receiving physician care found no difference in the likelihood of fever >38 degrees C on at least two consecutive measurements 6 h apart or documented wound, urinary, or bloodstream infection (3.7% midwives vs.3.1% physicians).[31] Finally, a prospective cohort study with matched controls reported the proportion of women receiving antibiotics after birth.[22] The rate was higher in the physician group 15.6% vs. 9.5%; however, prophylactic antibiotics given after cesarean surgery may have been included in this number, and the cesarean rate was also higher in the physician group. While none of these studies taken alone makes a convincing case that midwifery care prevents postpartum infection, together they suggest that, at the very least, midwifery care does not increase it.

The sole study reporting on blood loss severe enough to require transfusion reported similar rates (0.2% midwife group vs. 0.4% physician group).[22]

Two studies reported rates of maternal rehospitalization within 6 weeks.[29, 38] In both studies, rehospitalization rates were similar.

8. Midwife-led care produces equally good or better maternal and infant outcomes as physician-led or shared care with lower procedure and medication rates. A 2008 Cochrane systematic review compared midwife-led models of maternity care with physician-led or shared models of care.[25] The reviewers defined midwife-led care as:

> care where the midwife is the lead professional in the planning, organisation and delivery of care given to a woman from initial booking to the postnatal period. . . . Within these models, midwives are, . . . in partnership with the woman, the lead professional with responsibility for assessment of her needs, planning her care, referral to other professionals as appropriate, and for ensuring provision of maternity services (p. 4).

Control groups included women receiving physician-led care or, more frequently, care in which midwives and physicians (obstetricians, general practitioners, or both) shared responsibility.

The review included 11 RCTs (12,276 women) in which antepartum, intrapartum and postpartum care in the experimental arm were all midwife-led. Included studies were conducted in Australia, Canada, New Zealand, and the U.K. The control groups consisted primarily of women receiving care in shared care arrangements involving midwives in various capacities, and in at least six trials involving 5547 women, a majority of the intrapartum care in the control groups was apparently provided by midwives. In only one study involving 218 women, no care in the control group was provided by midwives.[24] In addition to the variation in the organization and composition of care delivered in control groups, included trials varied with respect to the method of randomization, whether the midwife-led care was provided by an individual midwife or a team of midwives, the level of continuity (proportion of women attended during birth by a known care provider), the occurrence and frequency of visits with physicians in midwife-led groups, the risk level of participants, and the birth settings. To test whether variations across studies affected findings, the reviewers conducted subgroup analyses to determine the effects of greater continuity in caseload (individual midwife) models, variations in maternal risk status, and less medicalized environments. The reviewers also performed sensitivity analysis, limiting analysis to the six trials deemed to be high quality based on allocation concealment.

In the main analysis, midwife-led care was associated with reduced use of regional analgesia/anesthesia (11 trials, 11,892 women, RR 0.8), instrumental vaginal birth (10 trials, 11,724 women, RR 0.9), and episiotomy (11 trials, 11,872 women, RR 0.8). Midwife-led care was associated with an increase in having no intrapartum analgesia/anesthesia (5 trials, 7039 women, RR 1.2), spontaneous vaginal birth (9 trials, 10,926 women, RR 1.04), breastfeeding initiation (1 trial, 405 women, RR 1.6), attendance at birth by a known midwife (6 trials, 5525 women, RR 7.8), and high perceptions of control during labor (1 trial, 471 women, RR 1.7). There were no significant differences in fetal/neonatal death ≥ 24 w gestation, amniotomy, augmentation of labor, induction of labor, use of opiate analgesia, cesarean section, perineal laceration requiring sutures, intact perineum, postpartum hemorrhage, duration of hospital stay, admission of infant to special or neonatal intensive care unit, neonatal seizures, or postpartum depression. In no subgroup or sensitivity analysis did outcomes favor physician-led or shared care arrangements. As the authors concluded, "Midwife-led care confers benefits and shows no adverse outcomes" (p. 17).[25]

An RCT that was excluded from the Cochrane systematic review (because it enrolled participants on admission to the hospital and thus did not meet inclusion criteria) compared 563 women receiving midwife-led intrapartum care with 487 women receiving intrapartum care from midwives who were supervised by physicians.[35] The study took place in a large tertiary care hospital in Hong Kong where continuous electronic fetal monitoring was performed routinely in all labors. The researchers found no differences in any of the outcomes studied, including mode of birth, episiotomy, postpartum hemorrhage, Apgar scores, neonatal intubation, or admission to a neonatal intensive care unit. Intravenous infusion (42% vs. 49%) and oxytocin augmentation (18% vs. 25%) were used less frequently in the midwife-led group.

9. Both midwifery care and midwife-ied models of care appear to be safe and

beneficial for medically and sociodemographically moderate-risk and high-risk women and their infants.

Midwives often care for women who are at risk of adverse pregnancy outcomes by virtue of social or demographic characteristics, health status, or both. In fact, much of the research evaluating the safety and effectiveness of midwifery care was conducted in these populations. In addition, a few studies focus specifically on women with medical risk factors.

Raisler and Kennedy's (2005) systematic review of midwifery care to poor and vulnerable women in the United States included seven studies that compared sociodemographic or medical/obstetrical risk factors of midwifery clients with those of other health care providers.[41] Two studies reporting national statistics and two studies reporting statistics at the state level showed that women attended by midwives were younger, less educated, more likely to be women of color, single, or uninsured or have Medicaid insurance, and had fewer prenatal visits and later entry to prenatal care. In three professional surveys, midwives in all practice settings reported caring for mixed-risk populations, uninsured or publicly insured women, or both.

The systematic review also demonstrated that midwifery care to poor and vulnerable women has produced consistently favorable results beginning with the introduction of professional midwifery in the U.S. in the 1920s.† Four studies demonstrated dramatic reductions in maternal and neonatal mortality and morbidity when populations with inadequate or no access to maternity care were offered care from midwives. In two of the studies, outcomes were compared with national statistics and maternal and perinatal mortality rates in the midwifery services were superior despite populations presumably disproportionately affected by poverty, medical risk factors, and history of inadequate health care access. Later studies reported outcomes of programs introducing midwifery care to poor and vulnerable women in settings where care had previously been provided by physicians. Two "before and after" studies found lower infant morbidity after the introduction of midwifery services while one RCT found more spontaneous vaginal births and fewer forceps-assisted deliveries while maintaining equivalent newborn outcomes. Seven additional descriptive studies also documented high rates of spontaneous vaginal birth and good maternal and infant outcomes, although these studies lacked controlled comparison groups.

The only study comparing newborn mortality rates by provider, excluded without explanation from Raisler and Kennedy's review of intrapartum outcomes, is an epidemiological study of linked birth and infant death records for all births occurring in the U.S. in 1991.[36] (The study is described in detail in mini-review 6.) The researchers found that black women, American Indian women, teenaged women, women with ≥ 3 previous births, unmarried women, those with less than a high school education, and those with late or no prenatal care were disproportionately cared for by midwives.[36] In addition, women in the midwife group were slightly more likely to have precipitous births or prolonged rupture of the membranes. Physicians, meanwhile, were more likely to attend births complicated by

† This systematic review should be interpreted with caution. Researchers failed to provide adequate information about exclusion criteria, included many studies without controlled comparison groups, and did not report original data from all included studies. They cast a wide net in order to capture all types of literature, including qualitative and descriptive studies, with the aim of describing the history and contemporary scope of midwifery practice with respect to poor and vulnerable populations and highlighting areas needing further inquiry. Despite its limitations, we have included this review because we believe that the reviewers took care to interpret the evidence critically.

placental abruption, breech or other malpresentation, or fetal distress. The risk of neonatal mortality was 32% lower for births delivered by a certified nurse-midwife than for physician-delivered births (OR 0.68), a difference unchanged when differences in demographic and medical risk factors were taken into account (OR 0.67).

Another study comparing midwife and obstetrician care in poor or vulnerable women was published after the cut-off date for inclusion. Researchers conducted a prospective cohort study comparing practices and outcomes in women cared for in labor by midwives (n = 196) with those of women managed by obstetricians (n = 179) in a population of women who "historically have life situations that place them at greater risk because of poverty, immigrant status, lack of social support, among other factors" (p. 781).[13] Included women had ≥ 3 medical or psychosocial risk factors, but they were excluded for having any of 52 high-risk conditions (including, among others, HIV+ status, heart or kidney disease, chronic hypertension requiring medication, sickle cell disease). Background health and demographic data were collected on all participants, and optimal background characteristics (those not associated with poor outcome) were summed to assign a Perinatal Background Index Score, expressed as a percentage of the 14 possible optimal traits. Researchers evaluated process and outcomes of care by calculating an "Optimality Index Score." A high score signified a good outcome for both mother and baby with little or no intervention, while a low score reflected a poor outcome, use of many interventions, or both. (The method for calculating this score is discussed in more detail in mini-review 5.) After adjustment for correlating factors, type of provider explained 13% of the variance in Optimality Index Score while the Perinatal Background Index Score explained only 7%. In addition, when researchers analyzed the subgroup who were free of chronic conditions (on the basis that chronic medical conditions were more common in the physician cohort), more women in the physician group were prohibited from eating or drinking in labor (20% vs. 5%), fewer women ambulated or changed position in labor (28% vs. 68%), more used any pharmacologic pain relief (82% vs. 64%) or epidural analgesia (51% vs. 31%), fewer used nonpharmacologic pain relief methods (51% vs. 88%), fewer had spontaneous vaginal births (63% vs. 80%), and more had primary cesarean surgery (16% vs. 6%).

Two studies focus on the influence of medical or obstetrical (rather than social or demographic) risk factors on outcomes of midwifery care. One retrospective cohort study compared the obstetric outcomes of a primary-care clinic staffed by midwives with the outcomes of a private practice staffed by obstetricians.[3] This study has been excluded from our other mini-reviews because the researchers compared a high-risk cohort with a low-risk cohort, so the populations were intentionally dissimilar. However, we have included it here for exactly that reason. Women in the midwife group were more likely to be teens, black or Hispanic, to have initiated prenatal care after 24 weeks, to smoke cigarettes or use drugs, to have unsure dates, to measure small-for-dates, and to have a urinary tract infection in pregnancy. Intrapartum and postpartum complications (including toxicology screen positive, postpartum hemorrhage, endometritis, retained placenta, amnionitis, placental abruption, pregnancy-induced hypertension, and shoulder dystocia) were also more frequent in the midwifery clinic group, affecting 9.5% of births vs. 2.1% in the physician group. Despite these differences, babies were in equally good condition at birth, as measured by Apgar scores, gestational age at birth, and birth weight. Moreover, midwifery clinic clients were significantly less likely to have primary (11% vs. 19%) or repeat (3% vs. 8%) cesarean sur-

gery. Among women medically eligible for VBAC, women in the midwife group were far more likely to plan vaginal birth (77% vs. 18%), and equally likely to have one (75% vs. 70%). The second study, a case-control study, was conducted in an Indian Health Service hospital in New Mexico in which rates of diabetes, pregnancy-induced hypertension, and medically-indicated labor induction were all substantially higher than national or statewide rates for the same years.[37] Despite the high prevalence of medical and obstetrical risk factors for cesarean surgery in the study population, midwifery care in labor reduced the likelihood of cesarean compared with obstetrician management. The study was confined to live births at or beyond 35 weeks of gestation, so mortality could not be measured and newborn morbidity would have been infrequent. However, the researchers do not report newborn outcomes, so it is impossible to determine if the high vaginal birth rate was accompanied by good health outcomes for the infants.

Turning to midwife-led care, a Cochrane systematic review and meta-analysis included five trials (5048 women) defined to be at mixed risk of complications by trial authors.[25] All five reported combined fetal loss and neonatal death, and meta-analysis of the results showed a reduction with midwife-led care (RR 0.76) compared with physician-led or shared models of care. Use of regional analgesia was also reduced with midwife-led care (5 studies, 4865 women, RR 0.8), as was the instrumental vaginal delivery rate (5 trials, 4871 women, RR 0.8). Spontaneous vaginal birth was more common in the midwife-led care group (4 trials, 4073 women, RR 1.1).

An Australian prospective cohort study also evaluated midwife-led vs. other models of maternity care.[50] Women presenting for prenatal care could self-select for care in their local independent midwifery group practice regardless of risk status, or they could choose a physician (obstetrician or general practitioner) practice or a practice in which midwives shared care with or were supervised by physicians. Midwives in the independent midwifery group practices determined when specialist care was indicated, in which case women continued to receive care from the midwives with the specialists brought in as needed. All women participating in the study were assigned a risk status using a common set of criteria. Women designated low-risk met none of the criteria for moderate- or high-risk. Women designated moderate-risk had at least one of a list of 39 moderate-risk factors (examples include scarred uterus, prior preterm birth, current mild preeclampsia, and mild substance dependence). Women designated as high-risk had any of 22 high-risk factors (examples include previous perinatal death with recurrent factors, threatened preterm labor, insulin-dependent diabetes, and HIV infection). Researchers compared all women receiving care in the independent midwifery group practices who gave birth at the study hospital over a 14-month period (n = 618) with all women receiving other models of care who gave birth at the same hospital during the same time period (n = 3548). Fifty-seven percent of the women in the midwifery group practice were at moderate risk and 7% were high-risk. In the other models of care, 62% were at moderate risk and 16% were high-risk. Regardless of risk status, midwife-led care yielded more favorable mode of birth outcomes. Fewer women had cesarean sections with midwifery care (11% vs. 13% low risk; 18% vs. 30% moderate; 24% vs. 34% high), more had spontaneous vaginal births (79% vs. 67% low risk; 72% vs. 54% moderate; 67% vs. 46% high), and fewer had instrumental vaginal deliveries (10% vs. 20% low risk; 10% vs. 16% moderate; 7% vs. 10% high). The overall difference in mode of birth was statistically significant in all three risk categories. Likewise, fewer women under-

went labor induction (13% vs. 25% low risk; 22% vs. 30% moderate; 20% vs. 35% high) or had epidural analgesia (23% vs. 49% low risk; 20% vs. 38% moderate; 17% vs. 33% high) in the independent midwifery group in all three risk categories. Finally, similar numbers or fewer women and babies in the independent midwifery group practice experienced adverse outcomes in all three risk categories, including postpartum hemorrhage, genital tract trauma, and admittance to special or intensive care nursery.

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CHAPTER 20

The Place of Birth: Birth Homes

"The hospital, including a birthing center within a hospital complex . . . is the safest setting for labor, delivery, and the immediate postpartum period."

ACOG Executive Board, 2006, p. 1[1]

"Our findings indicate that such a program is safe and that use of resources and procedures, such as operative deliveries and hospital stays, is substantially reduced with [the birth center model] compared with the traditional US model of perinatal care."

Jackson et al., 2003, p. 1003[12]

Birth was moved into hospitals—and continues to be concentrated into a smaller number of larger regional perinatal units—to maximize efficiency, medical training opportunities, and profits.[18] Along the way, birth became less about the woman, baby, or family and more about hierarchical relationships, efficient division of labor, and administrative processes.[26] In response, freestanding birth centers emerged as way to combine organized, efficient care delivery with woman- and family-centeredness and to return maternity care to the communities where women live. Away from the accoutrements of the medical management model, birth centers provide a venue for physiologic care. In a medical culture guided by the view that birth can go wrong at any moment, however, these birth center characteristics are seen as at odds with safety. This chapter explores whether women really trade off safety when they choose physiologic care in a woman-centered, low-technology environment, and how care can be organized to maximize safety and positive experiences simultaneously.

WHAT TO EXPECT IN A BIRTH CENTER

In the U.S. and Europe, freestanding birth centers are primarily vehicles for midwifery care or at least midwifery-style care. At the typical birth center, prenatal care emphasizes prevention, wellness, anticipatory guidance, shared decision-making, and ongoing screening for complications. Women who remain healthy throughout their pregnancies and go into labor spontaneously at term are eligible to labor and give birth in the center, which usually has a home-like atmosphere. During labor, midwives and other staff provide continuous, supportive care grounded in the physiologic care model. Postpartum care often includes early discharge and home visitation.

Present in the birth center but hidden from view are the tools and medicines to manage a postpartum hemorrhage, deliver intravenous fluids or medicines, resuscitate a depressed newborn, and respond to other common or serious problems. Absent are oxytocin pumps, epidurals, and the facilities and staff needed for operative delivery, as these introduce risks of their own that require medical management. When women planning birth center births need or elect one or more of these interventions, or if the labor otherwise becomes "high-risk," they are referred to hospital care.

The need to transfer to another birth setting to access interventions creates a disincentive to use them when another, low-tech solution can safely achieve the same goal. The ready accessibility of drugs and instruments in hospitals makes it easy for hospital staff to push and pull labor along to satisfy their needs and preferences, whereas birth center staff depend on patience, mobility, support, and comfort measures. Physiologic care also serves to steer women and babies clear of the "cascade of interventions," reducing the need for high-tech interventions to manage the adverse effects of interventions upstream. Predictably, women choosing birth centers are much less likely to have procedures like induction, oxytocin augmentation, instrumental vaginal delivery, episiotomy, and cesarean surgery than similar women receiving hospital-based care. (See mini-reviews 5-8.)

BUT WHAT ABOUT SAFETY?

In 2006, despite the existence of approximately 200 freestanding birth centers throughout the U.S., research establishing good outcomes in birth centers, and accreditation and state licensing mechanisms, the American College of Obstetricians and Gynecologists (ACOG) Executive Board quietly released a Statement of Policy opposing out-of-hospital birth settings, including freestanding birth centers. The policy cited safety concerns:

> Ongoing surveillance of the mother and fetus is essential because serious intrapartum complications may arise with little or no warning, even in low risk pregnancies. In some of these instances, the availability of expertise and interventions on an urgent or emergent basis may be life-saving for the mother, the fetus or the newborn and may reduce the likelihood of an adverse outcome (p. 1).[1]

Eventually, in response to pressure from birth center advocates including several prominent ACOG fellows, the Board amended its statement such that only home birth was cited as unsafe. The advocates did not produce any new evidence to support their reversal of opinion, but the data were already there: the seminal study on birth center safety was over a decade old,[20] and several smaller but well designed studies had been published in the intervening years finding equivalent or better outcomes for babies and mothers in birth centers versus hospitals. (See mini-reviews 1, 2, and 4.)

The apparently good outcomes of birth center care are inconsistent with the "common sense" view that if a disaster happens, the best place to be is in a hospital. The dominant belief is that the inconsistency arises from self-selection bias—the tendency for healthier women to select birth center care—not the intrinsic safety of the setting. However, studies use various approaches to minimize or compensate for self-selection bias, and the results suggest that the good outcomes observed in birth centers arise from the care model, not just the characteristics of the women giving birth there.

One study, conducted in San Diego, California, sets the gold standard for minimizing self-selection bias. Two midwives and a perinatologist prospectively conducted blind reviews of the prenatal records of all women in both the birth center and hospital groups to determine birth center eligibility.[12] Though statistical adjustments were made for differences in baseline characteristics, the authors anticipated criticism that undocumented differences might persist, so they looked for differences in outcomes between women who sought out birth center care for philosophical reasons and those who cited other reasons such as proximity or financial factors. In both the main analysis and the restricted analysis, there were more spontaneous vaginal births, similar neonatal outcomes, and significantly less use of technological interventions in the birth center group.

Another study, notable for its large size, mitigates self-selection bias by virtue of the maternity care system in which it was conducted.[2] In the U.K, women who are eligible for midwifery care may elect to give birth in any setting, including home or, where available, birth centers. Studying all women having midwifery care in the system thus provides the opportunity to assess differences across settings in women at similar risk. Nevertheless, researchers were concerned about self-selection bias, so they repeated their analysis after adjusting for socioeconomic and other differences across settings and after excluding women who had any complications at the start of labor. In all analyses, the likelihood of perinatal mortality or severe morbidity was equivalent between hospitals and freestanding birth centers, with large differences in the use of interventions favoring birth centers.

Scupholme and Kamons (1987) report the outcomes of the only natural experiment to shed light on the effect of selection bias on the comparative outcomes of birth center care.[22] To ameliorate overcrowding, a U.S. tertiary care hospital assigned low-risk women to its ancillary freestanding birth center. The study compared the outcomes of those who self-selected birth center care with those who were assigned there. They matched 148 women from each group based on age, ethnic group, financial status, and level of education and found no differences in labor characteristics, use of analgesia, mode of birth, Apgar scores, birth weight, or the likelihood or indication for intrapartum or newborn transfer.

Selection bias is always possible in birth center research, but the consistency of the findings despite varying methodology provides good evidence for their validity.

Still, is it possible that some force is working in the background to produce these observed effects? As Jackson and colleagues (2003) write, "These forces have to be quite large to provide a credible alternative explanation of our results" (p. 1004).[12]

Hospital-based Birth Centers: The Best of Both Worlds?

The advantages of the birth center style of care naturally lead to the question: "Why not have birth centers inside hospitals?" On the surface, it would seem reasonable that you could reap the benefits of the style of care—low rates of surgical intervention, effective non-pharmacologic pain management, and high satisfaction—while having surgical and anesthesia resources quickly at hand just in case. This model is, in fact, modestly effective: the Cochrane systematic review comparing in-hospital birth centers with conventional maternity units found small but significant differences favoring birth centers in likelihood of spontaneous vaginal birth and rates of intrapartum medical interventions.[11]

However, hospital-based birth centers do not fare as well when compared with freestanding birth centers. A large prospective study of maternity units in the United Kingdom showed that while rates of adverse outcomes were similar in freestanding and along-side (hospital-based) birth centers, intervention rates were higher and spontaneous vaginal birth rates were lower in the along-side units.[2]

Providing birth center care in a hospital complex also misses an important opportunity to provide primary maternity care in freestanding centers closer to where women live. Furthermore, framing in-hospital birth center care as "boutique" care misses the point that mother- and baby-friendly care should be made available to all women, regardless of where they give birth. A better model would be to humanize hospital-based care *and* provide access to community-based, freestanding birth centers.

BETTER SAFE THAN SORRY?

How do we reconcile the apparently good outcomes of birth centers with the fact that, sometimes, life-threatening emergencies do occur in birth? Is the chance of a rare catastrophic outcome grounds enough to hospitalize all birthing women? Critics have argued that that possibility, however remote, trumps any evidence of otherwise good outcomes.

While no study directly compares the outcomes of urgent complications occurring in birth centers with those occurring in similar populations in hospitals, research suggests that the fact that hospitals *can* respond quickly to emergencies does not mean that they *do*, or that women or babies can necessarily expect to

fare better with ready access to surgery. The rule of thumb is that all cesarean surgeries, and particularly those for urgent or emergent indications, should begin within 30 minutes of the decision to operate. Because this community standard is invoked by plaintiffs' attorneys in malpractice cases, there is no shortage of research by obstetricians aimed at demonstrating that they should not be held to it. The resulting body of literature makes a strong case that not only do outcomes correlate poorly with decision-to-incision times, but, even in well equipped hospitals, as many as half of urgent cesarean surgeries begin more than 30 minutes after the decision to operate.[3, 10, 14, 16, 17, 24, 25]

The literature on decision-to-incision times also makes clear that no interval between the event and surgical delivery, however brief, guarantees a healthy baby. In a hospital with operative facilities *in* the labor room and round-the-clock availability of surgical teams, 2 of 53 term babies delivered by "crash" cesarean section still died despite being born before 30 minutes had elapsed.[10] In a smaller study, the only term infant with a poor prognosis was born 20 minutes after the decision to operate.[25] In a multi-center study conducted by the Maternal-Fetal Medicine Units Network, a group of teaching hospitals that meet the highest standards for their perinatology services, 18 of the 22 perinatal deaths and 12 of the 17 cases of hypoxic-ischemic encephalopathy occurred in babies born by emergency cesarean section with decision-to-incision intervals shorter than 30 minutes.[3]

The ability to intervene quickly may avert serious outcomes sometimes, but obstetricians' own best estimate for "quick enough" is an impossible standard even in the most well equipped settings. For many women, the standard is irrelevant anyway because they cannot access a high-tech setting. Half of all U.S. counties have no obstetricians at all,[19] much less a fully staffed high-tech maternity unit. This shortage is a result of multiple forces, including the organization and financing of medical education and the demographics and preferences of obstetricians. It also results from deliberate regionalization efforts to maximize the numbers of women giving birth in large tertiary care hospitals.[18] As a result of these forces, the average woman lives farther from an equipped birth setting than she did in past decades, making her more vulnerable to an unplanned, unattended birth at home or en route to the hospital, along with the poor outcomes associated with these events.

Two studies suggest that, ironically, the presence of a community-based maternity unit provides a safety net for hospitals that are too far for women to reach. Nearly one in five women in a Norwegian birth center study planned hospital births but gave birth in the maternity homes because rapid labor progress or difficult weather conditions made travel to the hospital unsafe.[21] The authors of a study in New Mexico describe a case of a woman with placental abruption who, despite plans to give birth at the referral hospital because risk factors, presented to the maternity unit with vaginal bleeding.[13] She was urgently transported and had a precipitous vaginal birth soon after arrival at the referral hospital. Despite poor

condition at birth, the infant had normal neurologic and developmental evaluations at 15 months. It is possible that prompt diagnosis and ready access to urgent transport at the community-based maternity unit averted a worse outcome by helping the woman reach the hospital prior to birth, where her infant could then receive immediate intensive care.

ARE WE ASKING THE WRONG QUESTION?

These data underscore the need to consider birth centers and hospitals not as each other's alternative but as distinct but complementary settings in a maternity care system that tailors services to the healthcare needs and preferences of the women it serves. Studies that pit birth centers against hospitals by definition cannot measure the outcomes of integrated system design. One population-based study, however, evaluated the system rather than the setting. In a departure from the typical study design focused on outcomes of a birth center, researchers in New Mexico evaluated outcomes of a *population*, where low- and moderate-risk women were cared for in a community-based birth center, and high-risk women traveled to one of two referral hospitals to give birth.[13] The researchers reviewed the medical records for all pregnancies occurring in women in the community over a 5-year period, regardless of where the birth occurred. The total cesarean, primary cesarean, and instrumental vaginal delivery rates in the population were much lower than national rates despite the fact that the population studied, predominantly Native Americans, had higher rates of pregnancy-induced hypertension, chronic hypertension, and diabetes. And infant outcomes were good: the population-based perinatal death rate compared favorably to the nationwide rate (11.4 per 1000 births in the study community vs. 12.8 per 1000 nationally). (See mini-reviews 7 and 11.)

INTEGRATING BIRTH CENTERS INTO A SYSTEM OF MATERNITY CARE

When we pull back from the setting to the system, we can begin to envision freestanding birth centers as a point of entry into an integrated maternity care system that efficiently and safely serves the majority of childbearing women within their communities. No matter how fast the pace of the regionalization of maternity care, we will never achieve a system where all women give birth in settings with 24-hour in-house staff and immediate access to surgical facilities. Indeed, there are compelling arguments that we should not attempt to do so. Busier maternity units demand more processing of patients through the system, which leads to fixed limits on the allowable length of labor and builds in incentives to schedule more inductions and cesarean surgeries. In turn, more intervention leads to more unintended adverse effects of intervention and consequently the need for ready access to the means to manage iatrogenic complications. Centralization and medicalization work in concert to further reinforce the medical model view of childbirth as pathological.

Research and common sense tell us that a tiered, integrated system, in which community-based primary maternity care is linked with centralized specialist care, would serve all childbearing women effectively. Triaging healthy women to give birth in community-based birth centers frees up staff and other resources for women who truly need specialized care in tertiary care facilities. Situating basic maternity care services close to where people live means fewer women must travel great distances in labor, reducing the number of babies born en route to hospitals. And by providing physiologic care to a screened population of healthy women, birth centers minimize complications that arise both from pathology and iatrogenesis while having the capability of managing a range of problems that may occur despite these precautions and providing access to a higher level of care when it is truly needed.

MINI-REVIEWS

Notes:

- Reviews are limited to freestanding birth centers, which may be owned by a hospital but must be physically located outside of the hospital or hospital complex.
- We evaluate process and outcomes of intrapartum, postpartum, and newborn care in order to isolate the effect of place of birth. A discussion of the antepartum care delivered in birth center practices is outside of the scope of this book.
- Studies of birth center care are heterogeneous, affecting applicability of their findings to other populations or settings. Factors that may influence the presence and magnitude of observed differences across provider groups include birth center and study eligibility criteria; provider type in the birth center, after transfer, and in the hospital comparison group; timing of study enrollment; and geographic location and proximity to hospital.
- Assume differences are statistically significant unless otherwise noted.

1. Intrapartum stillbirth and neonatal death occur rarely with freestanding birth center care, with no significant difference between planned birth center care and planned hospital birth.

The National Birth Center Study (NBCS) reported on 15 cases of intrapartum or neonatal (within the first 28 d) death among 11,826 infants born to women who were admitted to freestanding birth centers for intrapartum care (1.3 perinatal deaths per 1000 births).[20] The combined intrapartum and neonatal death rate was reduced to 0.7 per 1000 after infants with congenital anomalies were excluded. Three of these eight remaining deaths occurred in post-term pregnancies (defined as ≥ 42 w gestation).

Study authors compared their mortality data with rates reported in the babies of low-risk women giving birth in hospitals in six other published studies. "Low-risk women" were defined

differently in the other data sets because those studies were designed to answer research questions unrelated to place of birth. However, in the absence of a control group, they provide a useful proxy for expected rates of perinatal mortality among infants of essentially healthy women. In fact, some of the data sets excluded women with labor complications such as meconium-stained amniotic fluid or prolonged rupture of the membranes. Despite this, the perinatal death rate in the NBCS compared favorably to those from the hospital-based studies. A subsequent analysis of NBCS data by Fullerton and Severino (1992) compared birth center outcomes with those of over 2000 low-risk women admitted to hospital-care settings during the same period.[9] A study strength was that investigators used identical data-collection instruments in both cohorts, but the study was weakened by over 25% of hospital records' lacking mortality data. The authors stated that the data that were available, however, suggested similar intrapartum and neonatal death rates between the two settings. In addition, smaller birth center cohort studies that report mortality data, while underpowered, consistently find equivalent or lower intrapartum or neonatal mortality in the birth center group compared with low-risk hospital cohorts.[6, 12, 13]

The Birthplace in England Study, a prospective cohort study of 64,538 women booked for midwifery care in National Health Service Trusts between 2008 and 2010, reported intrapartum stillbirth plus early neonatal death (within 7 d) by planned birth setting.[2] There were 9 deaths in 11,282 births to women booked for freestanding birth center care (0.8/1000) vs. 8 deaths in 19,706 planned hospital births (0.4/1000). Statistical significance was not reported. The researchers provided no information about causes of death, and babies with congenital anomalies were not excluded.

2. Freestanding birth center care does not appear to increase risk of severe neonatal morbidity when compared with hospital management.

> **Note:** The NBCS, one of the only studies large enough to detect differences in neonatal morbidity, is seriously flawed because researchers only collected data on serious complications that arose in birth centers, excluding the infants of women who transferred to the hospital in labor (12.4% of the entire sample).[20] We have therefore excluded it from this mini-review.

A 2011 large prospective cohort study in England reported rates of a composite measure of perinatal mortality or severe morbidity by planned place of birth.[2] The composite measure included intrapartum stillbirth, early neonatal death, neonatal encephalopathy, meconium aspiration syndrome, brachial plexus injury, fractured humerus, or fractured clavicle. After adjusting for baseline differences between groups, there were no differences in the rate of adverse outcome events between freestanding birth centers (3.5 per 1000) and traditional obstetric units (4.4 per 1000) or hospital-based midwife-led units (3.6 per 1000). Likewise, there were no differences in adverse outcomes among planned birth settings when the researchers limited their analysis to nulliparous women, multiparous women, or the subgroup of women with no complications at the start of labor.

Admission to a neonatal intensive care unit (NICU) is a useful indicator of serious morbidity in newborns. Researchers comparing 801 women admitted to birth centers in

labor with 3271 women who met birth center eligibility criteria but planned hospital births found no difference in NICU admissions.[6] A 2003 study that enrolled women at the first prenatal visit also found no significant difference in NICU admissions between infants of women planning birth center births and those planning hospital births (10% birth center vs. 12% hospital).[12]

In the same study, researchers evaluated the likelihood of "major neonatal morbidity," a composite variable of 16 serious neonatal conditions, and found similar rates after adjusting for correlating factors. No differences were found in neonatal readmission in the first 28 d.

Two studies reported on the likelihood of resuscitative efforts after birth. Jackson et al. (2003) found no difference in positive pressure ventilation.[12] David et al. (1999) reported that fewer birth center babies underwent resuscitation, but statistical significance was not calculated (1.6% vs. 3.3% in hospitals).[6]

3. Available data suggest that perinatal mortality in birth center populations is disproportionately concentrated in postterm births, but it does not tell us whether deaths could be averted by planned hospital delivery.

The NBCS is the only study large enough to look at perinatal death stratified by gestational age. Investigators found that 5 of 15 (33%) intrapartum or neonatal deaths, including 3 of 8 (38%) deaths from causes other than congenital anomalies, occurred in postterm pregnancies (≥ 42 completed w), even though only 11.6% of all women in the study were postterm.[20] However, there is no evidence that similar women planning hospital births fared any better: the perinatal mortality rate in normally formed babies born postterm in the NBCS was similar to that reported in a comparison hospital cohort of uncomplicated postterm births (2.3 per 1000 vs. 2.1 per 1000). Because so few women go into labor after 42 w and because perinatal mortality is uncommon, it is unlikely that any study will ever provide conclusive evidence of the comparative safety of different birth settings in women laboring at or beyond 42 w.

A study of 1453 women planning vaginal birth after cesarean (VBAC) in freestanding birth centers in the U.S. raises additional concern about the safety of laboring in birth centers at or beyond 42 w gestation. The risk of perinatal death among the 46 women who were at least 42 w pregnant was 4.3% (n = 2) vs. 0.4% (n = 5) among women presenting in labor before 42 w.[15] Again, we have no hospital group of postdates women planning VBAC with which to make a comparison. (See chapter 6 more information about this study.)

4. Freestanding birth center care does not appear to increase the risk of maternal mortality or severe morbidity when compared with hospital management.

No study of women planning to give birth in birth centers has reported a maternal death in the birth center group.[2, 6, 7, 12, 13, 20, 21] In the Birthplace in England Study (2011), a prospective cohort study of 64,538 women in midwifery care, women who planned birth center births were the least likely to be admitted for intensive care (0.2%) compared with women having hospital births in traditional units (0.6%) and others having hospital births in midwife-led units (0.7%).[2] The only other study that provides reliable data on maternal morbidity used composite variables for morbidity categories to increase the power of the study to detect statistically and clinically significant differences. Investigators found no

differences in major intrapartum complications (one or more of 15 serious conditions) or major postpartum complications (one or more of 8 serious conditions).[12] Significantly fewer birth center women had a maternal length of stay > 72 h (10.3% vs. 16%, difference 5.8% after adjusting for correlating factors), but they were no more likely to be readmitted after discharge home. As with newborn outcomes, the NBCS fails to provide useful information about maternal morbidity because the researchers only collected data on serious complications that arose in birth centers but not in women transferred to the hospital.[20]

5. Women who begin their care in freestanding birth centers experience fewer interventions in labor than similar women receiving hospital-based care.

A secondary analysis of the National Birth Center Study (NBCS) compares intervention rates among women who began their intrapartum care in birth centers with those beginning care in hospitals.[9] In both settings, care was predominantly provided by midwives, which eliminates the confounding effect of care provider philosophy. In order to control for differences in medical and obstetrical risk factors, the authors limited their analysis to those women who experienced no antepartum or intrapartum complications. This subgroup comprised 5167 women receiving birth center care and 495 women experiencing hospital care. Differences favoring birth center care were found in the rate of oxytocin augmentation (1% of birth center women vs. 2.2% of hospital women), amniotomy (41% vs. 51%), electronic fetal monitoring (EFM) (7% vs. 50%) IV fluids (8% vs. 24%), and experiencing more than four vaginal exams in labor (44% vs. 53%). Likewise, in the Birthplace in England Study (2011), planned birth center care was associated with lower rates of oxytocin augmentation (7% vs. 24% traditional obstetric unit and 10% midwife-led hospital unit) and active management of third stage labor (78% vs. 94% traditional obstetric unit and 86% midwife-led hospital unit).[2]

Whereas the NBCS and Birthplace in England Study included only those women who began intrapartum care in birth centers, Jackson et al. (2003) analyzed resource utilization patterns by intended place of birth at the first prenatal visit.[12] They included 1808 women in a "collaborative care" arrangement that involved midwife-led birth center care for women who remained low-risk throughout their pregnancies and labors and compared these with 1149 women who met birth center eligibility requirements at their first prenatal visit but planned hospital births with physicians. Using intent-to-treat analysis and controlling for race/ethnicity, parity, cesarean history, age, marital status, country of origin, height, and smoking during pregnancy, the investigators found significant differences in rates of use of every intervention they measured. Women who began their prenatal care in the collaborative care model were less likely than conventional hospital-management clients to experience labor augmentation (16% vs. 27% difference after adjusting for correlating factors 11%), amniotomy (53% vs. 57%, adjusted difference 5%), IV fluids (67% vs. 97%, adjusted difference 27%) and continuous EFM (48% vs. 94%, adjusted difference 46%).

6. Women who begin their care in freestanding birth centers experience fewer restrictions in labor than similar women receiving hospital-based care.

Routine restrictions of movement and oral intake may impede labor progress and increase discomfort for women. (See chapters 8 and 11 for additional information.) Fullerton and Severino (1992) and Jackson and colleagues (2003) compared the proportion of women

planning birth center births who experienced these restrictions with the rates among women planning hospital births.[9 12] (See mini-review 5 for more detail on the respective study designs.) Women in the NBCS were more likely to eat solid food than their hospital-based counterparts (15% vs. 11%) but no more likely to drink fluids (93% vs. 93%). While freedom of movement or use of ambulation was not directly measured, women in the NBCS were much more likely to use a shower or bath while in labor (40% vs. 24%), which suggests less restriction of mobility.[9]

Larger differences were found by Jackson and colleagues, perhaps because the hospital-based comparison group, although low-risk, were cared for by physicians.[12] Women planning birth center births at their first prenatal visit were more likely than hospital-based women to eat or drink (50% vs. 10%, difference after adjustment for correlating factors 40%), walk in labor (75% vs. 67%, adjusted difference 8%), and use a tub or shower in labor (37% vs. 3%, adjusted difference 32%). Considering that 69% of hospital-based women (vs. 30% of those planning birth center births) used epidural anesthesia and 94% (vs. 48%) had continuous EFM, the difference in ambulation in this study may be more pronounced than the numbers suggest. The authors did not describe the amount or type of ambulation used, but we can presume that ambulation among women with epidurals and/or continuous monitoring was limited or occurred only before these interventions were applied.

7. Fewer women beginning care in freestanding birth centers have instrumental vaginal delivery or cesarean surgery compared with similar women receiving hospital-based care.

Every study that reports on spontaneous vaginal birth reports higher rates among women receiving birth center care compared with similar women planning hospital births. In the Birthplace in England study, a prospective cohort study of 64,538 women in midwifery care, 91% of women planning birth center births had spontaneous vaginal births vs. 74% in the traditional hospital unit and 86% in the midwife-led hospital units.[2] Differences were statistically significant after adjusting for confounders. Likewise, a multi-center German study reported an absolute difference in the rate of spontaneous vaginal birth of 7% (91% birth center vs. 84% hospital).[6] In a U.S. study where participants were enrolled at the first prenatal visit (vs. at admission for intrapartum care), the difference after adjustment for confounding factors was twice as large at 15% (81% birth center vs. 63% hospital).[12] The smallest absolute difference is reported by Fullerton and Severino (1992) who, in their analysis of the NBCS data and a prospectively enrolled hospital comparison group, found an unadjusted absolute difference of 6% (93% birth center vs. 87% hospital).[9]

Similarly, studies consistently report lower cesarean surgery rates in women planning birth center births compared with women planning hospital births, although differences are not always significant. In the NBCS, the cesarean rate was 4.4% in the birth centers compared with 9.5% in a comparison cohort of women planning hospital births, but the authors failed to calculate statistical significance.[9] Furthermore, the authors did not make statistical adjustments for confounding factors but did note that the cesarean rate was 7.8% in the hospital group when nonvertex and postterm births were excluded, complications that are more common in women planning hospital birth. Subgroup analysis by parity revealed that the difference in overall cesarean rate was disproportionately attributable to the lower rate in cesareans among multiparous women (0.8% birth center

women vs. 3.8% hospital) compared with nulliparous women (9.9% birth center vs. 11.7% hospital). The authors did not separately analyze women with previous cesarean sections. It is therefore possible that the hospital group had more women with previous cesareans and that the higher rate of cesareans among multiparous women was in part attributable to repeat intrapartum cesareans. In the Birthplace in England Study, the cesarean rate in the birth center group was 3.5% vs. 11.1% in the traditional hospital unit and 4.4% in the midwife-led hospital unit. David and colleagues (1999) reported similar cesarean surgery rates (3.0% birth center vs. 4.6% hospital).[6] Jackson and colleagues (2003) used the most rigorous methodology among the studies to ensure similarity between the birth center and hospital cohorts.[12] All women planning hospital births met birth center eligibility criteria at their first prenatal visit and statistical adjustments were made for race/ethnicity, parity, cesarean history, age, marital status, country of origin, height and smoking during pregnancy. The cesarean rate was lower among women planning birth center births (10.7% vs. 19.1%, adjusted difference 4.7%).

Rates of instrumental vaginal birth were reported in four studies. Fullerton and Severino (1992) found a rate of 2.3% among women beginning their intrapartum care in birth centers vs. 3.1% among hospital-based women.[9] Much larger absolute differences favoring birth centers were found by David and colleagues (1999) (5% vs. 11%, absolute difference 6%), the Birthplace in England Study (2011) (4% vs. 14% traditional hospital unit, absolute difference 10%, and 9% midwife-led hospital unit, absolute difference 5%) and by Jackson and colleagues (2003) (8 % rate vs. 18%, adjusted difference 10%).[2, 6, 12]

8. Women who begin care in freestanding birth centers are less likely than similar women receiving hospital-based care to have episiotomies, lacerations requiring sutures, or both.

Two studies provide the clearest picture of perineal outcomes in birth centers because of their large size and because the comparison hospital-based groups included a similar proportion of women cared for by midwives.[2, 9] This eliminates the confounding effect of provider type on episiotomy rates and perineal integrity. In a secondary analysis of the NBCS, researchers compared women admitted to freestanding birth centers in labor with low-risk women planning hospital births and restricted their analysis to those with no antepartum or intrapartum complications, thereby isolating a group of "ultra-low-risk" women (5167 birth center; 495 hospital) for whom there was no discernible medical need for obstetric interventions. Episiotomy rates were lower among birth center women (21.1% vs. 33.7%). The birth center group experienced more lacerations (41.2% birth centers vs. 36.5% hospitals) but also had higher rates of intact perinea among nulliparous women (30% vs. 23%). In the Birthplace in England Study, the episiotomy rate among women planning birth center births was 9% vs. 19% in the traditional hospital unit and 13% in midwife-led hospital unit. Third- and fourth-degree lacerations were also significantly lower in the birth center group (2% vs. 3% in both hospital groups).

Episiotomy rates and perineal integrity data from other studies are difficult to interpret because the effect of provider type cannot be teased out from the effect of the planned birth setting. To what extent setting contributes to lower rates is unclear. However, all three studies that report episiotomy rates find them to be much lower in the birth center group than the hospital group.[6, 12, 23]

9. Rates of transfer to hospital care after birth center admission vary widely and are disproportionately higher among nulliparous women; most transfers occur for non-acute indications.

Most women admitted to freestanding birth centers will remain low-risk throughout labor, give birth without complications, and be discharged home with their babies without needing hospitalization. In the NBCS, 15.8% of participants transferred to hospitals during labor or after the birth.[20] In the Birthplace in England study, the overall transfer rate was 22% among 53 freestanding birth centers,[2] and in a German study of 15 freestanding birth centers the intrapartum transfer rate was 14%.[5] Combined intrapartum, postpartum and newborn transfer rates as low as 9% and as high as 32% have been reported.[8, 21] In reflecting on the variance in reported transfer rates among birth centers, Fullerton and colleagues (1997) suggested that differences in characteristics of the client population, facility-specific clinical practice guidelines, proximity to referral center, and level of integration with referral services affect expected and actual rates of hospital transfer.[8]

Demonstrating markedly less variance across birth centers is the distribution of reasons for transferring women. With only two exceptions,[5, 21] the most common reason for transfer was prolonged labor.[5, 9, 12, 13, 20] In a German and a Norwegian study,[5, 21] prelabor rupture of membranes without active labor was the most common reason, followed by prolonged labor. These two indications for transfer accounted for 38-65% of transfers across all of the included studies. The primary reason for newborn transfer in all of the studies that report this measure is respiratory difficulty, with transient tachypnea the most common condition reported.[13, 20]

Nulliparous women are far more likely to require transfer than multiparous women because of their increased risk of labor dystocia. In the Birthplace in England Study, the transfer rate among nulliparous women was 36% vs. 9% in multiparous women. A German study of 15 birth centers transferring to 31 hospitals found that 58% of transferred women were nulliparous vs. 49% of all women planning birth center births (statistical significance not calculated).[5] In a study comparing reasons and rates of transfer at two California birth centers with those reported in the NBCS, 75% and 72% of transfers in the two California birth centers were nulliparous women while 79% of transfers were nulliparous women in the NBCS.[9] In the NBCS, 47% of all transfers were for lack of progress in labor in nulliparous women. The contribution of nulliparous women with prolonged labor to the overall transfer rates in the two California sites was lower but still notable: 28% and 17%.[9] The study reporting the lowest intrapartum transfer rate included several birth centers where nulliparity was an exclusion criterion.[21]

10. Intrapartum transfers from birth center care to hospitals are infrequently urgent; women transferred in labor urgently are often managed expectantly once they arrive at the hospital, suggesting no imminent danger to the woman or her baby.

Because so many transfers occur for labor dystocia, prelabor rupture of membranes (PROM), and other non-acute conditions, the proportion of transfers for urgent indications is relatively small. In the NBCS, 15% of transfers were handled as emergencies.[20] In the German study, midwives deemed 11% of their intrapartum transfers emergencies.[5] Interestingly, how urgent the provider considers the transfer is a poor predictor of the ultimate urgency of delivering the baby. In the NBCS, 41% of emergency transfers in labor

were delivered more than an hour after arrival at the hospital,[20] suggesting that neither the woman nor her baby was in imminent danger in these cases.

One study further elucidates the subjectivity involved in determining the need for and urgency of a transfer. David and colleagues (2006) queried the birth center midwives who initiated transfers and the hospital personnel who accepted the transfers and compared their perceptions of the circumstances of the transfers.[5] The birth center providers characterized 11% of transfers as emergencies while the receiving hospitals considered 16% emergencies. Fourteen of 360 transfers were assessed as emergencies by the birth center midwife but not by the hospital staff, and 31 transfers were classed as emergencies by hospital personnel but not by the midwife.

11. Freestanding birth centers situated in rural communities or areas with low population density provide healthy, screened women a safe alternative to traveling long distances for labor and birth and may therefore represent an efficient model of rural health care delivery.

Nine of the 15 birth centers included in a multi-center German study were located in rural Bavaria. Investigators compared the neonatal cord-blood pH values or Apgar scores among the infants of three groups of women who had transferred in labor: those for whom the door-to-door transport time was ≤ 15 min (n = 146), 15-30 min (n = 117), and > 30 min (n = 67). They found no significant differences across the groups.[5] However, most transfers were for nonacute conditions where distance of transport would not affect outcomes. (See mini-review 10.) If reporting had been confined to urgent transfers, it is possible that a difference would have been detected.

In a study of 10 maternity homes in Norway, travel time to the hospital ranged from 2-3 h by ambulance but transport by aircraft was available for all but one of the maternity homes, which reduced the transport time to approximately 1 h.[21] In this study, there were two early neonatal deaths (0.2%), both due to Group B streptococcal infection. Both babies were born in the maternity homes. In one case, the woman gave birth immediately after admission, implying she would not have arrived at a hospital before the birth if she had planned a hospital birth unless that hospital was nearby, which was not the case in this community. Therefore it is unlikely that the planned place of birth was the reason for the neonatal death. In the other case, the mother had "normal first and second stage of labor and therefore the low Apgar score of 2 after 1 min and again after 5 min was unexpected" (p. 734). The researchers did not report whether screening and treatment for GBS were standard. Severe hemorrhage is the maternal outcome of concern, especially for birth centers remote from hospitals, but only one woman admitted to the birth center in labor required a blood transfusion, and she was discharged home the following day. No other adverse maternal outcomes were reported.

Leeman and Leeman (2002) analyzed outcomes of all pregnant women delivering at or after 20 w gestation over a 5-year period in rural New Mexico among a mostly Native American population.[13] The only maternity services within the community lacked operative or anesthesiology capability. High-risk women were transferred to hospitals with this capacity at the onset of labor or prenatally. Women who remained low- or moderate-risk throughout pregnancy were admitted to the community hospital in labor. The population-based (mixed-risk) perinatal death rate was 11.4 per 1000 births, which compared favorably

to the nationwide rate of 12.8 per 1000. The perinatal mortality rate at the community-based hospital was 1.2 per 1000, which was comparable to the rate reported in the NBCS (1.3 per 1000). The authors reviewed all cases of placental abruption (n = 4), uterine inversion (n = 1), umbilical cord prolapse (n = 1), and fetal distress (n = 5) that occurred at the community-based hospital to determine if lack of surgical facilities contributed to poorer outcomes. In all but two cases, either no adverse outcome occurred to either the mother or baby (eight cases) or a stillbirth occurred before the woman presented at the community hospital (one case). The latter could not have been prevented by presenting to a hospital with surgical capability. Both infants in the two remaining cases had normal neurologic and developmental assessments at 15 months of age despite poor condition at birth.

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The Place of Birth: Home Birth

Despite the rosy picture painted by home birth advocates, a seemingly normal labor and delivery can quickly become life-threatening for both the mother and baby. . . . Unless a woman is in a hospital, an accredited freestanding birthing center, or a birthing center within a hospital complex, with physicians ready to intervene quickly if necessary, she puts herself and her baby's health and life at unnecessary risk.

ACOG 2008, p. 1[2]

Homebirthers challenge whether contemporary. . . obstetrics truly offers health and safety, and by extension, absence of death and disability, while questioning whether the pain of childbirth is something to be avoided.

Cheyney 2008, p. 261[13]

A woman participating in a U.S. ethnographic study described telling her doctor she was planning a home birth: "He said 'Cool, and while you're at it, don't bother with a car seat'" (p. 258).[13] Another woman participating in a Swedish survey initiated a conversation about home birth safety with her doctor and recounted, "When he understood that I was serious about giving birth at home, he told me that he hoped he would not be in charge when I came in asking for professional help. When he saw in my record that I work with handicapped children, he looked at me and said, 'Okay, I see you know what happens to these babies'" (p. 7).[39] These are just two examples of a larger phenomenon: women planning a home birth are often accused of unnecessary risk-taking, selfish irresponsibility, or reckless hedonism.[12, 13, 39, 44] These accusations are pervasive in U.S. culture and in other countries to varying degrees, and individual obstetricians reinforce them, as has the American College of Obstetricians and Gynecologists (ACOG).[5, 51] Given this strong cultural bias, why *do* some women choose home birth? As we will see in this chapter, the answer provides a framework for understanding how to study the effects of birth settings, communicate about risks and benefits, improve care in all settings, and establish maternity care systems based on physiologic care principles, effective collaboration among care providers, and active participation of women and their families.

BELIEFS ABOUT SAFETY AMONG WOMEN CHOOSING HOME BIRTH

Despite widespread assumptions to the contrary, research suggests that women who plan home births *do* consider risks and safety. In fact, safety concerns about hospital birth impel many women to opt for home birth.[12, 13, 22, 39, 40] Although avoidance of death or disability is part of women's risk calculus, women who choose home birth describe a broader concept of safety and place a high value on practices that ease and facilitate labor, prevent complications, protect breastfeeding, and foster early mother-infant attachment. They believe that planned home birth offers a safety advantage over hospital birth because it allows relationships with care providers that are based on trust, active participation in decision making, and minimal exposure to potentially harmful interventions.

When U.S. researcher Judith Lothian interviewed twenty women planning home births, she discovered that "they valued the personal relationship with their midwife and believed that this relationship increased safety" (paragraph 4).[40] A similar theme emerged in three other qualitative studies.[12, 13, 39] Swedish researchers who surveyed home birth mothers wrote, "The women wanted to know the person who would probably be the first human being touching their newborn baby. They see the alienation not only as inconvenient or less cosy but also as a risk factor for an adverse obstetric outcome" (p. 4).[39] Being "in the hands of strangers" was in fact the most frequently cited risk of hospital birth, mentioned by 80% of respondents. Participants gave examples of physical harm that could result directly from poor relationships, such as inadequate monitoring of maternal and fetal wellbeing in busy units where staff were responsible for many women. Women in two U.S. studies also felt that a trusting, intimate relationship with their care providers and others who would attend their births was "necessary for surrender" (p. 262) to a psychophysiological state that would facilitate normal labor progress and increase comfort.[12, 13] A close relationship with caregivers, therefore, is seen indirectly to promote safety by reducing pain and suffering, fatigue, and the likelihood of needing treatment for pain and progress disorders, which, in turn, reduces the likelihood of experiencing the complications associated with those treatments. Some women also reported that a trusting relationship was a prerequisite for disclosure of significant issues in their history or harmful behaviors that could affect birth outcomes. For example, in a U.S. study, a woman reported that she felt her relationship with her home birth midwife enabled her to disclose and ultimately resolve pica behavior (eating non-food items such as soil),[13] and in a U.K. study, home birth midwives were significantly more likely than hospital-based midwives to report feeling capable of dealing with a woman's disclosure of sexual abuse.[31]

A relationship of mutual trust with the care provider also enables women choosing home birth to collaborate in decisions about care in pregnancy, labor, and birth, which represents to them another safeguard.[7, 12-14, 39, 43] Women planning

home births place a high value on obtaining knowledge from various sources, discussing options with their care providers, and making individualized choices based on their own needs and preferences and the scientific evidence.[7] They expect to give informed consent or refusal for prenatal testing options, the use of obstetric interventions, and pain management approaches, and to participate in, although not necessarily control, decision-making about the management of complications. They believe that tailoring care to the circumstances and preferences of the individual woman and baby will produce better outcomes. Women also recognize that having control, not over the physiological process of birth itself but over the birth environment, and the ultimate say in decisions about care contribute to long-term emotional health and preparedness for parenthood.[13, 39] Indeed, personal control has been found to be the strongest predictor of satisfaction with the childbirth experience,[24] and lack or loss of control is an independent risk factor for both dissatisfaction and, more importantly, symptoms of childbirth-related posttraumatic stress,[9, 46, 53] a condition present in up to 9% of women having hospital births in the U.S.[19]

Women who have had negative or traumatizing hospital birth experiences comprise a large proportion of those who choose home birth, and these women's perceptions of their previous experiences often revolve around lack of control. A woman in a U.S. study wrote, "In my first birth experience, I felt bullied, robbed, cheated, and fearful in the hospital environment. . . . I could not use my voice in the hospital and my doctor did not listen anyway. I was a passive patient, instead of being an active participant" (p. 122).[12] Another, in a Swedish study, responded, "I think risks [of hospital birth] are related to lack of respect and trust in the woman's ability to give birth. When I gave birth in the hospital, I felt more like an obstacle than the principal character in the birth of my child" (p. 5).[39] First-time mothers, although lacking traumatic birth experiences of their own, may turn to home birth in response to cultural messages that birth frequently results in emotional or physical trauma in the dominant system.[13] A participant in a U.S. study explained her choice for a home birth despite threats from her family to disown her:

> When I got pregnant, I was not going to be like all my friends. You know the story. . . . They go overdue by a couple of days, go in for an induction that doesn't work, and they end up with a C-section. Then they're in too much pain and too depressed to nurse, so they have to find a support group to process their feelings of victimization. I didn't know much, but I knew I didn't want that. You're not supposed to say this in our society, but I'm not totally convinced that obstetricians really know what they're doing. (p. 257)[13]

Exercising control and responsibility over decision-making also enables women choosing home birth to achieve their third safety-related goal: reducing

exposure to potentially harmful interventions and restrictions. Women commonly cited this benefit as a reason for their choice ,[12, 14, 39, 44] and several women made a direct link between low use of interventions and safety. Said one respondent in a U.S. study: "As far as I'm concerned, lower intervention means higher safety for both mother and baby" (p. 122).[12] Respondents in several studies specifically spoke of the risks of epidural analgesia and felt that staying at home decreased the likelihood that they would turn to it.[13, 39, 40] Said one Swedish mother: "It's so easy to use equipment or drugs just because they are there. When you are home, you have to use your capacity to find ways to cope with pain. Having an epidural might seem an easy way but as far as I know it also has a negative effect and increases the risk for an instrumental delivery or a caesarean section" (p. 5).[39]

DO WOMEN CONSIDER RISKS OF HOME BIRTH?

Women who desire home birth recognize that hospitalization imposes risks related to the overuse of potentially harmful interventions, but do they, as mainstream attitudes suggest, ignore the risks posed by laboring and giving birth remote from potentially life-saving interventions? Surprisingly little research deals directly with women's perceptions of the risks of death or serious injury in home birth. The one study that explores this issue, a postal survey of all women planning home births in Sweden between 1992 and 2005, suggests that most women acknowledge the possibility.[39] Of the 602 women who responded to an open-ended question about home birth safety, most said that they had considered the possibility of losing the baby (72%) or having their own life-threatening complication (53%) and being beyond help (24%). However, nearly one-third of women responded that they had not considered medical risks related to childbirth, preferring instead to maintain confidence in their ability to birth safely.

The extreme polarity in positions on home birth makes discourse on risk difficult. More than half the women reported avoiding talking to others about the risks of home birth. Women particularly avoided health care professionals, citing or anticipating judgmental responses. On the other hand, home birth midwives and other natural birth enthusiasts may echo the bumper-sticker refrain "birth is as safe as life gets" to discourage women from considering possible negative consequences of a choice to give birth remote from surgical facilities. These conflicting narratives undoubtedly contribute to women's avoidance behavior, as exemplified by one respondent's experience: "The attitudes and information we got from midwives and obstetricians were so inconsistent and I realized that I had to make my own decision" (p. 6).[39]

The authors of the Swedish study suggest that some of the avoidance behavior exhibited by home birthing women was maladaptive "escape avoidance" (p. 8),[39] a response to stress. The stressors in this case would mostly be demeaning and judgmental attitudes of physicians toward home birth and the conflict between the

desire to think positively and maintain confidence and the need to make contingency plans and establish whether proper safeguards are in place. Unfortunately, these obstacles to discussing risk with the very health care providers responsible for minimizing it interfere with achieving that goal.

VBACs AND BREECHES AND TWINS, OH WHY?

Health care professionals who concede that home birth is safe for low-risk women may have trouble understanding why a woman with prior cesarean surgery or who is carrying a breech baby or twins would consider a home birth, given the higher likelihood of a complication requiring emergency obstetric services. Data show clearly that adverse outcomes occur more frequently in this subpopulation of women choosing home birth. (See mini-review 2.) Considering these data and the central position that "high-risk" births play in the debate over home birth safety, we were surprised to find no studies describing how women arrive at the decision to plan home breech, twin, or VBAC births. However, we believe that the same three values we see in the general home birth choice literature—trusting relationships, desire for autonomy, and avoidance of unnecessary intervention—drive these choices as well.

Women with risk factors for a poor outcome or who are anticipating a less-than-straightforward birth may place an even greater value on having a care provider whom they can trust and who will provide constant, one-on-one monitoring and support. If a woman believes that being "in the hands of strangers" or looked after by machines rather than people is risky, she might seek to avoid adding that risk to an already high-risk pregnancy. Autonomy, too, is not easily relinquished, and the stakes here are much higher. The loss of control over the birth environment and decision-making typical in many hospitals is all but guaranteed for women carrying a breech baby or twins or who have had prior cesareans. In most cases women with risk factors face an unpalatable choice between having a home birth and exposing themselves and their babies to excess risk or being forced to submit to unnecessary surgery or other invasive procedures in order to obtain medical care.

Some home birth midwives and the larger natural birth community may also passively or actively encourage home birth in women with risk factors. Midwives may agree to attend home births in women with breech babies, twins, or prior cesareans because they, along with their clients, believe that it is the better of two suboptimal choices or because they anticipate that the woman will choose an unattended birth if the midwife were to decline to attend.[49] They may also justify their choice on the belief that they have knowledge and skill at assisting at breech or twin delivery or that physiologic care not obtainable in local hospitals, such as allowing a woman to birth a breech baby upright or avoiding oxytocin in a VBAC labor, may reduce the attendant risks. A few home birth midwives, pointing to

the rarity of adverse outcomes, may portray home birth as the safest choice for breeches, twins, and VBACs, but as death or serious morbidity occur rarely even in high-risk births, their rarity is no proof of superior safety. The optimal arrangement for breech, VBAC, and twin births is almost certainly home-style midwifery care in a hospital setting with the active collaboration and immediate availability of physicians. This, however, is almost never an option.

DO WE KNOW IF HOME BIRTH IS SAFE?

We have discussed the theoretical grounds on which home birth is believed to be safe, but do we have hard data on this point? We do, but we must keep in mind that the safety of home birth for any given woman and her baby will be modified by several factors: her health status and that of the baby, her midwife's skills to provide appropriate home-based care and manage situations requiring referral and transport, how far she lives from a hospital, and the quality of care she can expect to receive at that hospital. These factors are in turn influenced by national or regional protocols for client selection, midwife training and regulation, and the degree to which home birth services are integrated in the larger maternity care system. These vary significantly across maternity care systems, and sometimes even within a system. So large, population-based studies, which provide the "best evidence" on rates of mortality and serious morbidity, are of limited usefulness when results are applied to another population in which the context of home birth differs or to an individual woman seeking care in that system.

That said, several recent well-controlled, population-based studies have reported excellent outcomes in planned home birth. These studies suggest that perinatal mortality and morbidity are similar across settings, maternal morbidity rates are equivalent or favor home birth, and planned home birth results in much lower use of risky and costly interventions. (See mini-reviews 1, 3-5, and 7.) These studies, however, come from systems committed to evaluating objectively the outcomes of home birth, not coincidentally the same systems committed to safely meeting demand for home birth midwifery. In the Netherlands, England, and several Canadian provinces, midwifery is regulated, and guidelines for client selection clearly limit home birth to women at low obstetrical risk.[10, 16, 29, 33] All eligible women have a choice between hospital-based and home-based midwifery care, and women who require medical or surgical intervention at any point in the childbearing process have access to such care. The statistics these systems produce provide clear evidence that home birth *can* be safe. But they are often held up as evidence that home birth is intrinsically safe, or their results are applied where few or none of the systemic safeguards are in place.

Where does that leave women desiring planned home births in less optimal systems? Should lack of reliable evidence for the safety of home birth in a particular system justify hospitalizing all women giving birth in that system?

Because conventional obstetric management holds sway in the U.S., out-of-hospital midwifery is seen as a fringe alternative and is poorly integrated into the U.S. system.[15] Contrast that with the Netherlands, where all healthy women are cared for by midwives, and about one-third of babies are born at home.[20] Midwives are not just integrated into the system; the system is designed around the care they provide.

We do not disagree that home birth will be less safe in a system that marginalizes women who choose to give birth at home and the professionals who attend them there, but whose fault is that? Nearly a hundred years ago, obstetricians waged a successful campaign in the U.S. to move birth into the hospital without any evidence that hospital birth was safer. Efforts to measure and optimize the outcomes of home birth are severely hampered in the U.S. because obstetricians have driven home birth underground and failed to provide the complementary specialist services that improve safety when complications arise.

In the U.K., by contrast, policy makers working to reform the maternity care system in the 1990s dismissed obstetricians' claim that women's choice of birth setting should be restricted because there was not enough evidence of safety. In an analysis of the events that led up to U.K. system reform, Declercq (1998) quoted the testimony of a British policy maker:

> To consider it safer, or even to have a consensus view, is not the same as having evidence . . . are you not saying that you have made a policy on the basis of safety which was not justified on the statistics when they did exist, and now you say there is not any possibility of getting statistics? Is that not putting women into a trap? (p. 843).[17]

It is, of course, putting women in a trap. The inability of U.S. research to establish unequivocally the safety of home birth in a hostile, nonintegrated system is irrelevant because we know it can be safe in an integrated, regulated one. We also know that women will have planned home births whether or not it is sanctioned within the dominant medical system.[11, 13] If research shows that home birth can be safe, then institutions and institution-based care providers have a compelling professional and ethical obligation to help make it as safe as possible for those choosing to birth at home.

If obstetric leaders in the U.S. are looking for precedent, they need only look to the north. While most industrialized countries in Europe and elsewhere have midwife-led maternity care and many integrate a home birth option, in Canada, as in the U.S., doctors are at the helm and home birth has historically been an underground alternative. This is changing, and for this reason Canada offers a helpful example of how we might begin to dismantle a conventional medical-model system in favor of a midwife-led primary care system.

In response to consumer demand and growing evidence for the safety of community-based midwifery care, several provinces began to regulate midwifery and offer integrated access to home birth or birth centers in the 1990s, including British Columbia, where low-risk women could choose to plan a home or hospital birth with a registered midwife beginning in 1998.[32] Since then, British Columbia has produced some of the best data on the outcomes of planned home birth, thanks in large part to a multidisciplinary commitment to collect data not just on all planned home births but on low-risk women having hospital births as well.[32, 33] Early data suggested small excess serious morbidity in planned home births involving meconium-stained amniotic fluid, but subsequent data showed that this excess has disappeared, suggesting that a commitment to research may in fact have led to concrete improvement in home birth care and outcomes. (See mini-review 1.) Meanwhile, the Canadian government sponsored the Multi-disciplinary Collaborative Primary Maternity Care Project to establish standards for scopes of practice and collaboration among maternity care professionals, improve communication across disciplines, and study the health and cost impact of primary care models of providing maternity services.[47] In 2009, the College of Physicians and Surgeons of British Columbia issued a guideline, "reflect[ing] emerging societal, clinical and scientific advances in obstetrical care for women in British Columbia" (p. 1), reaffirming doctors' ethical obligation to provide safe, nondiscriminatory, respectful care to women requiring physician intervention or advice in a planned home birth.[50] Home birth still constitutes a very small proportion of the total births in the province, but it is integrated, woman-centered, and safe.

In the U.S., the tide may be starting to turn. In 2011, a group of high-level delegates, including some prominent obstetricians, convened in a multi-stakeholder consensus development meeting.[28] They issued a common ground statement affirming women's autonomy and describing an envisioned system optimizing interprofessional collaboration, service integration, midwifery regulation and accountability, and continuous data-driven quality improvement. This development came on the heels of an ACOG statement on home birth that acknowledged women's rights to make informed choices about place of birth and the important role of obstetricians in optimizing safety for women choosing home birth.[3] While the statement highlighted controversial safety data (see text box "What About Wax?") and opposed direct-entry midwifery, it represented a significant departure from their strictly anti-home-birth stance issued just a few years prior.[5]

While progress toward creating the framework for integrated home birth midwifery is necessary and positive, it is not sufficient to improve home birth safety. We must also address the valid reasons why women opt for out-of-hospital birth. Doing so could save lives: three out of the four perinatal deaths occurring in labor or after birth among normally formed babies in an Australian study of 1141

planned home births occurred in cases where the parents were advised against planning home births but refused or delayed hospitalization, and in at least one case a prior poor experience with hospital birth contributed to this refusal.[36] Five of 13 perinatal deaths in planned home births in the U.K. occurred in cases where the mother cited a prior traumatic hospital experience as her motivation for giving birth at home, and two refused transfer to the hospital when the midwife deemed it necessary.

We saw at the beginning of this chapter that women perceive home birth to be safer than hospital birth because they can trust their care providers, have autonomy, and avoid interventions that they do not want and are not supported by evidence. Women should be able to obtain these elements of care in hospitals, but do they? The only researchers ever to survey a nationally representative sample of women who gave birth in U.S. hospitals concluded decisively that they do not.[18] Childbirth Connection, the independent organization that sponsored the survey, sums up the findings:

> The data show many mothers and babies experienced inappropriate care that does not reflect the best evidence, as well as other undesirable circumstances and adverse outcomes. This sounds alarm bells. . . . Few healthy, low-risk mothers require technology-intensive care when given good support for physiologic labor. Yet, the survey shows that the typical childbirth experience has been transformed into a morass of wires, tubes, machines and medications that leave healthy women immobilized, vulnerable to high levels of surgery and burdened with physical and emotional health concerns while caring for their newborns.[41]

Improving hospital care may in fact be the most important strategy for improving the safety of home birth. If hospitals respected informed consent and refusal, if physiologic care was standard, and if hospital-based providers reliably offered evidence-based treatments for complications, fewer women would choose home birth as a strategy to avoid coercive, traumatic, and unsafe hospital experiences. In addition, if complications or risk factors arose in a planned home birth, midwives might initiate transfers with more confidence that it would improve the outcome, women would in turn transfer more willingly, and care at the receiving facility would be safe and effective. Moreover, this strategy would have another outcome of even greater moment: the collateral benefit of supporting home birth would be better, safer care for the vast majority of women who have no intention to give birth anywhere but the hospital.

MINI-REVIEWS

Notes:

- The best data on outcomes of planned home birth come from countries where all births are registered in national databases that record both planned and actual place of birth and that include uniform data on medical, obstetrical, and socioeconomic risk factors. Countries with such national databases are invariably those with national health care systems that also tend to regulate and integrate midwives and planned home birth. Outcomes may not apply to fragmented health care systems or those in which midwives are unregulated.
- Even when robust, reliable, population-wide databases are used to construct hospital comparison groups, researchers cannot eliminate all self-selection bias. Women who choose to give birth at home may differ from those who choose to give birth in hospitals in ways that are not easily captured in databases but nonetheless influence outcomes. Canadian researchers have noted that this need not invalidate research findings, however. They state, "Although our study cohorts were closely matched on prognostic variables, we do not underestimate the degree of self-selection that takes place in a population of women choosing home birth. This self-selection may be an important component of risk management for home birth and in that context is a desirable facet of study design. Our data indicate that screening for eligibility by registered midwives can safely support a policy of choice of birth setting" (p. 383).[33]
- Differences in planned home birth and planned hospital birth may arise from the birth setting, the care provider, or a combination of these. Comparing planned midwife-attended home birth with planned midwife-attended hospital birth minimizes differences arising from different models of practice.
- Except where noted, we have excluded descriptive analyses without control groups and studies with unselected hospital birth comparison groups (i.e., those in which home birth eligibility criteria have not been applied to the hospital cohort).
- Assume differences are statistically significant unless otherwise noted.

What About Wax?

Those familiar with the current home birth debate in the U.S. are likely aware of a meta-analysis published in 2010 by Wax and colleagues.[54] Proponents of universal hospitalization have pointed to the strengths of the Wax meta-analysis, which are that compared with previous attempts at systematic analysis of the research, this analysis includes more recent studies with superior methodologies and much larger sample sizes.[3] Proponents of home birth, on the other hand, point out its many flaws, among them inclusion of studies that do not separate planned from unplanned home births, statistical and computational errors, and selective reporting of outcomes. The most notable example of the latter was their reporting perinatal mortality defined as intrapartum stillbirths plus neonatal deaths in the first 28 d while failing to report perinatal mortality defined as intrapartum stillbirths plus neonatal deaths in the first 7 d, despite the fact that the latter data came from a more rigorous study with a much larger sample.[35]

We agree with critics who claim that the meta-analysis is flawed and that its most publicized conclusion—that planned home birth is associated with increased perinatal mortality—is invalidated by the exclusion of the most pertinent data on this point: the Dutch cohort study so large that it contributed 93% of all of data in the meta-analysis.[16] However, even if the review had been better done, we almost certainly would have excluded it, just as we have excluded the other four systematic reviews of home birth. We think that there is little if any value in meta-analysis because it cannot answer the crucial question, "Is home birth safe?" Meta-analysis fails because the answer will depend on the context, i.e., who was included in the study, what their care providers' qualifications were, what criteria determined when hospitalization was necessary, and how and by whom women were cared for in the hospital. These factors vary so widely across countries where home birth has been studied that the primary benefit of meta-analysis, namely larger sample size, is more than offset by the drowning out of contextual factors.

Indeed, three of the four groups of reviewers who previously attempted to parse the home birth literature neither pooled data nor claimed definitive findings. In the words of one review team, "Of course, the results of studies from different countries using different methods cannot be either easily combined or compared, and we will not attempt that here" (p. 140).[48] Another team wrote, "This review of home birth studies does not attempt to provide any definitive answer about the relative safety of home birth. Fundamentally, the ability to address the question is limited" (p. 328).[23]

In lieu of the Wax meta-analysis or any of its predecessors, we have independently reviewed and analyzed all of the constituent studies and, except where specifically noted, confined our analysis to those that separated planned from unplanned home births, reported outcomes by planned rather than actual place of birth, had qualified attendants, and included an appropriate low-risk hospital cohort.

1. Among infants of low-risk women planning home birth in an integrated system, perinatal mortality and morbidity rates are low and similar to comparable populations having planned hospital births; some evidence suggests a small but significant excess risk with planned home birth for nulliparous women.

Note: Few published home birth studies provide reliable data on the comparative safety for the fetus/newborn between planned home and hospital birth. Research has been limited by the following:

- difficulty identifying a low-risk hospital cohort for comparison,
- lack of statistical power due to small sample sizes,
- inclusion of unplanned home births in the home birth cohort,
- combining antepartum and intrapartum/newborn complications.

We have limited our analysis to studies of low-risk women with qualified home birth attendants that use reliable methods for determining and documenting planned place of birth, include appropriate low-risk hospital comparison groups, and have clear parameters for calculating mortality rates. We excluded studies that included antepartum fetal demise, unless data were reported in a way that allowed their exclusion. We have also restricted our analysis to clinically significant newborn outcomes, including mortality, admission to an intensive care unit, severe respiratory morbidity, prolonged ventilatory support, and birth injury.

Intrapartum and neonatal mortality

By far the largest study of perinatal mortality was a population-based survey of all low-risk women who gave birth from 2000-2006 in the Netherlands and who were in primary midwife-led care at the onset of labor.[16] All women in primary midwife-led care may self-select to planned home or planned hospital birth. Regulations restrict access to midwifery care (and planned home birth) to women whose labor begins spontaneously between 37-42 w and who are carrying singleton, head-down babies. There is a standard list of obstetric and medical indications for obstetrician referral regardless of the setting in which the midwife is providing care. This list includes history of ≥ 1 prior cesarean. All data were obtained from linked national birth and death databases that previous research has demonstrated to be reliable and valid. Overall, 529,688 women met study criteria, 321,307 of whom intended to give birth at home and 163,261 at the hospital. The intended place of birth was not recorded for 45,120 women. Groups were different with respect to age, whether women were originally of Dutch origin, socioeconomic status, parity, and gestation. The study reported intrapartum fetal death, intrapartum plus neonatal death in the first 24 h, and intrapartum plus neonatal death from 0-7 d. In all cases, no differences were found before or after researchers adjusted for parity, gestational age, maternal age, ethnic background, and socio-economic status. The intrapartum death rate was 0.03% in home group vs. 0.04% in hospital group; the intrapartum plus neonatal death during the first 24 h was 0.05% in both settings, and the intrapartum plus neonatal death rate from 0-7 d was 0.06% vs. 0.07%.

A similar but much smaller retrospective study was conducted in British Columbia, including all planned midwife-attended home births in the province from 2000-2004 in a national database that recorded intended place of birth.[33] As in the Netherlands, women eligible for planned home birth reached term with a singleton, head-down baby and had no significant medical conditions or obstetrical complications. Unlike in the Netherlands, women with one prior cesarean were permitted to plan home births. Registered midwives must offer home birth to eligible women. Researchers compared outcomes of all women planning a home birth at the onset of labor (n = 2899) with two comparison groups: women who met home birth eligibility but planned midwife-attended hospital births (n = 4752) and similar women who planned physician-attended hospital births (n = 5331). The physician group was matched 2:1 with the planned home birth group for multiple variables: year of birth, parity, single parent status, age, and hospital where the midwife had privileges. The hospital-based midwife group was matched only for the hospital at which the midwife had privileges. The researchers reported the rate of perinatal death (number of stillbirths or neonatal deaths in the first 7 d per 1000 births). The rate was low and comparable in all 3 groups. There was one death in the home birth group (0.35 per 1000) vs. 3 in each of the comparison groups (0.57 per 1000 in midwife-attended hospital births and 0.64 per 1000 in physician-attended hospital births.) The researchers did not report causes of death. No deaths occurred between 8-28 d postpartum in any of the groups. Researchers performed subgroup analyses excluding women with prior cesarean, limiting to women with spontaneous labor onset, and confining evaluation to those births occurring at home; in no case did the analysis change the findings or conclusions. The sole perinatal death in the home birth group did not occur at home but after hospital transport.

An earlier prospective study conducted by the same research team compared 862 planned home births, 571 planned midwife-attended hospital births, and 743 physician-attended hospital births.[32] Inclusion and exclusion criteria and matching procedures were the same as those used in the larger retrospective study. This study was conducted in the two years immediately following regulation of midwifery in the province, which might indicate that either the obstetric climate, the preparation of the midwives, or both were sub-optimal. Among babies who did not have congenital anomalies, three cases of perinatal death occurred in the home birth group (2 stillbirths and 1 neonatal death) compared with one death in the physician comparison group and no deaths in the midwife comparison group. In two of the three deaths in the home birth group, evidence suggested that the insult or death occurred prior to the onset of labor, but insufficient information is provided to confirm this. The relative risk of perinatal death comparing midwife-attended home birth with physician-attended hospital birth was 2.5, which was not statistically significant, although the confidence interval was wide, which means a statistically significant difference might have been found with a much bigger population.

Another Canadian study, this one conducted in Ontario, retrospectively analyzed outcomes of births in all women intending home birth at the onset of labor over a three-year period.[29] Data came from a Ministry of Health database to which midwives were obliged to provide information on each birth. Women who were "undecided" were included in the planned home birth group. The hospital birth cohort was derived from the same database and included women cared for by midwives and planning hospital births, excluding those with > 1 previous cesarean, breech presentation, multiple pregnancy, preterm delivery, oxytocin induction, prostaglandin cervical ripening, or antenatal transfer. The groups were

matched for parity and previous cesarean. There were 6692 births in each group. Three intrapartum stillbirths occurred among babies without anomalies in the home birth group vs. four in the hospital group. Six normally formed babies in the home birth group vs. two in the hospital group died in the first 28 d. One additional death occurred in the hospital birth group between d 28-42 vs. none in the home birth group. Circumstances of the deaths were not described.

Composite neonatal mortality and morbidity

Two studies compared the likelihood of any mortality or serious morbidity between planned home and planned hospital births.[10, 29] Combining mortality and serious morbidity into a composite variable increases the power of the study to detect statistically significant differences. In a large prospective cohort study in England, the composite variable included stillbirth after start of care in labor, early neonatal death, neonatal encephalopathy, meconium aspiration syndrome, brachial plexus injury, fractured humerus, or fractured clavicle.[10] Babies with congenital anomalies were included but the researchers did not provide information about the incidence of anomalies in each group or among the babies experiencing morbidity or mortality. Vaginal breech births were also included and incidence was significantly higher in the planned home birth group (0.4 % vs. 0.2%), but again the researchers provide no data about the contribution of breech births to neonatal outcomes. Overall, rates were similar between the planned home birth group (70/16,553, 4.2 per 1000 births) and the group that had planned, midwife-attended birth in traditional hospital maternity units (81/19,551, 4.4 per 1000), after adjusting for obstetric and sociodemographic factors. However, after excluding women who had complicating conditions at the start of labor, outcomes favored the planned hospital group (4.0 per 1000 home vs. 3.1 per 1000 hospital). In addition, more women in the home birth group were nulliparous, and among these women there was a significant excess of serious perinatal morbidity or mortality in the home birth group (9.5 per 1000 vs. 5.3 per 1000). There were no differences in the composite outcome in multiparous whether women with complicating conditions were included or excluded. In the mixed-parity group of women with no complicating conditions at the start of labor, the rate of intrapartum stillbirths plus early neonatal deaths was higher in the home birth group (0.7 per 1000 vs. 0.4 per 1000) and the rate of encephalopathy was slightly lower (2.1 vs. 2.3 per 1000), but the researchers did not calculate statistical significance of these differences.

In a retrospective study in Ontario, the composite variable combined all cases of intrapartum stillbirth or neonatal death from 0-27 d, Apgar score < 4 at 5 min, neonatal resuscitation requiring both positive pressure ventilation and cardiac compressions, admission to intensive care with length of stay > 4 d, or birth weight < 2500 g. Low birth weight was included on the basis that failure to screen for extremes of birth weight could result in planning an inappropriate place for birth. The study included 6692 women in each group, with both cohorts receiving midwifery care. Rates of any mortality or serious morbidity were similar (2.4% home birth vs. 2.8% hospital). The researchers conducted several sensitivity analyses to test whether inconsistencies in the database obscured differences. Findings remained unchanged.

Neonatal intensive care admission

The Dutch population-based study of 529,688 women in primary midwife-led care at the onset of labor reported no difference in the likelihood of newborns being admitted to neonatal intensive care after birth (1.7 per 1000 home birth vs. 2 per 1000 hospital), after adjusting for parity, gestational age, maternal age, ethnic background, and socio-economic status.[16]

The retrospective study of 6692 matched pairs in Ontario reported the likelihood of neonatal intensive care stay > 4 days.[29] Rates were similar in both groups (1.5% home vs. 1.7% hospital), but statistical significance was not reported.

Neonatal resuscitation

In the retrospective cohort study of 12,982 births in British Columbia, the likelihood of neonatal resuscitation involving positive pressure ventilation via endotracheal tube, chest compressions, or medications was 6.6 per 10,000 in the home birth group, 11 per 10,000 in the midwife/hospital group, and 27 per 10,000 in the physician/hospital group.[33] The difference between the home birth group and both of the hospital groups was statistically significant. Almost all of the excess was among babies receiving medications for resuscitation, which may have resulted from higher rates of opioid analgesia use in the hospital groups. Women who planned a home birth were also less likely to have a newborn requiring oxygen therapy beyond 24 h vs. women who planned midwife-attended hospital births (RR 0.37) and women who planned physician-attended hospital births (RR 0.4).

The earlier prospective study in the same region using the same inclusion and exclusion criteria had somewhat different results.[32] Five babies in the home birth group, including the one baby who died in the neonatal period, required > 24 h of assisted ventilation. No babies required prolonged ventilatory support in either of the two hospital comparison groups. Although the difference was not statistically significant between the home birth group and either hospital group, the findings raised concern about the management of babies with meconium-stained amniotic fluid. Two of the five babies had meconium aspiration syndrome, and researchers found evidence that tracheal suctioning in depressed infants with meconium stained amniotic fluid was less common in the home birth group. (See Meconium in mini-review 2.) The fact that prolonged ventilation was less common in the subsequent retrospective study could be attributable to changes in midwifery management of labors complicated by meconium-stained amniotic fluid in light of the earlier study's findings.[33] The prospective study found no differences across groups in the likelihood of positive pressure ventilation, chest compressions, or babies receiving oxygen for > 24 h. The researchers did find that babies born in the physician-attended hospital group were much more likely to receive drugs for resuscitation than babies in either midwife group (2.7% vs. 0.5% in both midwife groups), possibly because of the excess use of narcotics in labor (35% vs. 3% in midwife/home and 13% midwife/hospital), which may have caused respiratory depression in some newborns.

A third Canadian study reported the rate of positive pressure ventilation and cardiac compressions in similar cohorts of 6692 planned home births and 6692 planned hospital births.[29] Rates were identical (0.3% in both groups). A retrospective study in Western Australia that enrolled all women booked prenatally for a home birth in the region between 1981 and 1987 matched each planned woman with three Caucasian women planning hospital births of singleton babies.[56] Women were matched for year of birth, parity, previous stillbirth

or death of a liveborn child, maternal age, maternal height, marital status, and postcode. Women in the home birth group who transferred or changed their preference before the onset of labor remained in the home birth group for analysis, as did all intrapartum transfers. Researchers reported that resuscitation with methods beyond suctioning and administration of oxygen occurred less often in planned home births (1.1% vs. 7.1%, adjusted OR 0.2).

Birth Injury

One of the Canadian studies, the retrospective study comparing 2889 planned home births with 4752 planned midwife-attended hospital births and 5331 planned physician-attended hospital births, reported birth injury rates.[33] Birth injury (defined as subdural or cerebral hemorrhage, fracture of the clavicle, long bones or skull, facial nerve injury, Erb's Palsy, or unspecified birth trauma) was less common in the home birth group (0.2%) compared with the midwife/hospital group (0.7%, RR 0.3) and the physician/hospital group (0.9%, RR 0.3).

Birth injury was also reported less frequently in the home birth group in the retrospective analysis of 976 planned home births and 2928 matched hospital births in Western Australia (2.3% vs. 7%).[56] After adjusting for birth weight and gestational age, the odds ratio was 0.3. Most cases of trauma were scalp injuries; however, one hospital-group infant with obstetric trauma died of it. The authors provided no other information about how birth injury was defined.

A Dutch prospective cohort study reported outcomes from low-risk women planning home (n = 1140) or hospital (n = 696) births with 54 midwifery practices in one province from 1990-1993.[55] Data were gleaned from voluntary birth notification forms and questionnaires completed by the midwives and participating women. Outcomes were reported by parity. Although no adjustments were made for differences between groups, both groups were eligible for planned home birth when they booked for midwifery care. Birth trauma rates were similar between planned home and planned hospital birth in both nulliparous (0.6% home vs. 0.5% hospital) and multiparous women (0.6% home vs. 0.9% hospital).

2. Data on the safety of planned home birth in the presence of specific risk factors is scarce, although what is available suggests disproportionate mortality occurs in planned home births of twins, breech babies, and pre-term and post-term infants and when meconium is present in the amniotic fluid; planned home birth after cesarean was not associated with mortality in available studies, but these studies are too small to determine safety.

Note: We have allowed descriptive studies without control groups for this review.

Most data on the safety of planned home birth come from women with no risk factors for adverse outcomes. Little is known about the safety of planned home birth in the presence of risk factors such as prior cesarean surgery, breech presentation, twins, preterm or postterm birth, or meconium-stained amniotic fluid. We will summarize the available evidence, but we must emphasize that we cannot make any judgment on the comparative safety of home vs. hospital birth in the presence of these risk factors either because data reporting did not

permit comparison or, more commonly, hospital comparison groups excluded women with the same risk factors.

Vaginal birth after cesarean (VBAC): Outcomes from 57 women with prior cesarean were reported in a prospective study of planned home birth with certified nurse-midwives in the U.S.[37] All but four of the women had also had prior vaginal births. There was one intrapartum fetal death of a baby born at 42 w with meconium-stained amniotic fluid. Another baby was transferred to the hospital after birth for respiratory problems and later discharged in good condition. There were no serious maternal complications, and all but four (93%) women had spontaneous vaginal births. Three women had repeat cesarean surgery and the remaining woman had a vacuum-assisted delivery for fetal indications. There were no cases of uterine scar rupture. No other study reports outcomes specific to women with prior cesarean surgery. However, none of the deaths reported in any study we include that gives details of perinatal deaths attributed the death to uterine scar rupture or indicated that the mother had a prior cesarean. Two Canadian studies involving a combined 111 women with prior cesarean planning home birth reported no cases of uterine scar rupture.[32, 33]

Breech presentation: Four studies report outcomes of planned breech home births and all suggest that breech presentation significantly increases the risk of perinatal death in a planned home birth compared with planned home birth with a vertex fetus. No study compares mortality or morbidity in breech birth between planned home and planned hospital birth, although the Term Breech Trial reported an intrapartum plus neonatal mortality rate of 13 per 1000 in the vaginal birth group, which can be used as a benchmark of a theoretically achievable rate in hospitals.[26] A 2009 study comparing outcomes in women cared for by National Health Service (NHS) midwives with those cared for by independent midwives reports outcomes by planned place of birth in the independent midwife group only.[49] Between 2002 and 2005, national database records identified 1462 women booked for care with an independent midwife, of whom 1275 intended to give birth at home. Of the entire cohort, 64 women had breech births. We do not know what proportion of these intended to give birth at home. Of the 64 singleton breech babies, three died at home and one died after intrapartum transfer to the hospital and cesarean delivery. Additional deaths occurred among breech second twins. (See Twins.) Assuming that all 64 women carrying breech babies intended home birth, the mortality rate in singleton breech planned home births was 63 per 1000. A prospective study of all 5418 births intended to take place at home with certified professional midwives in the U.S. in 2000 included 80 women carrying breech births and planning home births at the onset of labor.[34] These resulted in two deaths, both of which occurred during labor, yielding an intrapartum and neonatal mortality rate in planned home breech births of 25 per 1000. An earlier U.S. study compared midwife-attended home births with physician-attended home births.[42] Births occurring at the hospital after antepartum or intrapartum transfer from a planned home birth were not included. Although the study was published in 1997, births occurred between 1969 and 1985. As the physicians did not attend planned breech births at home, we will limit reporting to the group of 1000 midwife-attended births, 29 of which were breech. Data were obtained retrospectively by direct or indirect chart audit. Of the 29 breech births, one had died prior to labor, three died in labor, and four died in the neonatal period. Excluding the antepartum demise, this yields an intrapartum and newborn mortality rate of 241 per 1000. An Australian study reports outcomes in all planned home births nationwide from

1985-1990.[8] Researchers identified 7002 planned home births from a national database and by querying home birth practitioners and support groups and investigated the cause of death for all intrapartum and neonatal deaths. Twenty-six deaths resulted from intrapartum asphyxia, and of these, four were known to be breech. The authors did not report the number of breech births occurring in the study, so we cannot determine a mortality rate, but it is clear that asphyxial deaths were disproportionately common in breech births compared with vertex births.

Twins: Perinatal mortality appears to be higher in planned twin home births compared with singleton home birth, but again, we do not have a comparison hospital group. A meta-analysis of four studies of planned birth route in twin pregnancies ≥ 32 w reported one death among 1208 infants born in the planned vaginal birth group, providing a benchmark for an achievable rate of perinatal mortality in twin births of < 1 per 1000.[27] The same four home birth studies that reported breech outcomes reported outcomes for twin births. In the U.K. study of women booked for care with independent midwives, there were 50 women expecting twins.[49] It is unclear how many of these intended home births. There were five deaths: one was preterm and breech and born at home, two were breech and born at home, one was breech and born after intrapartum transfer to the hospital, and one was vertex and born at home. This yields an intrapartum and neonatal mortality rate of approximately 50 per 1000. In the U.S. study of planned home birth with certified-professional midwives, there were no deaths among the 13 sets of twins.[34] In the earlier U.S. study of 1000 midwife-attended home births, nearly half of the twins born at home died.[42] Of eight sets of twins, one baby died before labor, four babies died in labor, and three babies died in the neonatal period. Excluding the fetal demise, this results in a mortality rate 438/1000. In the Australian study of 7002 planned home births, twins accounted for two of the 23 deaths related to intrapartum asphyxia.[8] Both were born preterm. The researchers do not specify how many women were carrying twins, so we cannot calculate a mortality rate.

Preterm (< 37 w) birth: When a woman books for prenatal care with the intention to give birth at home but goes to a hospital when preterm labor is diagnosed, this may be counted as either an antepartum or intrapartum transfer by researchers, complicating our analysis. We have limited our analysis to those studies that count preterm births in which the woman intends to give birth at home even after she recognizes that she is in preterm labor. A transfer to this hospital in this instance would be a true intrapartum transfer. Only one study reports the number of preterm births in this manner.[34] The U.S. study of planned home births with certified professional midwives reported no deaths among 77 babies born preterm. Other neonatal outcomes and rates of transfer were not reported by gestational age. Another study does not report the number of preterm births but does report deaths occurring in preterm babies.[8] In an Australian study of 7002 planned home births, one preterm singleton baby and two preterm twins (already mentioned above) were among the 23 babies whose deaths were attributed to intrapartum asphyxia. The researchers do not specify how many preterm births occurred in the sample, so we cannot calculate a mortality rate.

Postterm (≥ 42 w) birth: Five studies report outcomes in planned home births occurring at ≥ 42 w, two of which also report the proportion of study participants who remained pregnant at 42 w. None of the studies reported postterm-specific mortality in the hospital birth group, but a study of 76,761 pregnancies in Sweden reported stillbirth or neonatal mortality in 3.3 per 1000 first births and 1.6 per 1000 subsequent births, providing a benchmark rate

for hospital births.[30] In the large U.S. study of planned home birth with certified professional midwives, 361 births occurred at or beyond 42 w, resulting in one intrapartum and one neonatal death.[34] The combined intrapartum and neonatal mortality rate in post-term pregnancies was 5.5 per 1000. An earlier U.S. study reported outcomes of 1000 midwife-attended home births.[42] Births occurring at the hospital after antepartum or intrapartum transfer from a planned home birth were not included. Of the 26 post-term births, two had died prior to labor, three died in labor and one died in the neonatal period. Excluding the antepartum deaths, this yields an intrapartum and newborn mortality rate of 167 per 1000. Three studies report deaths among babies born ≥ 42 w but do not report the total number of post-term births, preventing us from calculating a mortality rate. Still, these data suggest that mortality is disproportionately more common in planned home births that occur postterm. A prospective descriptive study of 1221 planned home births with certified nurse-midwives in the U.S. reported two intrapartum fetal deaths in normally formed babies, both of which occurred in pregnancies ≥ 42 w with meconium-stained amniotic fluid.[45] There were three additional neonatal deaths in term babies. The study also reported on women who originally booked for a home birth but transferred before the onset of labor. All five women who transferred before labor for management postterm pregnancy gave birth to babies in good condition. An earlier retrospective study of 11,788 planned home births with certified nurse-midwives in the U.S. reported eight intrapartum fetal deaths in normally formed babies, two of which occurred in post-term babies.[6] There were five neonatal deaths of normally formed infants, all occurring in term babies. Finally, in an Australian study of 7002 planned home births, six of 23 perinatal deaths attributed to intrapartum asphyxia occurred in babies born ≥ 42 w.[8]

Meconium: A recent controlled study provides the only opportunity to compare outcomes in labors complicated by meconium-stained amniotic fluid between planned home and planned hospital births.[32] The prospective cohort study included all 862 women registered for planned home birth by 36 w and meeting eligibility criteria at the onset of labor over a 2-y period (1998-1999). Outcomes were compared with two comparison groups: 743 similar women planning physician-attended hospital births and 571 similar women planning midwife-attended hospital births. The likelihood of thick meconium was similar across the three groups (6% midwife/home and physician/hospital groups; 8% midwife/hospital group) as was the likelihood of meconium aspiration syndrome (0.2% in midwife/home vs. 0.4% physician/hospital vs. 0.8% midwife/hospital), but babies born at home were more likely to require > 24 h of assisted ventilation (0.8% vs. 0% in both hospital groups). Both of the babies born with meconium aspiration syndrome at home were among those requiring prolonged ventilatory support while none of the three babies born in the hospital with meconium aspiration syndrome required prolonged assisted ventilation. The researchers note, "Of the babies who were exposed to thick meconium and whose Apgar score at 1 min was < 7, 45% in the home birth group received tracheal suction compared with 75% in each comparison group. Babies exposed to thick meconium who are not vigorous at birth may be disadvantaged in the home birth group, particularly in view of the trend toward increased need for assisted ventilation in this group" (p. 322).[32]

Observational data offer additional evidence that meconium-stained amniotic fluid may be associated with excess mortality and serious morbidity in planned home births, although the absolute risk is still low. A retrospective study of 11,081 planned home births reported meconium-stained amniotic fluid in 116 (1%).[6] Meconium aspiration syndrome was

diagnosed in six, one of whom died and two of whom survived with cerebral palsy. A subsequent prospective study of 1221 women found much higher rates of meconium-stained amniotic fluid.[45] Meconium was present in 17% of laboring women (n = 202), including 5% (n = 57) in which the consistency of the meconium was moderate or thick. Meconium was present in both of the cases of intrapartum fetal death (one of which occurred hours after transfer to the hospital for abnormal fetal heart rate) and in one case of neonatal death. The intrapartum and perinatal mortality rate among planned home births complicated by meconium-stained amniotic fluid was thus 15 per 1000. The researchers did not report cases of meconium aspiration syndrome but noted that all three babies born after intrapartum transfer for meconium-stained amniotic fluid and all newborns transferred for respiratory problems (not necessarily meconium aspiration) were in good condition by one month. In a retrospective study of 7002 planned home births in Australia, meconium-stained amniotic fluid was present in 13 of 23 deaths attributed to intrapartum asphyxia and in 2 of 3 deaths attributed to shoulder dystocia.[8] The researchers did not report the proportion of labors in which meconium-stained amniotic fluid was present, nor whether abnormal fetal heart rate patterns were also present, but the study authors do note that "in seven cases, meconium or bradycardia, or both, were noted several hours before fetal death" (p. 386).[8]

3. Compared with planned home birth, planned hospital birth decreases the likelihood of spontaneous vaginal birth in healthy women.

A large prospective cohort study of nearly 65,000 midwife-attended births in England compared mode of birth in two hospital cohorts (traditional obstetrical unit and midwife-led unit), a freestanding birth center cohort (see chapter 20) and a planned home birth cohort.[10] Differences were reported with the traditional obstetrical unit as the reference, so significance of observed differences between the planned home birth group and the midwife-led unit cohort are not reported. Spontaneous vaginal birth was significantly higher in the planned home birth group compared with the planned hospital group (93% vs. 74%) after adjusting for baseline differences in obstetrical and sociodemographic factors. Instrumental vaginal delivery (15% vs. 4%) and cesarean section (11% vs. 3%) were significantly higher in the obstetrical unit compared with home birth. All differences were significant in nulliparous and multiparous subgroups and after excluding women with complicating conditions at the start of labor.

Two studies by the same team of researchers in British Columbia compare outcomes among women planning home birth with midwives, women planning hospital birth with midwives, and women planning hospital birth with physicians.[32,33] The studies' methods are described in mini-review 1. In the earlier of the two studies,[32] after adjusting for confounding factors, women in the home birth group were more likely to have spontaneous vaginal births (90% home vs. 76% midwife/hospital vs. 68% physician/hospital). Instrumental vaginal delivery was less common in the home birth group (3% home vs. 12% midwife/hospital vs. 13% physician/hospital) as was cesarean surgery (6% vs. 12% and 18%, respectively). Cesarean use in physician-attended hospital births was higher than in planned home birth in all subgroups (nulliparous, multiparous without prior cesarean, and multiparous with prior cesarean) and for the four most common indications: dystocia or "cephalo-pelvic disproportion" (CPD), fetal distress, repeat cesarean, and fetal malposition or malpresentation. Compared with midwife-attended hospital births, cesarean was used less in the home

birth group only among multiparous women and for only one indication: dystocia/CPD. Results of the subsequent study were similar with spontaneous vaginal birth rate highest in the home birth group (90% home vs. 82% midwife/hospital vs. 75% physicians/hospital).[33] Instrumental vaginal delivery rate was lower in the planned home birth group (3% vs. 7% midwife/hospital and 14% physician/hospital) as was the overall cesarean rate (7% vs. 11% in both comparison groups) and the cesarean rate in nulliparous women (13% vs. 19% and 22%, respectively). Use of cesarean for dystocia and nonreassuring fetal heart rate was less common in the home birth group compared with both comparison groups.

A third Canadian study, a retrospective analysis conducted in Ontario, likewise compared planned midwife-attended home birth with planned midwife-attended hospital births but did not include a physician-attended hospital birth arm.[29] Study methods are described in mini-review 1. The home birth group was less likely to have instrumental vaginal delivery (2.9% vs. 4.4%, RR 0.7) or cesarean surgery (5% vs. 8%, RR 0.6).

The Birthplace in England Study (2011) reported much higher rates of spontaneous vaginal birth in the home birth group (93% vs. 74% in the traditional hospital unit and 86% in the midwife-led unit).[10] Differences were significant after controlling for socioeconomic and obstetrical factors, and in nulliparous and multiparous subgroups after excluding women with complicating conditions at the start of labor. Rates of vacuum- and forceps-assisted vaginal delivery and intrapartum cesarean were also reported. After controlling for socioeconomic and obstetrical factors, all three modes of operative delivery were significantly higher in the traditional hospital unit vs. freestanding birth centers in the main analysis (8% vs. 3% vacuum, 7% vs. 3% forceps, 11% vs. 4% cesarean.) Rates in the midwife-led hospital unit fell between those of traditional hospital units and freestanding birth centers. In the subset analyses, differences between freestanding birth centers and the traditional hospital units remained significant for nulliparous and multiparous women and after excluding women with complicating conditions at the start of labor.

Two Dutch studies report rates of modes of birth. One is a prospective cohort study of 608 women enrolling for prenatal care with 25 midwifery practices, all of which offered women a choice of planned home or hospital birth.[52] Midwives in each practice were instructed to invite 25 consecutive women to participate. Eligible women were healthy women who met national Dutch criteria for home birth and were 20-24 w pregnant at the time of enrollment. Women self-selected to planned home (n = 425) or planned hospital birth (n = 183). Researchers administered a prenatal survey to measure attitudes toward medical technology and conducted chart review to obtain labor and birth data. No adjustments were made for confounding factors, but the only significant difference measured was age, with home birth women more likely to be 25-29 (39% vs. 26%). All data were analyzed separately for nulliparous and multiparous women. Multiparous women planning hospital births were significantly more likely to have either cesarean surgery (7% vs. 1%) or instrumental vaginal delivery (7% vs. 2%) than multiparous women planning home births. No differences were found among nulliparous women. The other Dutch study, a prospective study of low-risk women planning home (n = 1140) or hospital (n = 696) births with 54 midwifery practices, reported similar instrumental vaginal delivery and cesarean surgery rates in both nulliparous and multiparous women.[55] Researchers did not report statistical significance for spontaneous vaginal birth rates, but the rates can be calculated and appear to favor home birth in nulliparous women (17% vs. 20%).

Five additional studies found significantly higher spontaneous vaginal birth rates with planned home birth, but each suffers from significant flaws or limitations, including small sample sizes, poorly constructed comparison groups, and reliance on birth certificate data.[1, 21, 34, 38, 56] Instrumental vaginal delivery rates in the home birth groups ranged from 1.6% to 6% vs. 7.4% to 27% in the hospital groups. Rates of cesarean surgery ranged from 1.5% to 6% in the home birth groups vs. 7% to 23% in the hospital groups.

4. Severe maternal morbidity is rare in low risk women regardless of planned place of birth, but controlled studies suggest outcomes favor planned home birth. Studies provide surprisingly little data on adverse maternal outcomes other than operative delivery and genital tract trauma, both of which are significantly more common in women having planned hospital births. (See mini-reviews 3 and 5.) Other adverse maternal outcomes of interest include need for intensive care, severe excess blood loss, manual removal of the placenta, infection, and maternal death.

Only one study reports rates of maternal intensive care admission. The Birthplace in England Study (2011), a prospective cohort study of nearly 65,000 women in midwifery care, found similar rates between planned home and planned hospital births (0.4% home; 0.6-0.7% hospital).[10]

Consistent with other chapters in this book, we have restricted our analysis of severe excess blood loss to studies reporting blood loss > 1000 mL or leading to blood transfusion or hysterectomy. Five studies report rates of one or more of these outcomes. The Birthplace in England Study reported a lower blood transfusion rate in the home birth group (0.6%) than in either hospital group (1.2% in the traditional unit and 0.9% in the midwife-led unit), although the difference was only significant in multiparous women (0.4% vs. 0.7% in the traditional unit).[10] A prospective cohort study in British Columbia of 862 women planning midwife-attended home births, 571 planning midwife-attended hospital births, and 743 planning physician-attended hospital births found no difference in the likelihood of severe excess blood loss across groups (4.4% midwife/home vs. 5.3% midwife/hospital vs. 4.8% physician/hospital).[32] The study found no difference in the rate of blood transfusion, but the study authors noted that three of the four cases occurred in the home birth group. However, a much larger retrospective study conducted subsequently in the same region found that women in the planned home birth group were significantly less likely than those in either hospital group to experience > 1000 mL of blood loss (4% home/midwife vs. 7% hospital/physician (RR 0.6) and 6% hospital/midwife (RR 0.6).[33] Both studies captured all planned home births during the study periods, limited control groups to low-risk women without a documented contraindication to planned home birth, and matched the physician (but not the midwife) hospital cohort with the planned home birth group on multiple variables. A third Canadian study compared 6692 women planning midwife-attended home births with a matched group of 6692 low-risk women planning midwife-attended hospital births and found lower rates of blood loss > 1000 mL in the planned home birth group (0.8% vs. 1.2%, RR 0.7).[29] Consultation with or referral to an obstetrician for management of postpartum hemorrhage was also less frequent in the home birth group (1.2% vs. 1.6%, RR 0.8). The study did not report rates of blood transfusion or hysterectomy. A Dutch prospective cohort study of 1140 women planning home births and 696 home birth-eligible women planning hospital births reported lower rates of blood loss > 1000 mL with

home birth in both nulliparous (1.9% vs. 4.1%) and multiparous (0.6% vs. 3.7%) women, although the difference was only significant in the multiparous group.[55] Blood transfusion was also less common among multiparous women in the home birth group (0 vs. 1.8%).

Manual removal of the placenta was reported in the two British Columbia studies.[32, 33] The prospective study found no difference across groups (1.2% home/midwife vs. 1.5% hospital/physician vs. 1.2% hospital/midwife) while in the retrospective study, manual removal was least frequent in the midwife-attended home birth group (1% home vs. 1.7% hospital/physician vs. 1.8% hospital/midwife), but the researchers failed to report statistical significance for this outcome.

Maternal infection is poorly defined and inadequately reported in most studies, although there is no reason that case ascertainment would be different in planned home or hospital birth. The prospective study conducted in British Columbia combined intrapartum and postpartum infection, defining infection as "unexplained maternal pyrexia during labour with temperature greater than 38 degrees C on at least two occasions six hours apart, urinary tract infection on admission for the birth, major puerperal infection, or wound infection documented in the chart" (p. 320).[32] Rates were lower in the planned home birth group (0.7%) compared with both the midwife-attended hospital group (3.2%, adjusted OR 0.3) and the physician-attended hospital group (3.0%, adjusted OR 0.2). The subsequent retrospective study reported rates of urinary tract infection, wound infection, and puerperal infection.[33] Rates for each individual type of infection were consistently lowest in the home birth group, and when the three types of infection were combined for statistical analysis, the rate was significantly lower in the home birth group (0.03%) compared with the physician-attended hospital birth group (1.2%, RR 0.3) but not the midwife-attended hospital group (0.5%), probably because the study was underpowered to detect it. In the Dutch prospective study of 1140 planned home births and 696 planned hospital births, rates of mastitis, endometritis, and cystitis (bladder infection) were low in both groups and did not differ by planned place of birth.[55]

None of the studies was large enough to compare maternal death, an extremely rare outcome in low-risk women. The largest descriptive study of planned home birth, a Dutch database analysis of 280,097 births to women in midwife-led primary care at the onset of labor, 62% of whom intended to give birth at home, found no cases in either the planned home or planned hospital group. No other study among any of our included or excluded studies reported a maternal death with one exception: A New Zealand study of 9776 planned home births reported one maternal death in a woman who had an uncomplicated vaginal delivery with episiotomy at home in 1986.[25] She died of streptococcal puerperal sepsis on day seven. She had normal blood cultures, urine culture, and blood count on day four.

5. Compared with planned hospital birth, planned home birth decreases both the likelihood and severity of genital tract trauma.

Five good quality studies[10, 29, 32, 33, 55] and four moderate or poor quality studies[1, 34, 38, 52] compare episiotomy rates between planned home and planned hospital birth. Results highly favor planned home birth in all but two of the studies, both of them Dutch studies in which episiotomy rates were high in all groups and differences were significant among multiparous women only.[52, 55] Episiotomy rates were 5% or less home birth groups in six of the

remaining studies with hospital groups ranging from 6% to 33% in the hospital cohorts (6-19% when we restrict the analysis to high quality studies). One study, a matched-pairs study conducted in Switzerland from 1989 to 1992, is an outlier, with episiotomy occurring in 26% of vaginal births in the home birth group vs. 74% in the hospital.[1]

Rates of anal sphincter laceration were reported in seven studies,[1, 10, 32, 33, 38, 55, 56] ranging from 0.2% to 2.2% in the home birth groups vs. 0.4% to 4.6% in the hospital groups. In six of the seven studies, the rate was lower in the planned home birth group, however the difference was only significant in three studies.[32, 33, 38]

6. When urgent complications occur, they are almost always managed safely in the home or result in a transfer of care with a favorable outcome.

> **Note:** We have allowed descriptive studies without control groups for this mini-review.

The most detailed reporting of urgent complications in planned home births comes from three studies: a prospective descriptive analysis of 1404 U.S. planned home births,[45] a retrospective descriptive analysis of 11,081 U.S. planned home births,[6] and a retrospective cohort study of 976 planned home births in Western Australia.[57] The U.S. researchers provided details of all urgent intrapartum and postpartum/newborn transfers. Beginning with the prospective study, among 13 transfers for fetal distress, 12 babies were born in good condition and one had stable heart-tones when the woman was admitted to the hospital but was stillborn after several more hours of labor.[45] Among two cases of intrapartum bleeding (a sign of possible placental abruption) and one case of cord prolapse, all babies were born in good condition. The three women transferred for retained placenta were all discharged home after placenta delivery, and all three women transferred for postpartum blood loss were discharged home on day three "all well" (p. 465), which presumably indicates that none had a hysterectomy. All babies transferred alive in the neonatal period had recovered by one month or sooner. In the retrospective study, urgent transfer occurred in 1% of planned home births.[6] These included 60 intrapartum transfers for fetal distress resulting in three stillbirths (two of which occurred in babies with absent heart tones at the first labor assessment and the third occurring despite rapid transport and immediate cesarean surgery after admission to the hospital), one neonatal death, and three instances of low Apgar score (not defined). No deaths occurred among eight babies with cord prolapse; one stillbirth occurred in the two instances of placental abruption; and one death occurred in 12 babies born at home with meconium aspiration. There were no maternal deaths despite 41 cases of severe excess blood loss requiring transport to the hospital. The Australian study included 976 women who booked antenatally for a home birth, 778 of whom gave birth at home.[57] Researchers reported 52 cases of fetal distress, of which 34 were born in the hospital after intrapartum transfer. All but 5 of the 52 babies had 5-min Apgar scores > 7. Of those with 5-min Apgar scores ≤ 7, two had Apgar scores = 7, two died from lethal malformations, and one died of Listeria infection. In addition, 5-min Apgar scores were > 7 in all six cases of shoulder dystocia (five of which occurred at home)

and in the one case of cord prolapse that occurred after transfer to the hospital. Of the 778 women who gave birth at home, 16 had blood loss > 1000 mL, 8 requiring transfer to hospital. Two of these were for retained placenta without bleeding (in other words, the hemorrhage occurred at the hospital) and 6 for management of hemorrhage. The authors do not specify whether any of these women required a blood transfusion or hysterectomy. There were no maternal deaths.

A much larger and more recent study conducted in the Netherlands corroborates evidence that catastrophic outcomes are rare even in the presence of serious complications. Researchers used national database records to perform a retrospective analysis of 280,097 births in which the women were in the exclusive care of a primary-care midwife at the onset of labor.[1] In the Dutch system, any woman eligible for midwifery care may self-select to planned home or planned hospital birth, and in this cohort 62% intended to give birth at home at the onset of labor. The Dutch birth database categorizes all referrals to secondary (obstetrician) care by urgency level. Urgent referrals ("category 1") were referrals occurring during or after birth in which any of the following was listed among indications for referral: fetal distress, placental problems, abnormal presentation with ruptured membranes, postpartum hemorrhage > 1000 mL, intrapartum fetal death, 5-min Apgar score < 7, respiratory problems including meconium aspiration, or congenital malformations with need for immediate care. The percentage of urgent referrals was larger in the intended hospital group (4.1%) than in the intended home group (3.4%), with an overall urgent transfer rate of 3.6% (n = 9985). Among these, the average 5-min Apgar score was 9, indicating that most babies were in excellent condition. In fact, only 5.3% of those urgently referred had babies with 5-min Apgar score < 7. In addition, among those having urgent transfers, 1.1% had an intrapartum fetal demise or neonatal death, and 13% of newborns required assessment by a pediatrician after urgent referral. Unfortunately, the data are not reported such that we can evaluate outcomes of urgent referrals only among planned home births.

7. Planned home birth is associated with very low rates of obstetrical interventions compared with planned hospital birth in similar women.

> **Note:** Even among studies with robust methods for determining hospital-based controls, it is likely that women who self-select to home birth differ from women who self-select to hospital birth in ways that would influence the likelihood of obstetrical interventions. These differences may include subtle differences in health status as well as differences in attitudes about birth and technology. However, the magnitude of the differences noted suggests that not all of the difference is attributable to these variations.

Induction of labor: Three studies enrolled women prenatally and reported rates of pharmacologic induction. The most recent, a prospective study of 625 women receiving primary maternity care with Dutch midwives, enrolled women at 20-24 w of pregnancy.[52] Seventy percent of women self-selected to home birth, and, based on prenatal surveys, these women demonstrated a greater affinity for non-technological approaches to care than women who

self-selected to give birth at the hospital. Whether the woman planned a home or hospital birth with the midwife, pharmacologic induction required referral to an obstetrician. Among nulliparous women, 18% in the hospital group vs. 12% in the home group were referred for induction, a difference that did not achieve statistical significance. Among multiparous women, the difference was also nonsignificant (6% vs. 7%). In contrast, two studies comparing planned home birth with midwives vs. planned hospital birth with physicians found large statistically significant differences favoring planned home birth. A Swiss matched-pairs study (n = 214 pairs) reported pharmacologic induction in 3% of planned home births and 17% of planned hospital births (OR 0.2),[1] while a cohort study of 976 planned home births and 2928 planned hospital births in Western Australia reported induced labor in 2% of planned home births vs. 26% of planned hospital births (adjusted OR 0.05).[56]

Oxytocin augmentation: Five studies compare rates of oxytocin augmentation between midwife-attended planned home births and midwife-attended planned hospital births. Two of these studies also include a physician-attended hospital cohort. Two studies reported rates separately for nulliparous and multiparous women. The smaller of the two and found no difference between midwife-attended home and hospital births in either group.[52] The larger reported significantly lower rates with planned home birth in both nulliparous and parous women when compared to midwife-attended births in the physician-led maternity unit (17% vs. 35% nulliparous; 1% vs. 10% multiparous) but rates in the midwife-led hospital unit were similar to the home birth groups (18% nulliparous; 2% multiparous).[10] The remaining three studies comparing midwife-attended home birth and midwife-attended hospital birth found differences favoring planned home birth.[29, 32, 33] Rates of oxytocin augmentation in the home birth groups ranged from 6% to 9% compared with 13% to 19% in the midwife attended hospital groups. Absolute differences ranged from 5% to 13%. The two studies that also reported augmentation rates in matched samples of physician-attended hospital births reported rates of 17% to 18%.[32] Absolute differences between the home birth group and the physician-attended hospital group were 10% and 13%.[32, 33]

Amniotomy: Three studies compared amniotomy rates between midwife-attended planned home births and midwife-attended planned hospital births.[29, 32, 33] Two also included low-risk physician-attended births.[32, 33] Amniotomy was performed in 16-22% of planned home births and 27-32% of planned midwife-attended hospital births, absolute differences ranging from 6% to 13%. Rates in physician-attended hospital births were 37-40% with absolute differences of 21% and 20%.[32, 33]

Continuous electronic fetal monitoring (cardiotocography): Two studies compared rates of electronic fetal monitoring in midwife-attended planned home births, midwife-attended planned hospital births, and physician attended planned hospital births.[32, 33] In both studies, continuous electronic fetal monitoring was much more common in the hospital cohorts than the home birth cohorts. In the prospective study, 15% of the home birth group vs. 58% of the midwife/hospital group (absolute difference 43%) and 83% of the physician/hospital group (absolute difference 68%) had electronic fetal monitoring.[32] Results were similar in the larger, retrospective study: 14% of the home birth, 42% in the midwife/hospital group (absolute difference 28%), and 79% in the physician/hospital group (absolute difference 65%) had continuous monitoring.[33]

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Optimal Care for Protecting Maternal Mental Health: "If Mama Ain't Happy, Ain't Nobody Happy"*

Although this book focuses primarily on the physical outcomes of labor and birth care, we recognize that childbirth-related psychological morbidity may be a more significant public health problem than childbirth-related physical morbidity. While women and babies heal completely from most forms of physical morbidity, psychological morbidity can have a prolonged effect on the individual woman, her infant and other children, her partner, and her community. It can even lead to mortality: suicide is one of the leading causes of maternal death.[7]

The most complete data on maternal postpartum wellbeing in the U.S. come from the Listening to Mothers II Postpartum Survey, an online and telephone survey conducted in 2006 among 904 women who had given birth 6-18 months prior.[3] Researchers administered several screening tests for postpartum psychiatric disorders, including the Postpartum Depression Screening Scale short version and the Posttraumatic Stress Disorder Symptom Scale. Both screening tests are used in clinical practice to identify women with a high likelihood of having the condition and who need referral for diagnostic testing and treatment. Sixty percent of women met the criteria for depression while 18% scored high enough to be referred for childbirth-related posttraumatic stress disorder (PTSD). A full 9% appeared to meet all of the diagnostic criteria for PTSD. Nearly one in five (18%) had consulted a healthcare or mental health professional about their emotional wellbeing and nearly one in three (30%) reported that their emotional wellbeing interfered with their ability to care for their babies. Five percent of mothers had considered suicide.

Many factors that have little to do with labor and birth care influence postpartum emotional wellbeing, including prior mental health, substance use, partner and social support, financial resources, and newborn temperament, among others.

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But the staggering rates of *childbirth-related* PTSD signify that factors specific to the labor and birth environment or the care provided within that environment can have a significant impact.

Although there is little research that looks directly at the intrapartum care practices that minimize the risk of postpartum PTSD, optimal care strategies emerge from two related bodies of literature. First is the literature on maternal satisfaction. Women who experience birth trauma often attribute their traumatic stress to poor quality care. This was not necessarily care that resulted in physical morbidity: many of the women in a landmark qualitative study of 40 women suffering birth trauma apparently had "good" outcomes but "felt powerless, lacked information about the procedures, experienced physical pain, perceived unsympathetic attitudes of the health care providers, and lacked a clearly understood consent on their part for the procedures" (p. 29).[1] Whether a negative experience results in dissatisfaction or trauma depends to some extent on predisposing factors (such as history of mental illness) and the specific events of labor and birth (such as a "crash" c-section or newborn injury or death), but meeting a woman's expectations for safe, woman-centered care seems very likely to be an effective strategy for preventing traumatic stress even during difficult births.

The second relevant body of literature is on optimal intrapartum care of survivors of childhood sexual abuse. One in four women has experienced childhood sexual abuse (CSA),[4] a significant proportion of CSA survivors do not disclose their history to perinatal care providers,[5] and CSA can trigger retraumatization and is a significant risk factor for postpartum PTSD.[6] Sexual assault or rape during a woman's teens or adulthood can also impact the childbearing experience, although we have less research to guide optimal intrapartum care for this population. Some experts advocate using a "universal precautions" approach in which all healthcare professionals who come into contact with a childbearing woman should assume she has a history of prior sexual abuse or assault and provide care that is least likely to trigger traumatic stress.[2]

STRATEGIES FOR OPTIMAL CARE

- Screen for prior or current abuse, mental illness, and substance use. Coordinate services and treatment as needed.
- Provide full information and support for decision-making, recognizing that all women will not share the same values, preferences, or priorities. Never assume consent.
- "Relinquish control. Recognize that the woman has the right to control her birth experience to the extent that it is possible" (p. 494).[5] This may involve encouraging her to wear her own clothes, choose her labor support companions freely, and have freedom to move or vocalize as she pleases. It also involves honoring the woman's choices of whether and when to perform procedures or interventions.

- Talk to the woman face to face and maintain eye contact.
- Identify the woman's expectations for pain management and provide care aligned with those expectations.
- Secure permission before touching a woman, whether performing a vaginal exam, supporting the legs for the birth or an internal procedure, or touching the breast during lactation assistance. Explain the reason for touching her and how it will be done. Touch gently and solicit the woman's feedback about pain, fear, or discomfort. Discontinue or adjust touch if the woman asks. Avoid touching the woman if doing so is not likely to give important clinical information that will guide care or increase the woman's safety or comfort.
- Do not perform painful procedures without adequate analgesia or anesthesia. If the patient reports pain, stop all nonurgent procedures. If a woman experiences severe pain or emotional trauma during a procedure, debrief and offer ongoing emotional support afterward.
- Provide emotional support and praise before, during, and after labor and birth.
- Provide privacy and a comfortable environment. Minimize the presence of strangers.
- Encourage freedom of movement, recognizing that some positions such as supine, lithotomy, and hands-and-knees may trigger traumatic stress in women with abuse histories.
- If labor progress is slow, be patient and take time to explore the woman's emotional concerns and fears.
- Keep mothers and babies together, ideally skin-to-skin, after birth. If the woman does not seem interested in her baby or requests not to hold her baby right away, give her the time she needs. When she is ready, offer skin-to-skin contact, model positive interaction with the baby, and point out how the baby responds to her, such as recognizing her voice or calming down when held.
- Give the woman opportunities to talk through her birth experience and ask questions about what happened and why. Do not dismiss her concerns or anger just because the baby was born healthy. As Simkin and Klaus (2004) write, "A healthy baby with a depressed or traumatized mother is not a good outcome" (p. 77).[8]
- Secure access to emotional support and mental health follow-up after the birth, especially if a woman has a history of mental illness or substance use, had a difficult birth or poor outcome, or was combative or dissociated (blanked out or stopped responding to verbal communication) in labor.

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Optimal Care for Not-So-Optimal Babies

OPTIMAL CARE FOR THE PLUS-SIZED BABY: WHAT'S THE BIG DEAL?

Some obstetric complications occur more frequently as infant birth weight increases, including prolonged labor, shoulder dystocia, neonatal brachial plexus injury, maternal anal sphincter injury, excess postpartum blood loss, and neonatal hypoglycemia.[3,7,9] Instrumental vaginal delivery and cesarean surgery are also more common when the infant is large.

Yet most large infants are safely born vaginally,[4] and efforts to predict those who will encounter difficult births and to intervene prophylactically have failed to improve outcomes. This is in part because birth weight cannot be determined accurately and because even if estimations were accurate, no model reliably predicts which large babies can be born safely vaginally and which cannot.

Since no evidence supports the use of prophylactic cesarean surgery for suspected macrosomia,[23] and instrumental vaginal delivery increases the likelihood of shoulder dystocia and birth injury (see chapter 14), maximizing the chance of a safe, spontaneous vaginal birth is the optimal approach to the care of a woman whose baby may be large.

STRATEGIES FOR OPTIMAL CARE

- Refrain from fetal weight estimates. The belief that a fetus is macrosomic is a strong predictor of cesarean delivery, regardless of whether the baby is, in fact, large. (See chapter 7.)
- Do not induce labor. Prophylactic induction for suspected macrosomia does not reduce cesarean or shoulder dystocia rates. (See chapter 7.)
- Encourage mobility. It promotes labor progress and may increase the likelihood of spontaneous vaginal birth. (See chapter 8.)
- Recommend continuous labor support from a doula or other experienced, non-medical companion, which improves labor progress and promotes spontaneous vaginal birth. (See chapter 18.)
- Provide alternatives to epidural analgesia for pain management and train staff in their use. Epidural analgesia increases the need for instrumental vaginal delivery and may be more problematic in women already at risk for slow progress and difficult delivery. (See chapter 12.)

- Avoid episiotomy. It neither prevents nor relieves shoulder dystocia, and midline episiotomy increases the risk of anal sphincter injury. (See chapter 15.)
- Do not use fundal pressure to assist delivery. It increases the likelihood of infant brachial plexus injury, maternal anal sphincter injury, and other complications. (See chapter 14.)
- Suggest giving birth in the lateral or hands-and-knees position. These positions appear to reduce the incidence of shoulder dystocia[15] and protect against anal sphincter trauma. These and other nonsupine positions may also be associated with a small reduction in instrumental vaginal delivery. (See chapter 13.). Assisting the woman to her hands and knees (the Gaskin maneuver) appears to markedly increase the likelihood of uncomplicated resolution of shoulder dystocia.[5] (Hands-and-knees is possible with a modern, light epidural with assistance.)
- Keep babies skin-to-skin with the mother after birth. Infants removed from their mothers have lower blood glucose levels. (See chapter 17.) If necessary, a heelstick to measure blood glucose will cause less pain with the baby in the mother's arms, especially if the baby is suckling.[16, 20]

OPTIMAL CARE FOR THE MALPOSITIONED FETUS: "ROTATION, ROTATION, ROTATION!"

Occiput posterior (OP) positions—in which the back of the fetal head faces the mother's back—are among the most difficult conundrums in labor and birth. Unless and until the fetus rotates to an occiput anterior (OA) position, labor may be prolonged and associated with severe pain and exhaustion, the laboring woman and her support team may get discouraged, and obstetric interventions and complications are likely. Of particular concern, persistent OP is associated with an extraordinarily high rate of cesarean surgery. Several studies have reported up to two-thirds of OP babies being delivered by cesarean compared with less than 10% of OA babies.[13, 18, 24] In addition, oxytocin augmentation, instrumental delivery, maternal infection, anal sphincter damage, excessive maternal blood loss, posttraumatic stress, low Apgar scores, meconium-stained amniotic fluid, neonatal acidemia, and admission to neonatal intensive care are all associated with persistent OP position, while an uncomplicated, unmedicated vaginal birth is rare.

Many fetuses that begin labor in the OP position rotate spontaneously, but epidural analgesia, used in at least three-quarters of U.S. births, dramatically decreases the likelihood that the fetus will rotate on its own. (See chapter 12.) Other obstetric interventions, such as restricting maternal movement, also may decrease the likelihood of spontaneous fetal rotation, diminish the woman's coping ability, or both.

A 2010 article by Penny Simkin provides a structured review of evidence from randomized controlled trials (RCTs) and other relevant studies on strategies

to prevent, diagnose, and manage labors complicated by OP fetal positioning.[21] She contrasts the evidence with the usual advice or dogma in obstetric and midwifery practice. Based on this review of the evidence, she offers the following list of optimal care strategies, with which, based on our independent review of the same body of literature, we concur. We have added remarks in brackets to expand on her list. We also recommend Simkin's and Ancheta's book, *The Labor Progress Handbook*,[22] an excellent guide to providing the support and assistance described in this list.

STRATEGIES FOR OPTIMAL CARE*

- Do not try to put the baby into an occiput anterior position before labor. [No evidence suggests that techniques or exercises to encourage the fetus into an OA position before labor increase the chance that the baby will begin labor or be born OA.]
- Teach and encourage women and staff the movements, positions, and techniques to use in labor that change gravity influences and pelvic shape. [See chapters 8 and 14.]
- Provide space for laboring women to move and equipment to aid with positions and movement. [See chapter 8.]
- If the woman has back pain,
  - » do not assume that the fetus is occiput posterior; many causes for back pain are possible;
  - » confirm with ultrasound examination or another reliable method; [Ultrasound is the most reliable method of determining fetal position. Hands-to-belly assessments (e.g., Leopold's maneuvers) and digital vaginal exam are not reliable. "Belly mapping" methods that involve combining hands on assessment, auscultation of the fetal heart rate, and maternal perception of fetal movements have not been evaluated for reliability as an assessment technique in labor.]
  - » without ultrasound confirmation, consider other causes of back pain, and with trial and error, use measures listed next;
  - » treat the woman's pain nonpharmacologically (continuous labor support, walking, abdominal lifting, ice, heat, massage and pressure, bath or shower, hands and knees and other forward leaning positions, TENS [transcutaneous electrical nerve stimulation], and sterile water injections) and pharmacologically, if necessary;
  - » provide epidural or systemic medications if requested. [The woman should be informed that epidurals can cause a baby to turn or remain OP.]

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* Reprinted with permission from Simkin P. The fetal occiput posterior position: State of the science and a new perspective. Birth 2010;37(1):61-71.

- If labor progress stalls, with or without back pain,
  - » provide continuous labor support and encouragement; [Women need to know that labor is normally slower with an OP baby, that the baby is doing fine, and that it is OK to feel disappointment or frustration. Engaging a woman to help fix the problem may minimize feelings of helplessness and avoid suffering.]
  - » assume fetal malposition and confirm position of baby with ultrasound or another reliable method;
  - » treat nonpharmacologically and noninvasively, using ultrasound findings of fetal position to plan the direction of asymmetrical positions and movements (lunging, abdominal stroking, kneeling on one knee, side lying, and semi-prone positions) and assess the success of these measures;
  - » if not using ultrasound, try all positions and movements and use trial and error with the asymmetrical actions, emphasizing those that feel better to the woman; look for improved progress in dilation or descent; [Encouraging freedom of movement has no risks. (See chapters 8 and 13)].
  - » rotate the fetal head digitally or manually; [This intervention is effective at reducing cesarean sections, instrumental vaginal births, and maternal complications associated with birth of an OP fetus. [12, 19]]
  - » if these measures are not successful, use obstetric interventions.

The goals with this approach are to

- help the woman tolerate her discomfort, slow progress, or both;
- increase the rates of spontaneous vaginal births and decrease surgical deliveries;
- decrease the physical and psychological trauma and poorer outcomes in mothers and babies that are associated with the occiput posterior position.

OPTIMAL PRACTICE FOR THE BABY WITH MECONIUM STAINING: "MECONIUM HAPPENS"

As many as one in four babies may have their first bowel movement before birth.[10] This may occur as the result of physiological maturity in a healthy fetus or as a stress response from an acute or chronic hypoxic event. Fetuses may normally breathe meconium-stained amniotic fluid (MSAF) before birth without difficulty—all fetuses exhibit breathing movements beginning in early gestation. However, gasping breaths, a physiologic response to hypoxia, may bring meconium deeper into the lungs, where it can cause irritation and inflammation and occlude the airways potentially leading to a serious condition known as meconium aspiration syndrome (MAS). MAS occurs in about 1 in 10 babies born through MSAF.[10]

Most cases of severe MAS are thought to result from pathologic intrauterine processes such as chronic hypoxia and infection, leaving relatively few that are potentially preventable by labor and birth care practices.[1] In labor, the presence of meconium is most strongly associated with subsequent MAS when meconium is thick (i.e., poorly diluted because of low amniotic fluid volume), when the fetal heart rate pattern is nonreassuring, or when the baby is born depressed.[10]

Because both the passage of meconium and the gasping reflex can be precipitated by fetal hypoxia, optimal labor and birth care should involve, first and foremost, avoiding practices that unnecessarily stress the fetus. Other objectives of optimal care are to maintain adequate amniotic fluid volume to dilute meconium and support a gentle respiratory transition after birth. Proper monitoring for signs of fetal hypoxia is also critical.

STRATEGIES FOR OPTIMAL CARE

- Optimal practice for avoiding fetal hypoxia includes the following:
  - » Avoid misoprostol and other prostaglandins. Prostaglandins may increase the likelihood of meconium-stained fluid by overstimulating the uterus and leading to fetal hypoxia and meconium release or via direct effects on the fetal gastrointenstinal system. (See chapter 7.) Castor oil has been implicated as well.[14]
  - » Use physiologic oxytocin dosages and wait 30 minutes before increasing the dose when inducing or augmenting. High-dose/short-interval oxytocin protocols increase the likelihood of uterine hyperstimulation, which may precipitate fetal distress. (See chapter 7.)
  - » Avoid the supine position during the second stage of labor, which is associated with increased likelihood of fetal heart rate (FHR) decelerations. (See chapter 13.) Upright positions may also promote drainage of secretions from the airway during birth, as gravity would allow secretions to flow away from the baby's face after birth of the head.
  - » Encourage spontaneous, open-glottis pushing during second stage and allow at least 1-2 hours of passive fetal descent before pushing with an epidural. Both practices may reduce the likelihood of FHR decelerations. (See chapter 13.)
- Optimal practice for maintaining adequate amniotic fluid volume:
  - » Avoid artificial rupture of the membranes. Intact membranes cushion the fetus from the force of contractions. There is no evidence to support the practice of rupturing membranes to determine if meconium is present. (See chapter 9.)
  - » Offer oral hydration, which can increase amniotic fluid volume.[10] (See chapter 7.) Correct dehydration via intravenous fluids if the woman cannot tolerate oral fluids. (See chapter 11.)

  - » Evidence suggests little if any benefit from amnioinfusion in the presence of thick meconium. The largest randomized, controlled trial (RCT) (n = 1998) found no difference in any clinically important outcomes including mode of birth, MAS, or perinatal death.[8] Some smaller, methodologically weaker trials included in the Cochrane systematic review found differences in neonatal ventilation, neonatal intensive care admission, and cesarean section for fetal distress, however.[11] The Cochrane reviewers conclude, "Amnioinfusion is either ineffective . . . or its effects are masked by other strategies to optimise neonatal outcome" (p. 2).[11]
- Optimal practice for promoting a gentle respiratory transition:
  - » Delay umbilical cord clamping, which allows continuous oxygenation via the placenta and physiologic opening of the respiratory alveoli. (See chapter 17.)
  - » Place the infant skin-to-skin with the mother in a position that allows drainage of oral secretions. (See chapter 17.)
  - » Avoid suction in a vigorous infant. Suctioning frequently causes a vagal response and interferes with oxygenation, both of which may precipitate gasping. (See chapter 17.)
  - » In a depressed infant (with poor respiratory effort, pulse, or muscle tone), born through MSAF, perform endotracheal suctioning. Although there is no evidence to support this recommendation, for a baby whose first breath may be a deep gasp, it is reasonable to remove secretions in the pharynx and trachea that may be breathed into the lungs.[17]
- Additional considerations:
  - » Intermittent auscultation may be a reasonable option with MSAF. The available research on continuous electronic fetal monitoring (EFM) in the presence of meconium is sparse and dated. A single, unpublished RCT of 200 women included in the Cochrane systematic review of continuous EFM found a substantial increased risk of cesarean surgery (35% vs. 12%, absolute difference 23%), a reduced likelihood of spontaneous vaginal delivery (61% vs. 27%, absolute difference 34%), and no differences in newborn outcomes (Apgar score < 7 at 5 min, perinatal death, or scalp injury from blood sampling).[2] The study, however, was too small to detect differences in MAS and other serious neonatal outcomes.
  - » Meconium-stained amniotic fluid is a risk factor for perinatal mortality in out-of-hospital births. Consider transferring to a hospital if meconium-stained amniotic fluid is recognized in a planned home or birth center birth, especially if the meconium is thick, the woman is more than 42 weeks pregnant, there are any signs of fetal distress,

or meconium appears during labor after fluid that was initially clear. (See chapters 20 and 21.)

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ABOUT THE AUTHORS

Henci Goer, award-winning medical writer and internationally known speaker, has made it her life's work to analyze and synthesize the maternity care research in order to determine what constitutes safe, effective, satisfying care in childbirth. An independent scholar, she has become an acknowledged expert on evidence-based maternity care. Her first book, *Obstetric Myths Versus Research Realities*, to which this book is the successor, was a valued resource for childbirth professionals. Wanting to give pregnant women and their families the same access to the research evidence and therefore the ability to make informed decisions about their care, she followed it with *The Thinking Woman's Guide to a Better Birth*. Over the years, she has written consumer education pamphlets and numerous articles for trade, consumer, and academic periodicals. She served as project director and participated as an Expert Work Group member on the document, "Evidence Basis for the Ten Steps of Mother-Friendly Care" on behalf of the Coalition for Improvement in Maternity Services. Currently, she is a resident expert on Lamaze International's website where she moderates the "Ask Henci" forum and appears as a regular guest blogger on *Science & Sensibility*. Goer's major in biology at Brandeis University, her teaching experience as a Lamaze certified childbirth educator, and her work as a doula have served her well in her chosen career.

Amy Romano has worked in the maternity care field as a clinician, research analyst, educator, and consumer advocate since 2001. In 2010, she joined Childbirth Connection, where she directs the Transforming Maternity Care Partnership, a national effort to improve maternity care quality in the United States. Prior to joining Childbirth Connection, she practiced midwifery in the home, birth center, and hospital settings and taught in the nurse-midwifery program at the Yale School of Nursing. She also spent six years as a perinatal research and advocacy consultant to Lamaze International, where she analyzed, summarized, and critiqued research for the Lamaze community and launched the award-winning research blog, *Science & Sensibility*. Romano was also a member of the editorial team for the 9th edition of the landmark women's health book, *Our Bodies, Ourselves*, released in October 2011. Romano received her undergraduate degree from the University of Michigan and both a certificate and masters' degree in nursing at the Yale School of Nursing.

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