NIH State-of-the-Science Conference: Cesarean Delivery on Maternal Request

March 27–29, 2006

William H. Natcher Conference Center
National Institutes of Health
Bethesda, Maryland

Sponsored by:

- National Institute of Child Health and Human Development, NIH
- Office of Medical Applications of Research, NIH

Co-sponsored by:

- National Institute of Diabetes and Digestive and Kidney Diseases, NIH
- National Institute of Nursing Research, NIH
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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

Contents

Introduction

Despite the national goal of reducing rates of cesarean delivery to 15 percent of births established as part of *Healthy People 2010*, cesarean delivery rates have continued to increase. In 2004, 1.2 million or 29.1 percent of births in the United States were by cesarean delivery. An estimated 2.5 percent of births that year were cesarean deliveries performed on request, in the absence of medical necessity, and the rate of cesareans on request appears to be growing rapidly over time.

The potential benefits of elective cesarean delivery as compared to vaginal delivery are not fully understood but are thought to include decreased risk of urinary incontinence, pelvic organ prolapse, anal sphincter damage, and fecal incontinence. Elective cesarean delivery also has the benefit of flexible timing for mother and physician. However, like any major surgical procedure, there are risks associated with cesarean delivery. Risks that are known to be higher for cesarean deliveries than for vaginal delivery include adverse reactions to anesthesia, breathing problems, bleeding, infection, urinary tract injury, and injury to the baby. In addition, recovery time following cesarean delivery is typically longer than for vaginal delivery.

Given these risks, any decision to deliver by cesarean delivery when vaginal delivery is also available should be informed by the best possible information regarding potential health outcomes, good and bad, for both mother and baby. Toward that end, the National Institute of Child Health and Human Development and the Office of Medical Applications of Research of the National Institutes of Health will convene a State-of-the-Science Conference from March 27 to 29, 2006, to assess the available scientific evidence relevant to the following questions:

- What is the trend and incidence of cesarean delivery over time in the United States and other countries (when possible separate by intent)?

- What are the short-term (under one year) and long-term benefits and harms to mother and baby associated with cesarean by request versus attempted vaginal delivery?

- What factors influence benefits and harms?

- What future research directions need to be considered to get evidence for making appropriate decisions regarding cesarean on request or attempted vaginal delivery?

An impartial, independent panel is charged with reviewing the available published literature in advance of the conference, including a systematic literature review commissioned through the Agency for Healthcare Research and Quality. The first day and a half of the conference consists of presentations by expert researchers and practitioners, and open public discussions. On Wednesday, March 29, the panel will present a statement of its collective assessment of the evidence to answer each of the questions above. The panel will also hold a press conference to address questions from the media. The draft statement will be published online later that day, and the final version will be released approximately 6 weeks later.

General Information

Conference sessions will be held in the Natcher Conference Center, NIH, Bethesda, Maryland.

The conference may be viewed live via Webcast at http://videocast.nih.gov/. Webcast sessions will also be available after the conference.

The dining center in the Natcher Conference Center is located on the main level, one floor above the auditorium. It is open from 6:30 a.m. to 2:30 p.m., serving hot breakfast and lunch, sandwiches and salads, and snack items. An additional cafeteria is available from 7:00 a.m. to 3:30 p.m., in Building 38A, level B1, across the street from the main entrance to the Natcher Conference Center.

The telephone number for the message center at the Natcher Conference Center is 301–594–7302.

Conference Sponsors

The primary sponsors of the conference are:

- National Institute of Child Health and Human Development, NIH
- Office of Medical Applications of Research, NIH

The co-sponsors of the conference are:

- National Institute of Diabetes and Digestive and Kidney Diseases, NIH
- National Institute of Nursing Research, NIH
- Office of Research on Women's Health, NIH

The Agency for Healthcare Research and Quality (AHRQ) provided additional support to the conference development.

Financial Disclosure

Each speaker presenting at this conference has been asked to disclose any financial interests or other relationships pertaining to this subject area. Please refer to the material in your participant packet for details.

Panel members signed a confirmation that they have no financial or other conflicts of interest pertaining to the topic under consideration.

AGENDA

Monday, March 27, 2006

8:30 a.m. Opening Remarks
Duane Alexander, M.D.
Director
National Institute of Child Health and Human Development
National Institutes of Health

8:40 a.m. Charge to Panel
Susan Rossi, Ph.D., M.P.H.
Deputy Director
Office of Medical Applications of Research
Office of the Director
National Institutes of Health

8:50 a.m. Conference Overview and Panel Activities
Mary E. D'Alton, M.D.
Panel and Conference Chairperson
Willard C. Rappleye Professor of Obstetrics and Gynecology
Chair, Department of Obstetrics and Gynecology
Director, Obstetrics and Gynecology Services
College of Physicians and Surgeons
Columbia University

I. What Is the Trend and Incidence of Cesarean Delivery Over Time in the United States and in Other Countries (When Possible Separate by Intent)?

9:00 a.m. Evidence-Based Practice Center Presentations:

Possible Pathways for Planned Vaginal and Planned Cesarean Deliveries
Anthony G. Visco, M.D.
Associate Professor
Division of Urogynecology and Reconstructive Pelvic Surgery
Department of Obstetrics and Gynecology
University of North Carolina at Chapel Hill

Incidence and Trends of Cesarean Delivery on Maternal Request
Meera Viswanathan, Ph.D.
Research Health Analyst
RTI International at Research Triangle Park

Monday, March 27, 2006 (continued)

I. What Is the Trend and Incidence of Cesarean Delivery Over Time in the United States and in Other Countries (When Possible Separate by Intent)? (continued)

9:20 a.m. Background, Trends, and Epidemiology
Fay Menacker, Dr.P.H., C.P.N.P.
Statistician
Division of Vital Statistics
National Center for Health Statistics
Centers for Disease Control and Prevention

9:40 a.m. Discussion
Participants with questions or comments for the speakers should proceed to the microphones and wait to be recognized by the panel chair. Please state your name and affiliation. Questions and comments not heard before the close of the discussion period may be submitted at the registration desk. Please be aware that all statements made at the microphone or submitted later are in the public domain.

II. What Are the Short-Term (Under One Year) and Long-Term Benefits and Harms to Mother and Baby Associated With Cesarean by Request Versus Attempted Vaginal Delivery?

Maternal Short-Term Consequences

10:15 a.m. Evidence-Based Practice Center Presentation: Short-Term Maternal Consequences Associated With Cesarean Delivery on Maternal Request Versus Planned Vaginal Delivery
Anthony G. Visco, M.D.
Associate Professor
Division of Urogynecology and Reconstructive Pelvic Surgery
Department of Obstetrics and Gynecology
University of North Carolina at Chapel Hill

10:35 a.m. Maternal Mortality With CesareanDelivery in Massachusetts (1995–2003) and a Review of the Literature
Benjamin P. Sachs, M.D.
Professor and Chair
Obstetrics and Gynecology
Beth Israel Deaconess Medical Center
Harvard Medical School

10:55 a.m. Maternal Morbidity and Short-Term Outcomes
Joseph R. Wax, M.D.
Professor of Obstetrics and Gynecology
University of Vermont
Maine Medical Center

Monday, March 27, 2006 (continued)

II. What Are the Short-Term (Under One Year) and Long-Term Benefits and Harms to Mother and Baby Associated With Cesarean by Request Versus Attempted Vaginal Delivery? (continued)

11:15 a.m. Discussion

Noon Lunch
Panel Executive Session

Maternal Long-Term Consequences

1:00 p.m. Evidence-Based Practice Center Presentation: Long-Term Maternal Consequences Associated With Cesarean Delivery on Maternal Request Versus Planned Vaginal Delivery
Anthony G. Visco, M.D.
Associate Professor
Division of Urogynecology and Reconstructive Pelvic Surgery
Department of Obstetrics and Gynecology
University of North Carolina at Chapel Hill

1:20 p.m. Sexual Function and Childbirth
Victoria L. Handa, M.D.
Associate Professor
Department of Obstetrics and Gynecology
Johns Hopkins University

1:40 p.m. Reproductive Consequences
Melissa L. Gilliam, M.D., M.P.H.
Associate Professor of Obstetrics, Gynecology, and Epidemiology
The University of Chicago

2:00 p.m. Discussion

2:40 p.m. Pelvic Floor Disorders Overview
Anne M. Weber, M.D., M.S.
Program Officer
Contraception and Reproductive Health Branch
National Institute of Child Health and Human Development
National Institutes of Health

3:00 p.m. Anal Incontinence
Dee Fenner, M.D.
Director of Gynecology
Department of Obstetrics and Gynecology
University of Michigan

Monday, March 27, 2006 (continued)

II. What Are the Short-Term (Under One Year) and Long-Term Benefits and Harms to Mother and Baby Associated With Cesarean by Request Versus Attempted Vaginal Delivery? (continued)

3:30 p.m. Urinary Incontinence
Ingrid Nygaard, M.D., M.S.
Professor
Department of Obstetrics and Gynecology
University of Utah College of Medicine

4:00 p.m. Impact on Development of Pelvic Organ Prolapse
Holly E. Richter, Ph.D., M.D.
Medical Surgical Gynecology
University of Alabama at Birmingham

4:30 p.m. Discussion

5:30 p.m. Adjournment

Tuesday, March 28, 2006

II. What Are the Short-Term (Under One Year) and Long-Term Benefits and Harms to Mother and Baby Associated With Cesarean by Request Versus Attempted Vaginal Delivery? (continued)

Fetal/Neonatal Consequences

8:30 a.m. Evidence-Based Practice Center Presentation: Neonatal Consequences Associated With Cesarean Delivery on Maternal Request Versus Planned Vaginal Delivery
Meera Viswanathan, Ph.D.
Research Health Analyst
RTI International at Research Triangle Park

8:50 a.m. Cesarean Section on Request at 39Weeks: Impact on Shoulder Dystocia, Fetal Trauma, Neonatal Encephalopathy, and Intrauterine Fetal Demise
Gary D.V. Hankins, M.D.
Professor and Vice Chairman
Department of Obstetrics and Gynecology
University of Texas Medical Branch at Galveston

9:10 a.m. Neonatal Mortality/Morbidty and Developmental Outcomes
Mark A. Klebanoff, M.D., M.P.H.
Director
Division of Epidemiology, Statistics, and Prevention Research
National Institute of Child Health and Human Development
National Institutes of Health

Tuesday, March 28, 2006 (continued)

II. What Are the Short-Term (Under One Year) and Long-Term Benefits and Harms to Mother and Baby Associated With Cesarean by Request Versus Attempted Vaginal Delivery? (continued)

9:30 a.m. Implications of Labor on Neonatal Outcome
Lucky Jain, M.D., M.B.A.
Professor and Executive Vice Chair
Department of Pediatrics
Emory University

9:50 a.m. Discussion

III. What Factors Influence Benefits and Harms?

Economics and Ethics

10:30 a.m. Cesarean Delivery on MaternalRequest: Wise Use of Finite Resources? View From the Trenches
Maurice L. Druzin, M.D.
Professor and Chief
Division of Maternal-Fetal Medicine
Obstetrics and Gynecology
Stanford University

10:50 a.m. Ethics of Permitting or Limiting Choice of Method of Delivery
Howard Minkoff, M.D.
Chairman
Department of Obstetrics and Gynecology
Maimonides Medical Center

Choices Made by Patients or Physicians

11:10 a.m. Impact on the General Obstetrical Practitioner
Millie Sullivan Nelson, M.D.
Head
Department of Obstetrics and Gynecology
Christie Clinic at Champaign

11:30 a.m. Impact From the Patient Perspective
Susan Dentzer
Health Correspondent and Head of the Health Policy Unit
The NewsHour with Jim Lehrer on PBS

11:50 a.m. Discussion

1:00 p.m. Adjournment

Wednesday, March 29, 2006

9:00 a.m. Presentation of the draft State-of-the-Science Statement

9:30 a.m. Public Discussion

The panel chair will call for questions and comments from the audience on the draft consensus statement, beginning with the introduction and continuing through each subsequent section in turn. Please confine your comments to the section under discussion. The chair will use discretion in proceeding to subsequent sections so that comments on the entire statement may be heard during the time allotted. Comments cannot be accepted after 11:30 a.m.

11:00 a.m. Panel Meets in Executive Session

Panel meets in executive session to review public comments. Conference participants are welcome to return to the main auditorium to attend the press conference at 2:00 p.m.; however, only members of the media are permitted to ask questions during the press conference.

2:00 p.m. Press Conference

3:00 p.m. Adjournment

The panel's draft statement will be posted to www.consensus.nih.gov as soon as possible after the close of proceedings and the final statement will be posted 3–4 weeks later.

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Abstracts

The following are the abstracts of the proposed speaker presentations at the NIH State-of-the-Science Conference: Cesarean Delivery on Maternal Request. They are designed for use by the panelists and the participants in the conference, and as a reference document for anyone interested in conference deliberations. Invited speakers' names are underlined in those abstracts where additional names are listed as authors. We are grateful to the authors, who summarized their materials and made them available in a timely fashion.

Abstracts for the following presentations do not appear:

Impact on the General Obstetrical Practitioner—Millie Sullivan Nelson, M.D.

Impact From the Patient Perspective—Susan Dentzer

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Possible Pathways for Planned Vaginal and Planned Cesarean Deliveries

Anthony G. Visco, M.D.

For the systematic review of cesarean delivery on maternal request (CDMR) versus planned vaginal delivery, we defined CDMR 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. We focused on primary cesarean deliveries. We recognized that the available literature does not explicitly define CDMR as a specific study group to allow for comparison with other planned routes of delivery. In the absence of high-quality evidence, we compiled a summary of the best available literature, using proxies for CDMR, frequently relying on studies that define groups by *actual* route of delivery and not *planned* route of delivery. To clarify the nature of these complex pathways, and to highlight the potential confounders inherent in these comparisons, we present a framework of possible pathways for primiparous women with singleton pregnancies at term (see figure 1). The pathways begin with planned routes of delivery, describe common labor events and potential confounders, and ultimately lead to various actual routes of delivery.

Appropriate Comparisons

The appropriate comparison is that of intent: *planned* vaginal delivery compared with *planned* CDMR. Planned vaginal delivery does not always result in spontaneous labor followed by spontaneous vaginal delivery. Therefore, the ideal evidence demands a comparison of intent: *planned* vaginal delivery with *planned* CDMR, rather than the comparison of actual delivery routes, such as spontaneous vaginal delivery, with unlabored cesarean.

Limitations of Existing Comparisons

Studies lacked consistent and clear definitions of routes of delivery. Studies inconsistently took "planning" before delivery, indications for cesarean, and laboring status into account for their categories of mode of delivery. The lack of consistency in terminology made comparing outcomes for planned routes of delivery extremely challenging and sometimes impossible.

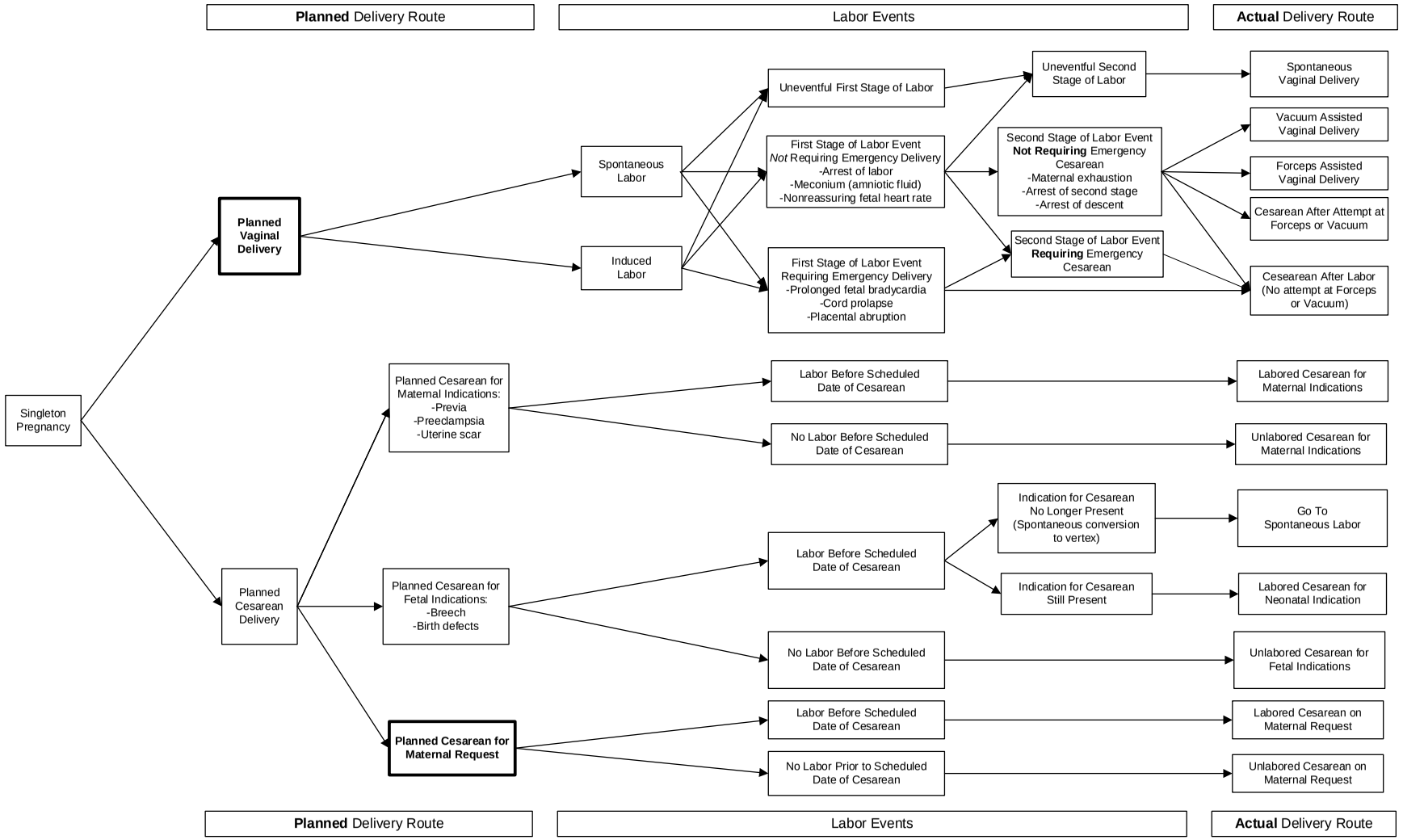
The majority of studies included in the systematic review reported outcomes by *actual* route of delivery. A design centered on actual delivery route often allows investigators to distinguish between labored and unlabored cesarean deliveries. In studies limited to unlabored cesareans, women who present in labor before their scheduled date of delivery are, by definition, excluded. Excluding these women may overestimate potential benefits (e.g., reduction in pelvic floor disorders) and potential harms (e.g., neonatal respiratory morbidity) associated with CDMR, because the studies then cannot account for any effect that labor has on outcomes of interest. Studies that include both labored and unlabored planned cesareans may have a rate of labor that exceeds the rate of labor expected for a population planning CDMR and may allow for a longer period of time in labor before cesarean delivery.

The absence of data on appropriate routes of planned deliveries required us to use proxies for CDMR. These proxies usually compared actual routes of delivery, not planned routes of delivery, similarly leading to bias from failure to account for intent-to-treat. One such proxy was cesarean delivery for breech presentation. We recognized the significant confounding effect this indication would have on neonatal outcomes, so we used it as a proxy only for maternal outcomes. However, the extent to which studies of breech presentation serve as appropriate proxies for maternal outcomes of planned vaginal delivery compared with those of planned CDMR is unclear. For instance, the risk of infection may be higher in planned cesarean for breech, if the length of time between labor onset or rupture of membranes to cesarean delivery is higher than it would be in true CDMR. Conversely, the risk of infection in the planned vaginal delivery group may be higher, because the number of women undergoing a labored cesarean is greater than the number expected in a typical population of women with vertex presentations.

The RTI-UNC EPC Team

Meera Viswanathan, Ph.D.; Anthony G. Visco, M.D.; Katherine Hartmann, M.D., Ph.D.; Mary Ellen Wechter, M.D.; Gerald Gartlehner, M.D.; Jennifer M. Wu, M.D.; Rachel Palmieri, B.S.; Michele Jonsson Funk, Ph.D.; Linda Lux, M.P.H.; Tammeka Swinson, B.A.; Kathleen N. Lohr, Ph.D.

Figure 1. Possible Pathways for Planned Vaginal and Planned Cesarean Deliveries



Note: Text in bold represents ideal comparison groups for this review.

Incidence and Trends of Cesarean Delivery on Maternal Request

Meera Viswanathan, Ph.D.

The rates of cesarean delivery on maternal request are thought to be rising; evidence on volume of this trend is unclear. We undertook a systematic review to examine trends and incidence of cesarean delivery—one of the four Key Questions (KQ) specified by the Planning Committee for the National Institutes of Health State-of-the-Science Conference: Cesarean Delivery on Maternal Request.

We searched MEDLINE,® Cochrane Collaboration resources, and Embase (1990 to June 2005). We excluded studies that: (1) did not report on women of reproductive age; (2) were published in languages other than English; (3) did not report information pertinent to the key clinical questions; (4) had fewer than 50 subjects for randomized controlled trials (RCTs) or 100 subjects for observational studies; or (5) were not original studies. Additionally, we excluded studies that did not provide data on both planned cesarean delivery and planned vaginal delivery. All eligible studies were reviewed, and relevant data were extracted, entered into tables, and summarized by descriptive methods. From our review of 1,406 abstracts, 13 addressed KQ 1.[1–13]

KQ 1: Incidence and Trends of Cesarean Delivery on Maternal Request

KQ 1 referred to the incidence and trends in cesarean deliveries over time in developed countries; it made specific reference to primary cesarean before onset of labor, Cesarean Delivery on Maternal Request (CDMR), medical indications, and malpresentation as proportions of total cesarean deliveries. The absence of data to answer this question is striking. Regarding incidence, the available literature yielded rates of cesarean deliveries as a proportion of all deliveries for a wide array of time points and countries. For 2001 in the United States, data suggest rates of more than 25 percent. Elsewhere in the developed world for 2001, rates of cesarean delivery ranged from 14 percent in the Netherlands to 35 percent in Italy. Since 2001, the rates of cesarean delivery have risen in the United States; recent figures put the rate at more than 29 percent for 2004.

The rate of cesarean deliveries is rising worldwide. Both "elective" cesarean deliveries (sometimes defined as unlabored) and "nonelective" cesarean deliveries contribute to this rise; however, the proportions vary by country, study, and time period. Four studies distinguished between prelabor primary and repeat cesareans. An Irish study reported an unlabored primary cesarean delivery rate of 18.9 percent of all cesarean deliveries during the 12-year period from 1989 to 2000. One study from Australia showed that prelabor primary cesarean delivery as a percentage of all deliveries rose from 4.1 percent in 1980 to 4.8 percent in 1987. In the United States, primary prelabor cesarean delivery rates were approximately 5 percent of all deliveries in 1996 and approximately 7 percent in 2001. In 2001, "primary elective" prelabor cesarean rate as a proportion of all cesarean deliveries was 28.3 percent in the United States.

The extent to which CDMR is contributing to the rise in cesareans remains unclear. Finally, we did not find sufficient data to comment on medical indications or malpresentation as a proportion of all cesarean deliveries.

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Background, Trends, and Epidemiology

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Overall Trends

The cesarean rate increased dramatically during the 1970s and early 1980s and then began to decline in the late 1980s (based on data from the National Hospital Discharge Survey). Cesarean data became available from certificates of live birth in 1989, and by 1991 all States and the District of Columbia were reporting this information. Between 1989 and 1996, the total cesarean rate decreased as a result of a decrease in the primary rate (16.1 percent to 14.6 percent) and an increase in the rate of vaginal births after cesarean (VBAC) (18.9 percent to 28.3 percent). Since 1996, these trends have reversed.

Nearly 3 in 10 births (29.1 percent) were delivered by cesarean in 2004, the highest rate ever reported in the United States.[1] The overall rate has increased by more than 40 percent since 1996, reflecting two concurrent trends: an increase in the primary rate from 14.6 percent to 20.6 percent and a decline in the VBAC rate from 28.3 percent to 9.2. The increase in the primary rate does not appear to be related to a change in the medical risk profile of U.S. mothers[2] and may be associated with nonclinical factors such as demographics, physician practice patterns, and maternal choice.[3–5]

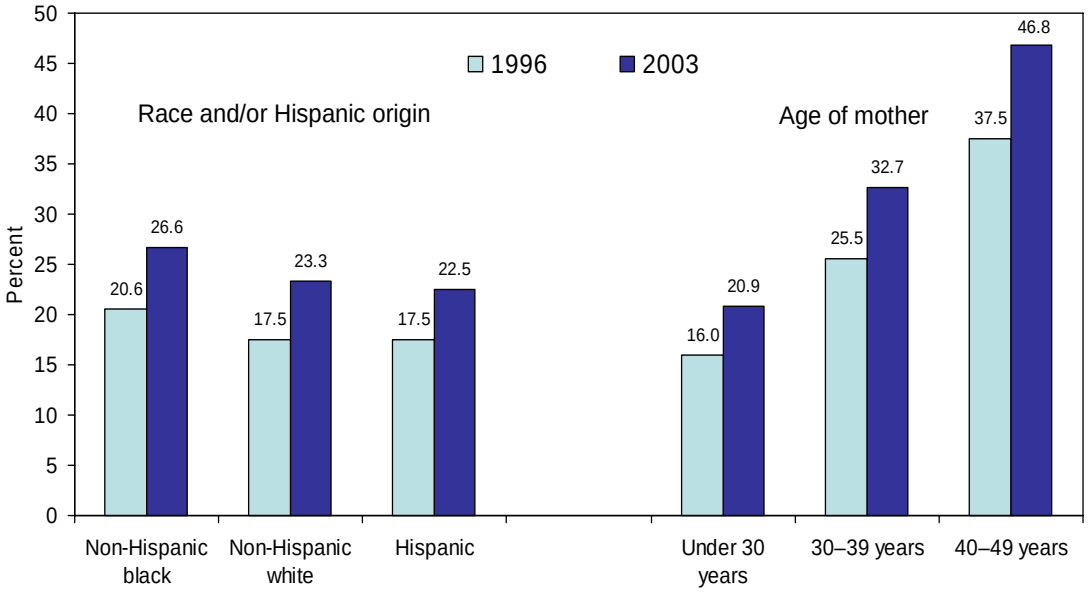
The steep decline in the VBAC rate and accordingly, the increase in the repeat cesarean rate, may be related to reports of risks associated with VBAC, more conservative practice guidelines, legal pressures, as well as the continuing debate regarding the risks and benefits of vaginal birth versus cesarean section.[6–11]

Data on Maternal Request Cesarean Delivery

The increase in the primary cesarean rate has been widespread, for mothers of all ages, races, and ethnic groups.[12] Some of the increase in the primary cesarean rate may be due to an increase in maternal request cesarean delivery, defined here as elective cesarean delivery without a medical or obstetrical indication. There is little systematic information available on mothers' attitudes concerning such medically elective cesarean deliveries; therefore, some studies have used criteria of exclusion,[13,14] although some have preferred the concept "no indicated risk."[15]

Trends for first and repeat cesarean rates for women defined as at low risk for a cesarean delivery by the Healthy People 2010 (HP2010) objectives (i.e., a woman with a full-term [at least 37 completed weeks of gestation], singleton pregnancy [not a multiple pregnancy] with vertex fetal presentation [head facing in a downward position in the birth canal]), are similar to the trends for all women (figure 1).[16,17]

Figure 1. Cesarean Rates for First Births for Low-Risk[1] Women by Age and Race and Hispanic Origin of Mother: United States, 1996 and 2003



[1]Number of cesareans per 100 live births to women giving birth for the first time and women with full term, vertex singleton infants.

NOTES: Beginning in 1997, data for women aged 40–49 years include data for women aged 50–54 years. Race categories are consistent with the 1977 Office of Management and Budget standards.

Source: National Vital Statistics System, 1996 and 2003.

Rates for even lower-risk first-time mothers (i.e., women who meet the HP2010 criteria and in addition have no risk factors or complications of labor and/or delivery reported on the birth certificate) almost doubled between 1996 and 2003.[15, 18] A report using recent hospital discharge data showed rates of first cesarean delivery with no labor prior to delivery and without certain clinical indications have risen steadily between 2001 and 2003.[19]

When evaluating the consequences of a medically elective cesarean delivery to women assumed to be in good health, it is important to consider that a cesarean delivery involves major abdominal surgery with the risks inherent in any surgical procedure. It may also be assumed that the infants delivered are at or near term. Between 1996 and 2003, total cesarean rates increased at all gestational ages, with the greatest increase (about 33 percent) for moderately preterm (32–36 weeks) and term (37–41 weeks) infants.[12] Early, even slightly early delivery, may affect infant health.[20,21] For example, compared with term infants, those born near term (34–36 weeks) are at higher risk for infant mortality.[22,23]

Future Research Directions

From the data presented, there is a clear need for further research on the short- and long-term medical, social, and psychological factors that impact a decision to have a cesarean delivery for other than medical reasons. There is very little research on the timing and nature of how mothers and clinicians approach a decision to have a medically elective cesarean. There is also little known of the short- and long-term medical, social, and psychological risks and benefits of a

medically elective primary cesarean for both mother and infant and what factors (mother's age, parity, race, ethnicity) might impact outcomes. Since a first cesarean delivery now means that subsequent deliveries are likely to be cesarean deliveries, there is also a need for more research into the positive and negative outcomes of multiple repeat cesareans. The most recent revision of the U.S. Standard Certificate of Live Birth will provide some useful detail, including whether a trial of labor was attempted prior to a cesarean delivery.[24]

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Short-Term Maternal Consequences Associated With Cesarean Delivery on Maternal Request Versus Planned Vaginal Delivery

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The evidence on the balance of risks and benefits of Cesarean Delivery on Maternal Request (CDMR) versus planned vaginal delivery is unclear. We undertook a systematic review to examine outcomes associated with planned route of delivery—one of the four Key Questions (KQ) specified by the Planning Committee for the National Institutes of Health State-of-the-Science Conference: Cesarean Delivery on Maternal Request.

We searched MEDLINE,® Cochrane Collaboration resources, and Embase (1990 to June 2005). We excluded studies that: (1) did not report on women of reproductive age; (2) were published in languages other than English; (3) did not report information pertinent to the key clinical questions; (4) had fewer than 50 subjects for randomized controlled trials (RCTs) or 100 subjects for observational studies; or (5) were not original studies. Additionally, we excluded studies that did not provide data on both planned cesarean delivery and planned vaginal delivery. All eligible studies were reviewed, and relevant data were extracted, entered into evidence tables, and summarized by descriptive methods.

The comparison groups varied widely. We developed a four-tier classification system of relevance to CDMR based on the following criteria: (1) whether studies analyzed outcomes by planned route of delivery (trials of route of delivery); (2) whether CDMR was included as a comparison group (high relevance); (3) whether comparison groups comprised planned cesareans (moderate relevance); and (4) whether studies involved undefined "elective" or a mix of planned and unplanned, unlabored cesareans (low relevance). We summarized the strength of evidence for each outcome, judging the evidence to be strong for results that are clinically important, consistent, and free from serious doubts about generalizability, bias, or flaws in research design. We judged evidence to be moderate for studies of strong design, with some inconsistencies or concern about generalizability, bias, research design flaws, or for studies of weaker design with consistent evidence. We judged evidence to be weak for studies of weaker design with inconsistent results, or studies of strong design with inconclusive results.

From our review of 1,406 abstracts, 54[1–54] addressed maternal and neonatal short- and long-term outcomes.

KQ 2: Outcomes of Cesarean Delivery on Maternal Request

Overall, few moderately relevant studies were available, and the strength of evidence is weak for nearly all outcomes.

Short-Term Maternal Outcomes for Primary Cesarean Deliveries

Mortality. Four studies suggested no evidence of difference in maternal mortality associated with planned vaginal versus planned cesarean delivery. These studies provided weak evidence overall.

Infection. The 12 studies that included maternal infection as an outcome provided weak evidence that the risk of maternal infection was lower with planned cesarean than with unplanned cesarean delivery and lower for vaginal than for cesarean delivery.

Anesthetic complications. Two studies showed a lower rate of anesthetic complications with planned vaginal than with planned cesarean delivery; the third reported no significant difference between these two routes of delivery. These studies provided weak evidence suggesting a lower rate of anesthetic complications with planned vaginal delivery.

Hemorrhage and blood transfusion. Eleven studies provided moderate strength of evidence showing a lower risk of hemorrhage and blood transfusion in planned cesareans than in vaginal delivery. These studies also yielded evidence of lower hemorrhage or blood transfusion in planned cesareans than in unplanned cesareans.

Hysterectomy. Three studies yielded weak evidence on the association between emergency hysterectomy after childbirth and either planned vaginal or planned cesarean delivery. The rarity of the outcome results in insufficient statistical power to draw firm conclusions regarding the risk associated with either delivery route.

Thromboembolism. Eight studies provided weak evidence for an association between thromboembolism and planned vaginal or planned cesarean delivery. Studies reported no consistent direction or magnitude of effect.

Surgical complications. Ten studies provided weak evidence on surgical complications associated with planned vaginal and planned cesarean delivery. Studies generally showed a lower risk of surgical complications in planned "elective" cesarean than unplanned "emergency" or "labored" cesarean deliveries.

Breastfeeding. One study provided weak evidence that, although women with planned vaginal deliveries may initiate breastfeeding sooner than women with planned cesarean deliveries, they do not report any difference in the duration of breastfeeding. Other evidence suggests that women are more likely to bottlefeed following a cesarean delivery (planned or unplanned) compared with a vaginal delivery.

Postpartum pain. Four articles (from three studies) reported on postpartum pain using various pain measures at different time periods. Together, these studies provide weak evidence of no significant difference in pain between modes of delivery, but they draw from populations with breech deliveries and may, therefore, overestimate the pain in the planned vaginal delivery group.

Psychological outcomes: postpartum depression. Two studies provide weak evidence suggesting no differences in postpartum depression by delivery route. As with pain, studies with

breech populations likely overestimated the rate of complications, interventions, and possible negative psychological outcomes in the planned vaginal delivery group.

Psychological outcomes: other. Seven articles (from six studies) yielded weak evidence about a range of other psychological outcomes. The data were consistent in reporting that women who had an unplanned cesarean birth or an instrumental vaginal delivery were more likely to experience adverse psychological outcomes than were women who either underwent a spontaneous vaginal or a planned cesarean birth. The variety of outcomes and measures makes a summative assessment of other outcomes challenging.

Maternal length of stay. Four studies provided moderate evidence that length of stay is higher for cesarean delivery, planned or otherwise, than for vaginal delivery.

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Maternal Mortality With Cesarean Delivery in Massachusetts (1995–2003) and a Review of the Literature

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Recently, there has been growing interest in primary elective cesarean delivery. Maternal mortality is one of the most crucial issues within this discussion. The exact risk attributable to this mode of delivery is still unknown. There are publications that report an increase in the risk of maternal death with cesarean delivery compared to vaginal delivery; others report no significant difference. However, the majority of these studies have significant limitations.

In order to address these shortcomings in the literature, we reviewed the literature reporting on maternal deaths subsequent to 1982 and investigated the pregnancy-related maternal deaths in Massachusetts between Jan. 1, 1995 and Dec. 31, 2003.

There were nine publications eligible for review.[1–9] The incidence of maternal death associated with cesarean delivery ranged from 0/17,740 to 29/31,596 (0 to 92/100,000). The relative risk of death with elective cesarean delivery as compared to vaginal delivery was reported as low as 0.77. Three studies, including the only randomized controlled trial, reported no statistically significant difference in maternal mortality based on method of delivery after controlling for confounding variables. In addition, we reviewed the Royal College of Obstetricians and Gynaecologists publications, "Report on Confidential Enquiries into Maternal Deaths in the United Kingdom" for the years 1997–1999 and 2000–2003. The earlier publication reports a 0.8 relative risk of mortality with scheduled cesarean delivery compared to vaginal delivery.[10] The more recent report groups elective and scheduled deliveries (including cases with preexisting risk factors) and cites an associated 2.8 relative risk of maternal death compared to vaginal delivery.[11]

In an effort to further investigate the issue of maternal mortality with cesarean delivery, we investigated the pregnancy-related maternal deaths in Massachusetts between January 1, 1995 and December 31, 2003. All cases were identified by the Department of Public Health (DPH) of the Commonwealth of Massachusetts Maternal Mortality and Morbidity Committee. Medical records were reviewed for each maternal death.

There were 761,278 live births in Massachusetts between 1995 and 2003. Twenty-two percent were known cesarean deliveries. The absolute number and the overall percentage of deliveries that were primary cesarean deliveries increased each triennium, accounting for 17.7 percent of all deliveries from 2001 to 2003. There were 53 maternal deaths in Massachusetts over 9 years with an overall maternal mortality rate (including all pregnancy-related deaths reported to the DPH) of 7.27. There were 22 cases excluded from the analysis on the condition that the method of termination of the pregnancy was not cesarean or vaginal delivery (e.g., dilation and evacuation or ruptured ectopic pregnancy) or the method of delivery did not contribute to the maternal death (e.g., postmortem cesarean section).

Of the remaining 31 cases, 17 deaths were associated with cesarean delivery, 4 of which were primary procedures. The maternal mortality rate for this sample was recalculated to be 2.91 to 5.35 per triennium. The maternal mortality rate associated with primary cesarean delivery

decreased from 6.37 from 1995 to 1997 to 2.32 from 2001 to 2003. The relative risk of maternal death with primary cesarean delivery compared to vaginal delivery (excluding vaginal births after cesarean [VBACs]) decreased from 5.84 in the first triennium to 0.56 in the final triennium (table 1). In addition, the relative risk of maternal death with repeat cesarean delivery decreased dramatically; however, in the most recent triennium included in analysis, maternal death was four times more likely following a repeat cesarean delivery as compared to vaginal delivery. In reviewing the deaths associated with repeat cesarean delivery in the last triennium, however, none were felt to be directly due to the surgery itself.

Table 1. Relative Risk of Maternal Mortality With Method of Delivery and the Incidence of Maternal Death Clearly or Likely Attributable to Cesarean Delivery Surgery by Triennium

Year	Method of Delivery	No. of Deaths	RR Maternal Mortality	Deaths Due to Cesarean Surgery/ Total Cesarean Deliveries
1995–1997	Vaginal	2	1	2/48,283
	Primary cesarean	2	5.84	
	Repeat cesarean	4	21.72	
1998–2000	Vaginal	4	1	0/54,141
	Primary cesarean	1	1.26	
	Repeat cesarean	5	12.31	
2001–2003	Vaginal	7	1	0/67,052
	Primary cesarean	1	0.56	
	Repeat cesarean	4	4.05	
	VBAC*	1	5.54	

*There was one death associated with VBAC delivery from 1995 to 2003.

Of the 17 cases associated with cesarean delivery, there were no deaths associated with primary elective cesarean delivery or cesarean delivery with a primary indication of breech presentation. Deaths following cesarean delivery were analyzed to determine if the surgical procedure itself contributed to the death. Fourteen of the 17 cases were clearly not related to the surgery. The incidence of maternal death clearly or likely associated to cesarean delivery was 2 in 48,283 cesarean deliveries in the first triennium. There were no deaths clearly attributed to the cesarean delivery in 121,193 procedures performed between 1998 and 2003 (table 1).

These results were derived from population-based statewide data and include deaths from both teaching and community hospitals. The causes of death were felt to be accurate as they were reviewed by an established maternal mortality committee in combination with autopsy reports available in 76 percent of cases. Unfortunately, the risk of maternal mortality with trial of labor versus elective antepartum cesarean delivery could not be determined because the total number of women in each category is unknown. In addition, there are several other important factors to

be considered, including whether cesarean delivery results in increased significant maternal morbidity.

In summary, the risk of maternal death with primary elective cesarean delivery is less than that associated with vaginal delivery. In addition, death directly due to the surgery itself is extremely rare.

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Maternal Morbidity and Short-Term Outcomes

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Ideally, a randomized clinical trial would compare maternal morbidity associated with patient request cesarean to routine delivery management. However, no such investigation is available. Alternative research designs indirectly addressing the question include retrospective population-based cohort studies of maternal outcomes by actual route of delivery (not considered in this abstract),[1–5] retrospective population-based cohort studies of planned delivery route of vertex fetuses,[6] retrospective cohort studies of maternal outcomes by planned route of breech delivery,[7–11] or randomized trials of planned cesarean versus planned vaginal delivery for the term singleton breech.[12–15]

Allen and colleagues used the Nova Scotia (Canada) Atlee Computerized Perinatal Database to study nulliparous women at term (37–42 weeks) with no obstetric or medical complications delivering vertex singletons with no major anomalies from 1988 to 2001. They compared maternal morbidity in women delivering by cesarean without labor (*n*=721) to women entering spontaneous labor intending spontaneous vaginal delivery (*n*=17,714). Febrile morbidity was more frequent with prelabor cesarean (1.1 percent, Relative Risk [RR]=2.2; 95 percent Confidence Interval [CI]=1.1–4.5) while postpartum hemorrhage was more frequent with spontaneous labor onset (6.2 percent, RR=1.6; 95 percent CI=1.1–2.4). Subgroup analysis showed that the higher hemorrhage incidence reflected the contribution of operative vaginal delivery and cesarean in labor. Planned vaginal delivery incurred the unique 5.4 percent overall risk of third- and fourth-degree lacerations, occurring with 3.2 percent of spontaneous vaginal and 15.2 percent of assisted vaginal deliveries. Composite morbidity was similar for prelabor cesarean (7.0 percent, RR=0.8; 95 percent CI=0.6–1.1) and spontaneous labor (8.4 percent), reflecting similar rates of transfusion, wound infection, hematoma evacuation, and intraoperative trauma.

Five retrospective cohort studies examined maternal outcomes by planned cesarean versus planned vaginal delivery of the term/near-term breech-presenting fetus.[7–11] Twenty-two to 63 percent of women were assigned to planned cesarean and 37–78 percent were assigned to planned vaginal delivery, of whom 52–83 percent delivered vaginally. Total maternal morbidity among the planned cesarean patients ranged from 12 to 28 percent compared to 8–23 percent in the planned vaginal delivery patients. However, three studies included cystitis as a measure of morbidity, which occurred more frequently among planned cesareans.[7,8,11] A random effects meta-analysis of these data (test of homogeneity p=0.05) demonstrated a summary odds ratio of 1.48 (95 percent CI=1.14–1.93), favoring planned vaginal delivery. Excluding cystitis as an outcome, adverse maternal events ranged from 2.4 to 15.7 percent in planned cesareans and from 5.1 to 18.9 percent in planned vaginal deliveries. A fixed effects meta-analysis of these data (test of homogeneity p=0.29) demonstrated a summary odds ratio of 1.02 (95 percent CI=0.77–1.34).

Three randomized trials comparing planned cesarean to planned vaginal delivery for breech assessed short-term maternal outcomes.[12–15] A Cochrane Database Systematic Review of these three trials noted somewhat increased overall maternal morbidity in the planned cesarean group (9.1 percent vs. 8.6 percent, RR=1.29; 95 percent CI=1.03–1.61).[16] However, two of the trials were small, randomized patients in labor, and were conducted in the 1970s and early 1980s,

raising questions of labor and temporal changes in cesarean technique impacting operative morbidity.[12,13]

The largest and most recent trial evaluated 2,088 women from 121 centers in 26 countries with term (≥37 weeks), singleton, frank or complete breech fetuses <4000g and no lethal anomalies.[14,15] Of the 1,041 subjects for planned cesarean, 941 (90.4 percent) delivered by cesarean, of which 471 (50.0 percent) were in labor. Of the 1,042 subjects for planned vaginal delivery, 591 (56.7 percent) delivered vaginally, 123 (22 percent) with forceps. There were no significant differences between the study groups by overall morbidity (planned cesarean vs. planned vaginal delivery RR=1.13; 95 percent CI=0.92–1.39) or specific outcomes of hemorrhage, transfusion, genital tract injury, wound complications, systemic infection, or depression. There were no hysterectomies or venous thromboemboli.[14] Three-month followup of these subjects revealed no significant differences in rates of depression or pain. However, pain with planned cesarean was more frequently abdominal (8.8 percent vs. 4.6 percent, $p<0.001$) and among planned vaginal subjects more often genital (5.5 percent vs. 1.8 percent, $p<0.001$).[15]

The available data, though limited, suggest that term-planned cesarean and planned vaginal delivery have similarly low rates of absolute and relative short-term maternal morbidity. Endometritis and cystitis are more frequent with cesarean, while hemorrhage is more frequent with planned vaginal delivery. Much of the morbidity of planned vaginal delivery is the morbidity of unplanned cesarean in labor and operative vaginal delivery, particularly forceps. Thus, the relative risk of short-term maternal morbidity of planned cesarean versus planned vaginal delivery will depend on the proportion of women ultimately delivering in the planned manner, and the frequency with which delivery occurs by an alternative, unplanned method.

Several gaps in current knowledge are amenable to future study. While serious anesthesia-related complications during cesarean are rare,[17] there are no comparative studies with planned vaginal delivery. Large population-based cohort studies can address this outcome and other rare but serious complications, such as venous thromboembolism. Additionally, stratification of operative vaginal deliveries' outcomes by instrumentation and classification would provide informative data. Finally, planned vaginal delivery should be evaluated with respect to spontaneous onset versus induced labor.

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Long-Term Maternal Consequences Associated With Cesarean Delivery on Maternal Request Versus Planned Vaginal Delivery

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The evidence on the balance of risks and benefits of Cesarean Delivery on Maternal Request (CDMR) versus planned vaginal delivery is unclear. We undertook a systematic review to examine outcomes associated with planned route of delivery—one of the four Key Questions (KQ) specified by the Planning Committee for the National Institutes of Health State-of-the-Science Conference: Cesarean Delivery on Maternal Request.

We searched MEDLINE,® Cochrane Collaboration resources, and Embase (1990 to June 2005). We excluded studies that: (1) did not report on women of reproductive age; (2) were published in languages other than English; (3) did not report information pertinent to the key clinical questions; (4) had fewer than 50 subjects for randomized controlled trials (RCTs) or 100 subjects for observational studies; or (5) were not original studies. Additionally, we excluded studies that did not provide data on both planned cesarean delivery and planned vaginal delivery. All eligible studies were reviewed, and relevant data were extracted, entered into evidence tables, and summarized by descriptive methods.

The comparison groups varied widely. We developed a four-tier classification system of relevance to CDMR based on the following criteria: (1) whether studies analyzed outcomes by planned route of delivery (trials of route of delivery); (2) whether CDMR was included as a comparison group (high relevance); (3) whether comparison groups comprised planned cesareans (moderate relevance); and (4) whether studies involved undefined "elective" or a mix of planned and unplanned, unlabored cesareans (low relevance). We summarized the strength of evidence for each outcome, judging the evidence to be strong for results that are clinically important, consistent, and free from serious doubts about generalizability, bias, or flaws in research design. We judged evidence to be moderate for studies of strong design, with some inconsistencies or concern about generalizability, bias, research design flaws, or for studies of weaker design with consistent evidence. We judged evidence to be weak for studies of weaker design with inconsistent results, or studies of strong design with inconclusive results.

From our review of 1,406 abstracts, 54[1–54] addressed maternal and neonatal short- and long-term outcomes of primary cesarean deliveries. We updated or summarized recent reviews for maternal outcomes of subsequent cesarean deliveries.

KQ 2: Outcomes of Cesarean Delivery on Maternal Request

Overall, few moderately relevant studies were available, and the strength of evidence is weak for nearly all outcomes.

Long-Term Maternal Outcomes for Primary Cesarean Deliveries

Urinary incontinence. Nine articles (from eight studies) provided weak evidence that rates of stress urinary incontinence for planned "elective" cesarean section were either lower than or no different from those for vaginal delivery. Numerous problems limit evidence on this outcome: lack of high-quality prospective studies that compare planned routes of delivery, have adequate power, include comprehensive long-term followup, account for multiple deliveries, account for variations in practice patterns including use of epidural anesthesia and episiotomy, use validated urinary questionnaires administered at consistent time points from delivery, and define incontinence in a standardized fashion by its occurrence, severity, and impact on quality of life.

Anorectal function. Seven articles (from six studies) provided weak evidence showing a reduced risk of anal incontinence in planned cesarean deliveries compared with unplanned cesarean or instrumental vaginal deliveries. Evidence was inconsistent about differences between planned cesarean and spontaneous vaginal delivery.

Pelvic organ prolapse. We found no evidence on the association between pelvic organ prolapse and planned vaginal or planned cesarean delivery.

Sexual function. One study provided weak evidence that sexual function does not differ by planned route of delivery.

Long-Term Maternal Outcomes Relevant to Subsequent Cesarean Delivery

Subsequent fertility issues. Studies other than those included in this review suggest a higher risk with all cesarean deliveries (unplanned or planned), but we found no reliable evidence of difference relevant to CDMR.

Subsequent uterine rupture. A recent update of a systematic review on the outcomes of vaginal birth after cesarean (VBAC) provided moderate evidence on subsequent uterine rupture. The update found no statistically significant differences between trial of labor after cesarean and elective repeat cesarean delivery with regard to rates of *asymptomatic* uterine rupture rates. The update noted that two studies of fair or good quality found a small but higher risk of *symptomatic* uterine rupture in trial of labor after cesarean than in elective repeat cesarean delivery.

Placenta previa. Given that placenta previa is the most common placental implantation anomaly, we updated a recent meta-analysis examining the relationship between placenta previa and a history of cesarean delivery. Our update supports the earlier meta-analytic conclusion that the odds of placenta previa are associated with advancing maternal age and increasing parity. The literature provided moderate evidence that the risk of placenta previa increases with previous cesarean delivery.

Subsequent stillbirth. Studies other than those included in this review suggest a higher risk with all cesarean deliveries (unplanned or planned), but we found no reliable evidence of difference relevant to CDMR.

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Sexual Function and Childbirth

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In the popular press, women are told to anticipate a decline in sexual function during the first few months after childbirth.[1,2] Indeed, clinical research suggests a short-term measurable decline in sexual function after delivery.[3–7] By 3 months after a first delivery, 7 to 20 percent of women have still not resumed intercourse.[3,6–8] Among those who have resumed sexual relations, up to two-thirds report a variety of sexual complaints, including dyspareunia, loss of desire, difficulty achieving orgasm, and vaginal dryness.[3–7,9,10] The majority of these complaints resolve during the first postpartum year.[3,5,6]

There is an assumption that postpartum sexual function fares better after cesarean delivery,[2] but the impact of cesarean delivery on postpartum sexual function has only recently been studied. In a large, multicenter randomized trial of elective cesarean (the Term Breech trial),[11,12] there was no impact of planned method of delivery on resumption of sexual relations, pain during sex, or satisfaction with sexual relations. A limitation of this study is that 50 percent of participants received help completing the postpartum questionnaire. Therefore, sexual concerns may have been underreported. In general, it is important to know whether cesarean delivery (or other obstetrical interventions) has a clinically meaningful impact on sexual function after delivery. The purpose of this abstract is to review the potential benefits and harms of maternal request cesarean on short-term (under 1 year) and long-term sexual function.

Based on our current understanding of female sexual function, there are several plausible mechanisms by which route of delivery could impact postpartum sexual function. First, the risk of dyspareunia may be affected by route of delivery. Dyspareunia is reported by 41 to 67 percent of women 2–3 months after childbirth.[3–5,7] Perineal pain typically resolves by 3 months after delivery,[3] although dyspareunia takes somewhat longer to resolve.[3,4] For example, 1 year after delivery, dyspareunia was reported by 11 percent of Swedish women, but "major" dyspareunia by less than 2 percent.[13] Among women delivering vaginally, dyspareunia is strongly associated with the severity of perineal trauma sustained at delivery.[4,9,14] This would suggest that dyspareunia might be reduced by cesarean delivery. To date, the majority of studies show less short-term dyspareunia after cesarean delivery but no difference by 3–6 months postpartum.[5,8,9,15–18] An important question is whether we can identify modifiable risk factors for persistent dyspareunia. Operative vaginal delivery[3,7–9,16,17,19,20] and severe perineal lacerations[7,21,22] have been investigated as factors that might increase persistent dyspareunia. If severe perineal lacerations, which complicate at least 5 percent of vaginal births[23] contribute to long-term dyspareunia, that would be an argument in favor of "prophylactic" cesarean. At this point there is inconsistent evidence of long-term harm from severe lacerations or operative delivery, with many studies suggesting no difference after the first 6–12 months.[5,8,19–21] More research is needed to investigate the long-term prognosis for dyspareunia after vaginal delivery, and whether this complication can be reduced through "prophylactic" cesarean delivery.

A second plausible mechanism for the impact of route of delivery on sexual function is pudendal neuropathy. The pudendal nerve is the primary afferent nerve for the perineum, vulva, and clitoris.[24] It mediates some of the reflex pathways involved with female sexual function.[24] Pudendal nerve trauma has been demonstrated after vaginal delivery,[25–28] either as a result of

compression of the nerve by the fetal head or by stretching of the nerve. Both of these mechanisms are consistent with events in the second stage of labor.[25,27,29,30] Pudendal nerve damage has been associated with duration of the second stage, operative delivery, and fetal birthweight.[27] It may be less likely to occur if delivery is accomplished via cesarean delivery prior to labor.[31] Whether pudendal nerve injury could cause a clinically measurable impact on female sexual function remains to be investigated. Also, because recovery from pudendal neuropathy occurs in the first 2–6 months after delivery,[26,32] it isn't clear that long-term sequalae would persist. Nevertheless, long-term evidence of neuropathy has been demonstrated, with apparent effects on continence.[28] Therefore, a long-term impact on sexual function is plausible.

A third possible mechanism for the impact of route of delivery on female sexual function is the impact on the general health of the mother.[10] In one study, self-rated general health was significantly worse after cesarean delivery than spontaneous vaginal delivery 7 weeks postpartum.[16] After cesarean delivery, women are more likely to be readmitted to the hospital.[17] Also, after cesarean, women report more fatigue in the first 2 months after delivery, but this difference does not persist.[17] Despite these short-term differences in maternal general health after delivery, one study that addressed the impact of general health on sexual function found that poor maternal health in the post-partum period was not associated with poor sexual function.[16]

An additional possible mechanism for the impact of route of delivery on female sexual function would be via psychosocial and cultural factors. Female sexual function is likely to be impacted by transition to role as a mother, changes in body image, marital satisfaction, mood, and fatigue.[33] While these factors are known to influence female sexual function after childbirth, it is not clear whether route of delivery would have an impact on these factors.

There are several important areas for future research. First, a more thorough understanding of female sexual function would inform future research. At this time, we have a limited understanding of the physiological and psychological mechanisms for normal female sexual function. Second, valid measures of sexual function are needed to improve the assessment of outcomes in clinical trials. Most research to date has been conducted without validated research questionnaires and with only a very limited characterization of sexual function (e.g., dyspareunia and resumption of intercourse as the sole measures of dysfunction). There are a number of validated self-administered questionnaires for assessing female sexual function in clinical research, but it's not known whether these are valid for measuring sexual function related to childbirth. For example, the Female Sexual Function Index (FSFI)[15,34] was validated in a population with a mean age of 40 years and unknown parity.[34] The Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ)[35] has been developed to measure the impact of pelvic floor disorders (such as incontinence and pelvic organ prolapse) on sexual function. This instrument would therefore be of potential use as a condition-specific measure of sexual function. Again, this instrument has not been validated in population of postpartum women. A third area for future research is the quality-of-life impact of postpartum sexual dysfunction. For example, what sexual problems are most bothersome or worrisome to new mothers (and their partners)? The impact of sexual difficulties has not been studied in detail, and priorities have yet to be assessed in relevant populations.

Finally, prospective, longitudinal studies would help to clarify the possible long-term impact of various obstetrical interventions, including maternal-request cesarean delivery. Studies should have adequate power to control for potential confounders, including breastfeeding. A

detrimental impact of breastfeeding on postpartum sexual function has been recognized.[6,7,33] Other potential confounders include parity, age, preexisting sexual complaints, depression, and the status of the woman's relationship with her partner. Given the longitudinal changes in sexual function over the first year postpartum, and our limited understanding of factors that impact the prognosis for sexual function years after childbirth, assessment of long-term maternal outcomes should be a priority for future research.

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Reproductive Consequences

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As the process of labor and delivery has been associated with urogenital damage, the issue of cesarean delivery as a means of avoiding this problem has arisen. Potential benefits of this practice, however, must be weighed against the potential harms. Currently, the average American woman bears more than one child. Thus, one must consider the effect that cesarean delivery on request might have on a woman's current and subsequent pregnancies and on her overall reproductive health.

In the first delivery, based on limited data, cesarean section on demand appears to hold small risk of long-term reproductive complications, such as hysterectomy, compared to vaginal delivery. Allen and colleagues compared maternal morbidity in term, nulliparous females and found similar overall complication rates in women undergoing elective cesarean delivery compared to those delivering vaginally following spontaneous labor. Of interest, those undergoing cesarean delivery following labor had a higher rate of complication (16.3 percent) compared to women who delivered by elective cesarean (7 percent).[1]

Beyond the current pregnancy, we must consider subsequent reproductive health. Women who undergo cesarean delivery may have lower rates of future childbearing. The association between cesarean section and infertility has been demonstrated in a number of epidemiologic studies.[2–6] The mechanism for this association requires further elucidation. Biologic explanations suggest scarring, adhesions, and placental implantation might contribute to an increased time to subsequent conception.[6] Others have suggested a psychosocial mechanism in which negative factors associated with cesarean delivery contribute to reluctance to become pregnant again. Studies describing emotions regarding the cesarean delivery,[7–9] issues in marital adjustment,[10] and problems in bonding and breast feeding would support this reasoning.[11] One would suspect that some of these factors would be mitigated if a woman elected to have a cesarean delivery. In addition, important confounders must be taken into account including maternal age and history of subfertility;[12] though there is evidence that this relationship still exists when controlling for these confounders.[5] The risk of infertility appears unrelated to endometriosis. There are numerous case reports of endometriosis of the abdominal wall, abdominal scar, or even formation of a fistulous tract following cesarean delivery. Yet, the incidence of this occurrence and the reproductive sequelae, if any, are not known.[13]

When a woman does conceive, a prior cesarean delivery may place her at increased risk of fetal wastage. In the first trimester, both ectopic pregnancy and spontaneous abortion appear to be slightly more common in women who have undergone cesarean delivery. Using data from a Finnish National registry, Hemminki and colleagues found the relative risk of ectopic pregnancy following cesarean delivery to be 1.28 ($p<0.05$).[14] This study reported a similarly slight increased risk of miscarriage in the subsequent pregnancy. A small case control study of women with a history of ectopic pregnancy did not find an association with prior cesarean delivery.[15] Growing literature reports cases of ectopic pregnancies implanting within the uterine scar following cesarean delivery. While some have been successfully treated with methotrexate and/or surgical excision, others have resulted in hemorrhage and emergency hysterectomy.[16–18] The epidemiology of uterine scar ectopic has yet to be fully described.

Data linking previous cesarean delivery to unexplained still birth in the subsequent pregnancy are concerning. In a large-scale retrospective cohort study, women with a prior cesarean delivery had an increased risk of unexplained fetal death apparent from 34 weeks gestation onward (Relative Risk [RR]=2.23; 95 percent Confidence Interval [CI]=1.48–3.36) compared to women with no prior cesarean delivery. When restricting the sample to those women delivering between 34 and 39 weeks (thus accounting for women with plans for repeat cesarean delivery) the risk persisted.[19]

Perhaps the largest body of evidence on impaired uterine function following cesarean delivery relates to abnormal placentation. While the exact mechanism is unknown, one hypothesis suggests that uterine scarring prevents normal implantation and migration of the placenta resulting in placenta previa, accrete, increta, percreta, or abruption. Lydon-Rochelle and colleagues found the relative risk of abruption to be 1.3 (95 percent CI=1.1–1.5) and the risk of placenta previa to be (1.4; 95 percent CI=1.1–1.6).[20] In another study of primiparous women the risk of abruption was 2.41 in the first subsequent pregnancy and 3.89 among multiparous women.[14] A number of authors have demonstrated the association between placenta previa and cesarean delivery to be independent of other known risk factors for abnormalities of placentation, and that the risk of placenta previa increases with subsequent cesarean deliveries and increasing parity independent of route of delivery.[21]

In addition to abnormalities of placentation, cesarean delivery is associated with uterine rupture in subsequent pregnancies, particularly for those women who choose to labor. In a large, multicentered, observational trial, there was a 0.7 percent risk of symptomatic uterine rupture among women undergoing a trial of labor. There were no ruptures in the women undergoing elective repeat cesarean delivery. The rate of uterine dehiscence was higher among women undergoing a trial of labor: 0.7 percent versus an elective repeat cesarean delivery 0.5 percent (Odds Ratio [OR]=1.38; 95% CI=1.04–1.85). The rate of hysterectomy was not statistically different in the two groups (0.2 and 0.3 respectively).[22] In an earlier trial, McMahon and colleagues also found higher maternal risk associated with trial of labor.[23] Finally, Mozurkewich and colleagues conducted a meta-analysis based on 15 studies and found a similar risk profile, though the risk of hysterectomy was reduced in women undergoing a trial of labor to 0.39 (95% CI=0.27–0.57).[24] Yet, electing for repeat cesarean does not avoid these risks, as rupture can occur prior to labor and some women will experience labor despite desiring repeat cesarean.

Ultimately, a woman's decision regarding route of delivery can have important and serious consequences for her subsequent reproductive life and health. Fetal wastage, abnormalities of placentation, and uterine rupture may affect the health and well-being of the woman and her offspring. Thus, the balance of data would suggest that cesarean delivery on request is harmful for a woman's future reproductive health.

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Pelvic Floor Disorders Overview

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Public Health Significance of Pelvic Floor Disorders in Women

Pelvic floor disorders in women are a group of conditions including pelvic organ prolapse, urinary incontinence, fecal incontinence, and other sensory and emptying abnormalities of the lower urinary tract and lower gastrointestinal tract. With the steady increase in the population of older women, the national cost burden related to pelvic floor disorders is huge in terms of direct healthcare costs, lost productivity, and decreased quality of life. It is estimated that one or more of these conditions affects up to one-third of adult women, although accurate prevalence figures are very difficult to obtain. In one study based on a "population" under one healthcare system, 11 percent of women had surgery for urinary incontinence or pelvic organ prolapse during their lifetime, and 30 percent of those who had surgery had at least two procedures to correct the problem.[1] In the United States each year, an estimated 135,000 women undergo surgery for urinary incontinence.[2] Up to 225,000 women have surgery for prolapse[3,4] at an estimated direct medical cost of over $1 billion.[5] The number of surgeries performed for fecal incontinence is unknown.

Women who undergo surgical treatment for pelvic floor disorders represent only a small fraction of all women with these disorders. For some pelvic floor disorders, such as urinary incontinence due to detrusor overactivity, surgery is not indicated and management consists only of nonsurgical therapy. For other disorders, such as prolapse, some women are treated nonsurgically, while many others do not seek or receive treatment at all. In addition, many women have some combination of more than one pelvic floor disorder (such as urinary symptoms with pelvic organ prolapse). Considering the lack of consensus in defining the presence or absence of a clinically important problem, it is no wonder that there are no reliable figures for the total number of women affected by pelvic floor disorders in the United States or elsewhere in the world.

Similarly, there are no accurate figures for the total costs for pelvic floor disorders. Any cost estimate should consider all costs, including direct medical costs of surgical and nonsurgical treatment, indirect medical costs, and nonmedical costs, although most estimates consider only one aspect of costs, typically direct medical costs. This is true of a recent estimate of direct costs for urinary incontinence in the United States, at $16 billion per year.[6] The only cost estimate for prolapse focuses on surgery, and there are no cost data at all for fecal incontinence.

Given the substantial public health burden of pelvic floor disorders, much research attention has been focused on identifying risk factors, especially modifiable risk factors, for the development of pelvic floor disorders. Some epidemiologic and clinical evidence has implicated changes due to pregnancy and childbirth as important pathophysiologic events in women's lifetime risk of pelvic floor disorders. This issue is of critical public health importance since most American women have at least one child. Indeed, some clinicians have already advocated changes in obstetric management, some who promote cesarean delivery on demand and some who even recommend cesarean delivery for all women as a means of protecting pelvic floor function and preventing the development of pelvic floor disorders. Coincident with changed

obstetric practice for vaginal birth after cesarean (VBAC) and the addition of "elective" or "maternal request" as a newly legitimate indication for cesarean, the rate of cesarean delivery in the United States is climbing ever higher. After a nadir of 20.7 percent in 1996, the rate has increased each year since then to reach an all-time high of 29 percent.

Effects of Pregnancy and Delivery on Pelvic Floor Function

Ideally, the effects of pregnancy on pelvic floor function would be studied in women during their first-term pregnancy. However, resolution of the effects of pregnancy cannot be studied independent of the effects of delivery. More information is available on urinary function during and after pregnancy, and less information on anorectal function and pelvic organ prolapse.

Urinary Function During and After Pregnancy

Although changes in urinary function, including the development of urinary incontinence, occur commonly in pregnancy, the pathophysiology of these changes remains poorly understood. Despite marked increases in intra-abdominal pressure during pregnancy, continence is maintained in many women in association with increased functional urethral length and increased urethral closure pressure,[7] although not all studies have demonstrated changes in pregnancy detectable by urodynamic testing.[8,9] Perineal ultrasound of the urethrovesical junction shows lowering of the pelvic floor as early as 12–16 weeks of pregnancy,[10] which argues against changes due solely to the effects of uterine enlargement in later pregnancy. The contribution of hormonal changes to continence status during and after pregnancy has not been clearly delineated.

Urinary incontinence occurs in up to 25 percent of women in early pregnancy, and up to 60 percent in later pregnancy.[11–13] The severity of symptoms tends to worsen as pregnancy progresses.[14] In most cases, incontinence resolves after delivery but risk factors for persistence have not been consistently identified. The effect of the type of delivery on the risk of persistent postpartum incontinence is not consistently reported by studies that focus on this issue. Early after delivery, the type of delivery seems to have the strongest effect. In one of the few randomized trials of delivery type to address this (although not as a primary aim), the Term Breech Trial found less urinary incontinence in women in the planned cesarean delivery group (4.5 percent, relative risk 0.62) compared to the planned vaginal delivery group (7.3 percent).[15] Since 43 percent of women in the planned vaginal delivery group actually had cesarean delivery, the results of this study probably underestimate the true difference between cesarean and vaginal delivery. Observational studies have also shown lower rates of incontinence between women who deliver vaginally compared to women who deliver abdominally.[16,17]

However, the effect of type of delivery seems to diminish with time. In the EPINCONT study,[17] the prevalence of incontinence was similar regardless of type of delivery in the oldest age group of women studied (ages 50 to 64 years). Incontinence 5 years after the first delivery was not influenced by the type of delivery.[18] The risk of incontinence accumulates with the number of cesarean deliveries; after three or more cesarean deliveries, the prevalence of incontinence was similar (38.9 percent) compared to women delivering vaginally (37.7 percent).[16]

In fact, the influence of even one delivery on the lifetime risk of urinary incontinence remains controversial. Many clinicians and patients believe that one of the major risk factors for developing urinary incontinence is childbirth, and some studies (some that used only univariate analyses) have shown strong effects of increasing parity.[16,19–22] However, in other studies, particularly those using multivariate analyses, the effect of parity diminishes or disappears. For the first 5 years after delivery, some studies show that the first vaginal delivery imparts the highest risk for incontinence, and that subsequent vaginal deliveries do not increase the risk substantially;[18,23] other studies, including comprehensive reviews, show no effect of parity on the risk of incontinence, especially later in life.[24–26] This has also been shown by a study that found similar rates of incontinence in nulliparous nuns and parous postmenopausal women.[27]

In summary, parity seems to influence the risk of urinary incontinence, but primarily in women during their reproductive years. While cesarean delivery seems to offer moderate protection from the development of urinary incontinence, its effect is of short duration (less than 5 years from delivery). Despite increased attention to this issue in the professional and lay press,[28,29] there have been no formal analyses of the risks and benefits associated with an increased rate of cesarean delivery in terms of short- and long-term changes in women's risk of urinary incontinence.

Anorectal Function During and After Pregnancy

In the few studies that have directly evaluated anorectal function in pregnancy, no change has been consistently identified.[30] Few women seem to develop new symptoms of fecal incontinence during pregnancy, although this has not been well studied. However, new onset fecal incontinence or other symptoms of disordered defecation (e.g., fecal urgency) occur quite commonly after delivery. As with urinary incontinence, the hormonal contribution to anorectal function during and after pregnancy has not been determined.

The risk of fecal incontinence for women delivering vaginally is highest in women who have sustained anal sphincter damage (third- or fourth-degree perineal laceration), occurring in up to 50 percent of women in the early postpartum period. As with urinary incontinence, many anorectal symptoms seem to resolve spontaneously within the first 6 to 12 months postpartum. However, in contrast to urinary incontinence, subsequent vaginal delivery, particularly if another anal sphincter laceration occurs, is associated with a higher risk of persistent fecal incontinence symptoms.[31–33] The increased risk of fecal incontinence with anal sphincter damage persists and worsens with time.[34,35]

Data on risk factors for anal sphincter laceration must be interpreted with caution, primarily because of the strong association between sphincter laceration and episiotomy, and differences in clinical practice regarding episiotomy type in the United States compared to England and Europe. Anal sphincter laceration is a common occurrence (up to 20 percent) at vaginal delivery in the United States, where midline episiotomy is the preference. However, in England and Europe where mediolateral episiotomy is preferred, anal sphincter laceration is a distinctly uncommon event at vaginal delivery (2 percent or less). It is likely that when anal sphincter damage occurs with mediolateral episiotomy, it represents a much different level of pelvic floor damage than when anal sphincter damage occurs with midline episiotomy, although this has not been well studied.

Most studies show that midline episiotomy is one of the strongest risk factors for the occurrence of anal sphincter laceration, with the risk increased up to 22 times compared to women with spontaneous perineal lacerations.[36] (The risk of anal sphincter laceration seems unchanged or perhaps lower if mediolateral episiotomy is performed.) In a study comparing episiotomy rates in the United States over time, anal sphincter laceration occurred in 8.3 percent of women (on average, 1 in 12) with episiotomy, compared to 3.8 percent of women (1 in 26) delivered without episiotomy.[37] This reflects an excess of an average 81,400 anal sphincter lacerations per year in the United States. Although the rate of episiotomy has decreased over the past 20 years (from 65 percent in 1979 to 39 percent in 1997), it remains much higher than current scientific evidence supports. Studies have reported good maternal and neonatal outcomes with episiotomy rates less than 10 percent.[38] Different rates of episiotomy are not well explained by differences in the patient population, but are largely due to differences in providers and their beliefs about the benefits of episiotomy.[39] Among clinicians, obstetricians have the highest rate of episiotomy use compared to family practitioners or midwives;[40] among obstetricians, private practitioners have a much higher rate than academic practitioners (in one study, 67 percent versus 18 percent[41]).

Even when anal sphincter damage is recognized at delivery, current methods of surgical repair are inadequate. Persistent anal sphincter defects are present in up to 85 percent of women who sustain anal sphincter damage and repair at the time of vaginal delivery.[42,43] After sphincter damage and repair, 42–54 percent of women still experience symptoms of gas or fecal incontinence after delivery.[42,44] Especially since surgical repair cannot restore normal anorectal anatomy and function, it is critically important to prevent the initial damage at vaginal delivery.

For women who remain symptomatic after anal sphincter repair immediately after delivery, when anal ultrasound shows persistent anal sphincter defects, anal sphincteroplasty is standard treatment. Although anorectal symptoms generally improve after secondary repair of anal sphincter damage, the improvement is not long-lasting. In a study that followed women after anal sphincteroplasty with at least 5 years of followup, no one was fully continent, and 15 percent had undergone more than one procedure.[45] In contrast to clinical practice for persistent or recurrent urinary incontinence where secondary treatments (e.g., sling procedures, collagen periurethral injection) are generally safe and effective, secondary treatments for fecal incontinence (e.g., muscle transposition procedures, artificial anal sphincters) carry high rates of morbidity with a much lower chance of successful treatment. Again, this emphasizes the point that the most effective way to prevent fecal incontinence in women is to reduce the rate of anal sphincter damage at childbirth.

While most attention has been focused on fecal incontinence as a consequence of childbirth, it may not be a consequence of vaginal delivery itself but of specific obstetric practices, primarily the high rate of midline episiotomy use in the United States. Obviously, not all anal sphincter damage can be avoided by minimizing episiotomy use and, even if it could, that would not prevent all cases of postpartum fecal incontinence. Other proposed mechanisms leading to fecal incontinence after vaginal delivery include injury to the pudendal nerve, possibly as a result of stretch and compression during the second stage of labor. However, even cesarean delivery does not protect women completely from the development of postpartum anorectal dysfunction. Recent studies have identified new fecal incontinence symptoms even after elective cesarean delivery without labor.[15,46] It is uncertain whether this reflects changes due to pregnancy, the surgical delivery, or possibly both.

In summary, damage sustained at vaginal delivery, particularly direct injury to the anal sphincter, clearly increases the risk of fecal incontinence. However, the strongest risk factor for anal sphincter damage is midline episiotomy, a specific obstetric practice, the use of which should be minimized by current evidence-based standards of care. It remains unknown whether the benefits of elective cesarean delivery in preventing anal sphincter injury and preventing some but not all postpartum fecal incontinence outweighs the risks incurred by mother and infant, particularly when the cumulative risk of serial deliveries is considered.

Pelvic Organ Prolapse During and After Pregnancy

Unfortunately, there is relatively less information in the literature regarding the development of pelvic organ prolapse and its relationship to pregnancy and delivery. This may be due, in part, to the long interval of time between delivery and the clinical presentation of prolapse in most women. In one prospective study that did have prolonged followup of 20 years with more than 17,000 women, a strong association between birth and surgery for prolapse was shown; importantly, a "dose-response" relationship was seen in which the risk rose substantially between one and two births and then rose to a lesser degree with further births.[47] After their first birth, women were 4 times more likely to subsequently require hospital admission for prolapse; with two children, the likelihood increased to 8.4 times. Nulliparous women accounted for less than 1 percent of prolapse in the study.

Studies are examining anatomical changes that occur after vaginal delivery, such as abnormalities seen in the levator ani muscle that are not seen in nulliparous women.[48] Ongoing work is examining how these levator abnormalities are associated with the development of prolapse, and how obstetric practices, such as operative vaginal delivery, may be associated with the occurrence of such levator injuries.

Some studies that have been performed to analyze the effect of parity on risk of prolapse have used a case-control design, with women undergoing surgery for prolapse as cases and selected women as controls. Four studies to date have identified increased parity as a risk associated with subsequent prolapse surgery, although only one used multivariate analyses to control for the effect of confounding.[49–52]

As noted earlier, the lifetime risk that a woman in the United States will have surgery for prolapse or incontinence is very high at 11 percent. Evidence, in agreement with clinical observations, has demonstrated the high risk of requiring repeat surgery in almost one-third of women in one study,[1] and clinical observations support a high risk of recurrence, particularly for prolapse. Given the strong association between childbirth and prolapse, and the relatively poor success rate over time for prolapse surgery, it seems imperative to focus research on understanding the relationship between pregnancy, birth (vaginal and cesarean), and subsequent life changes on a woman's overall risk of prolapse. Ideally, such research would identify modifiable risk factors that could be influenced to decrease that risk and ultimately prevent the cascade of changes that result in clinically important prolapse that is difficult to successfully treat.

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Anal Incontinence

Dee Fenner, M.D.

Anal incontinence (AI) is the involuntary loss of flatus or either liquid or solid stool that is a social or hygienic problem.[1] Fecal incontinence (FI) is characterized only by the loss of solid or liquid stool, and is therefore less common.[1,2] These embarrassing and socially isolating conditions have been associated with documented negative impacts on quality of life (QOL) in several studies.[2–4] Among studies of community-dwelling adults, FI is estimated to affect 2 to 13 percent of respondents.[2] Population-based surveys have found age, vaginal parity, and a history of a sphincter laceration or operative vaginal delivery to be independent risk factors for FI.[4,5]

The maintenance of fecal continence is a complex system involving normal stool consistency and volume, normal colonic transit time, a compliant rectum, innervation of the pelvic floor and anal sphincters, and the interplay between the puborectalis muscle, rectum, internal anal sphincter (IAS), and external anal sphincter (EAS). Loss of or damage to one or more of these structures or functions can lead to AI. AI following vaginal delivery has been related to both nerve and muscle damage.[6,7]

AI has been reported in 5 to 26 percent of women during the first year following vaginal delivery.[7–10] Eason reported a prospective study of 949 consecutive women who delivered vaginally. At three months post-partum, 3 percent complained of FI, while 26 percent reported incontinence of flatus. Independent adjusted risk factors for incontinence of stool or flatus were forceps delivery (Relative Risk [RR]=1.4; 95 percent Confidence Interval [CI]=1.0–2.1) and third or fourth degree laceration (RR=2.1, 95 percent CI=1.4–3.1).[10]

AI After Sphincter Disruption

Anal incontinence occurs in 15 to 59 percent of women after anal sphincter laceration and primary repair.10-12 FI occurs in 2 to 23 percent.[10–12] Overt or visible sphincter lacerations occur in 0.7 to 19.3 percent[13,14] of births with the majority of injuries in primiparous patients.[10] Zetterstrom found 28 percent of women suffering from flatal incontinence and 2 percent from FI at 9 months following clinically detectable third or fourth degree lacerations.[9] Risk factors for third and fourth degree sphincter lacerations include nulliparity, birth weight greater than 4000 grams, maternal age greater than 35, midline episiotomy, forceps delivery, and vacuum extraction.[7–11,14–16]

Occult sphincter lacerations of the IAS and EAS are detected by transanal or transperineal USN that would otherwise be undetected through an intact or partially torn perineum. In 1993, Sultan reported 35 percent of primiparous women and 4 percent of the multiparas had new sphincter defects 6 weeks following vaginal delivery. AI was reported by 20 percent of women with sphincter defects, compared to 1 percent of the women without sphincter defects.[7] Subsequent studies have reported the prevalence of occult sphincter defects between 12 and 28 percent with one- to two-thirds patients developing new AI symptoms when evaluated during the first year following delivery.[17–19]

AI, Aging, and Symptoms Distant From Delivery

Differences in rates of incontinence reported by women with and without lacerations may fade with advancing age, depending on the time since delivery. Nygaard reported in a-30 year retrospective cohort, that the prevalence of AI among women who delivered vaginally with sphincter rupture, episiotomy without sphincter rupture, or with Cesarean delivery were equivalent.[20] However, Pollack, in a prospective cohort study of 242 women 5 years after vaginal delivery identified age (Odds Ratio [OR]=1.1, 95% CI=1.0–1.2), prior overt sphincter laceration (OR=2.3, 95% CI=1.1–5.0), as well as subsequent vaginal delivery (OR=2.4, 95% CI=1.1–5.6) as predictive of anal incontinence symptoms.[21] DeLeeuw, et al. reported a retrospective cohort study on 125 matched pairs with a median follow-up of 14 years after index delivery. FI was reported in 39 women with sphincter lacerations, compared to 16 controls (OR=3.1; 95% CI=1.57–6.10).[22]

AI and Cesarean Section

Primary Cesarean delivery does not provide complete protection from AI. The incidence of new onset urge AI after emergency Cesarean section, elective Cesarean section, and following vaginal delivery was 3 percent, 2 percent, and 2 percent respectively with equal incidence of fecal soiling regardless of delivery mode.[23] However, in another study at 6 weeks post-partum, 0/35 patients reported AI following Cesarean section compared to 38/200 women who delivered vaginally.[24] In one trial, which randomized women to Cesarean vs. vaginal delivery, no differences were found between delivery groups in the incidence of fecal or flatal incontinence 2 years postpartum.[25] This is consistent with smaller, non-randomized studies as seen in table 1.

Table 1. Cesarean Section vs. Vaginal Delivery vs. FI

Author	Study Design	Number FI		Risk (95% CI)	Comment
		C-sect	Vaginal		
Hannah[25]	RCT	8/611	3/306	1.10 (0.47–2.58)	FI
		82/611	31/306	1.14 (0.80–1.61)	Gas
Eason[10]	Cohort	2/114	22/681	0.5 (0.01–2.3)	FI at 3 months
		26/114	163/681	1/0 (0.7–1.4)	Gas
				0.8 (0.6–1.2)	Adjusted for other variables
MacLennan[26]	Survey	4/100	33/718	0.68 (0.3–3.2)*	FI
		9/100	91/718	0.86 (0.3–2.6)*	Gas
				0.78 (0.2–2.6)*	Adjusted for FI
				0.77 (0.4–1.5)*	Adjusted for gas, age, and parity
Fornell[5]	Survey	9/184	8/100	0.61 (0.3–1.5)*	FI

*Odds Ratios (Modified 3rd International Consultation on Incontinence page 288[1])

In conclusion, AI following vaginal delivery is strongly associated with sphincter lacerations and operative delivery. More research is needed to assess the short- and long-term benefits of controlling modifiable risk factors, including operative vaginal delivery, midline episiotomy, and the role of elective Cesarean section in preventing AI. The majority of current studies lack the power, matched controls, and long-term followup to make recommendations concerning the mode of delivery and the impact on AI, especially as women age.

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Urinary Incontinence

Can Elective Cesarean Delivery Prevent Urinary Incontinence, and If So, to What Degree?

Ingrid Nygaard, M.D., M.S.

The International Continence Society defines urinary incontinence (UI) as "the complaint of any involuntary leakage of urine."[1] Women with severe UI have a marked deterioration in their quality of life—most substantially curtail activities, many become homebound, and for some, UI is the defining event that prompts nursing home admission. However, it is important to bear in mind that severe incontinence (daily and frequent) impacts a minority, roughly 5 percent, of adult women, while more than half report "any" incontinence, and 5–25 percent at least weekly leakage.[2]

Including UI under the umbrella of pelvic floor disorders suggests that we primarily consider the pelvic floor to be the problem as well as the solution. Thus, the debate about elective cesarean delivery focuses on childbirth's impact on the pelvic floor and the degree to which elective cesarean delivery can spare the nerves, muscles, and ligaments to the urethra, bladder, and pelvic floor muscles. However, UI often occurs because of problems outside the pelvic floor. Some of the risk factors that have consistently been associated with UI include, amongst others, obesity, diabetes, stroke, and various functional issues. The fact that there are many etiologies for the same symptom (urine leakage) complicates our ability to assign causation to vaginal delivery without confounding.

Various types of evidence have been used to study the association between childbirth and UI, such as pudendal nerve terminal motor latency or other neurophysiologic testing, urodynamics testing, physical examination findings, radiologic studies, histologic studies, or molecular evidence. Studying such surrogate outcomes helps us understand the mechanisms of disease, but does not provide the actual clinical information that we seek about the role that elective cesarean delivery plays in preventing UI.

While outside the scope of this presentation, the reader should bear in mind that in developing countries, vesicovaginal fistulae following childbirth constitute a great societal problem. In the United States, rates of certain urogenital fistulae (such as uterovesical) have increased slightly as the cesarean delivery rate has increased; however these remain rare and therefore will not be addressed.

There are almost no data about elective cesarean delivery. Therefore, to best inform this discussion, in the absence of actual data, we can consider differences between pregnant women who have not yet delivered and women that have delivered versus women that have not carried a fetus. It stands to reason that nulligravid women have the least risk for UI attributable to childbirth and that if no differences exist between nulligravid and gravid women, no difference is likely to exist between women delivered by elective cesarean and women delivered vaginally.

Nulligravid pregnant women leak more often than nulliparous counterparts.[3] Numerous cross-sectional studies reveal that 25–75 percent of women report symptoms of stress urinary incontinence (SUI) during pregnancy. Antepartum incontinence strongly predicts postpartum incontinence.[4] While most find that the incontinence resolves within the first year after the first delivery,[5] transient incontinence after the first delivery strongly predicts UI 5 years later.[6] These data highlight the importance of sufficiently long followup time in any study assessing the impact of delivery practices on UI.

In younger women, vaginal delivery generally increases a woman's chance of experiencing UI in the short term. Based on results from a large population-based study,[7] a woman's risk of moderate or severe incontinence would be decreased from about 10 percent to about 5 percent if all of her children were delivered via cesarean. Similarly, in a large study of Australian women,[8] being parous was strongly associated with UI in younger women. Data are mixed about whether having more children changes the risk of UI over the first delivery.[9]

However, several facts warrant attention. First, some women that delivered solely via cesarean and others that never bore children also had incontinence. Second, the protective effect of cesarean delivery and nulliparity on UI dissipates by ages 50–60, such that older women have the same rate of UI regardless of their delivery status. For example, in a recent study, 143 pairs of nulliparous and parous postmenopausal sisters reported similar rates of UI (45–50 percent), and there was a high concordance in continence status within biological sisters, suggesting that in these older women, genetics played a bigger role than childbirth on developing UI.[10] This highlights the importance of considering the population studied when assessing the role of childbirth in UI.

Finally, it is important to understand that studies that compare postpartum UI between women that delivered vaginally and women that delivered by cesarean do *not* allow us to answer the question of how UI incidence differs between two policies: planned cesarean before labor versus planned vaginal delivery. Given that more than 20 percent of women anticipating vaginal delivery currently deliver by cesarean, if labor itself has an impact on the risk of UI, the protective benefit of cesarean delivery will necessarily be diluted. Only one randomized trial has assessed the difference in pelvic floor symptoms after planned elective cesarean delivery or planned vaginal birth, the Term Breech Trial.[11] While the conclusions are limited by the large number of women in the planned vaginal birth group who delivered by cesarean instead, the short-term results are of interest. Three months postpartum, women in the planned cesarean delivery group reported less UI than those in the planned vaginal birth group, but 2 years later, the UI rate between the two groups was similar.[12]

Conclusion

The following key points summarize current knowledge about the role of cesarean delivery on UI:

- Vaginal delivery increases the short-term risk of UI in young and middle-aged women more than does cesarean delivery.

- Most women with UI have mild incontinence.

- Nulliparous women also develop UI.
- Older nulliparous women are as likely to have UI as older parous women.
- Nearly eight in nine women deliver babies, usually via the vaginal route, but only one in nine undergoes surgery for UI or prolapse.[13]
- Vaginal delivery itself is neither always sufficient nor necessary to cause UI in most women (and by inference, cesarean delivery is not sufficient to prevent all UI).
- Long-term followup is essential to understand the role that further deliveries (either by cesarean or not) and other life events play on the risk of UI.

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Impact on Development of Pelvic Organ Prolapse

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Pelvic organ prolapse (POP) describes the abnormal location of pelvic organs into or outside of the vagina. The prevalence of POP has been shown to increase with age, thus, as the population ages, it has been estimated that the demand for healthcare services related to pelvic floor disorders and specifically prolapse will increase at twice the rate of the population itself.[1] The lifetime risk that a woman in the United States will have surgery for prolapse or urinary incontinence is 11 percent, with up to one third of surgeries representing repeat procedures.[2] Approximately 200,000 women undergo inpatient surgery for POP each year in the United States.[3] However, many women with POP are managed conservatively or never present for evaluation. Thus, surgically managed patients that are often described in the literature do not represent the full spectrum of disease in the population.

Risk factors identified in the development of POP include pregnancy, parity, episiotomy, instrumented delivery, increased second stage of labor, hysterectomy, chronic pulmonary disease, hypertension, and obesity.[4–7] These factors are thought to impact on the anatomy and physiology of the pelvic floor. The pelvic floor includes the levator ani muscles, the urethral and anal sphincter muscles, and endopelvic connective tissue. The first level of muscular support are the paired iliococcygeus muscles which arise laterally from the arcus tendineus, a thickened band of obturator internus fascia extending from the pubic bone to the ischial spine, traveling medially and posteriorally meeting the contralateral muscle behind the rectum in a midline raphe which fuses with the coccyx. The second part of the levator ani is the pubovisceral muscle, which includes the puborectalis and pubococcygeus muscle. They form a U-shaped sling encircling the urogenital hiatus, the midline potential space through which the pelvic organs pass.

The levator ani muscle groups have two important functions: to maintain a constant basal tone, keeping the urogenital hiatus closed. If this basal tone is lost or decreased, the urogenital hiatus can widen, facilitating decent of the pelvic organs. The second function is to contract reflexively in response to certain actions that increase intra-abdominal pressure such as coughing. It is thought that this effect plays a role in maintaining continence with increases in intra-abdominal pressure.[8] The levator ani muscles are innervated by anterior sacral nerve roots S2-S4 where motor branches of these nerve roots travel over the cranial surfaces of the pelvic floor and are susceptible to compression and stretching during vaginal delivery. In addition to the muscles and nerves, the pelvic floor includes a complex system of ligamentous support known as the endopelvic fascia of connective tissue, which envelops the pelvic organs and attaches them to the pelvic side wall. There is a dearth of literature ascribing direct attributable risk of the development of POP to vaginal delivery as compared to elective cesarean section. Data suggest that the connective tissue muscular support and innervations of this area may sustain pressure injury from pregnancy itself as well as during the process of parturition, where stretching, tearing and even rupture or avulsion of the connective tissue, muscles and nerves of these vital support structures may be impacted. This may then manifest immediately, in the short term (that is less than 1 year from delivery) or in the long term with POP.

It has only been in the last 5–10 years that we have a measurement system in order to document progression or remission of descent or prolapse of the vagina and the pelvic organs.[9] It

has also been in the last 5–10 years where we have had validated reliable questionnaires with which to assess symptoms in patients with POP. Prior to this time, the most available data on the effect of pregnancy and delivery on pelvic organ support have been obtained by imaging, including translabial ultrasound and magnetic resonance imaging studies.[10]

While increasing epidemiologic data[4–7] fuel an association between vaginal delivery and the development of pelvic floor dysfunction, the temporal delay between possible causative events and occurrence of symptoms of the disorder make elucidation of the direct pathophysiologic processes involved to be problematic. Population-based estimates of POP prevalence exist. Mant et al. studied 17,032 women who attended family planning clinics in England and Scotland between 1968 and 1974.[6] In one of the only prospective cohort studies on POP with long-term followup, they describe an incidence of hospital admission for repair of prolapse of 2.04 per 1,000 woman years at risk. Carley et al. performed a case control study on 480 women who underwent corrective surgery for urinary incontinence, POP or both and whose obstetric history was obtainable through chart review.[11] The control group was composed of 150 women having routine screening mammography who completed a questionnaire regarding obstetric, gynecologic, and urologic history. Women who underwent surgery were of greater parity, less often nulliparous, less likely to have had a cesarean delivery, and more likely to have had a vaginal delivery than those with no surgery. A cross-sectional analysis of women ages 50–79 years enrolled in the Women's Health Initiative indicated that 41 percent of women with a uterus had some form of POP at baseline.[12] After controlling for age, body mass index, and other health/physical variables, parity and obesity were strongly associated with increased risk for uterine prolapse, cystocele and rectocele. In a cross-sectional study of 487 Swedish women ages 20–59, Samuelsson et al. reported that 31 percent of women overall and 44 percent of parous women had some form of POP, though only 2 percent of all women in the study had a prolapse that reached the introitus when screened.[4]

Of all risk factors examined by Mant et al., parity showed the strongest association with risk of requiring surgery for POP;[6] compared to nulliparous women, women with one child were four times more likely and those with two children were 8.4 times more likely to develop POP requiring hospital admission. The authors did not distinguish between parity and mode of delivery. Samuelsson et al. reported that the most prominent factors of etiologic importance for POP were parity, age, and pelvic floor muscle strength, with high birthweight also associated with increased prevalence of POP among parous women. Few studies have attempted to compare prolapse rates in women undergoing elective cesarean delivery for term breech with those after emergency cesarean delivery and vaginal delivery. A population-based retrospective cohort study of 15,441 primiparas who delivered singleton breech at term (1982–2000) reported that hospitalization with vaginal descensus was not significantly related to mode of delivery in the follow-up period (5–18 years after the first delivery). However, this information does not account for subsequent deliveries or changes in anthropomorphic or other demographic variables. For most of these epidemiologic studies, the two most significant etiologic factors for the development of prolapse are felt to be advancing age and parity.[4–7] More recently, interest in elucidating the effects of pregnancy itself on the development of POP has been studied.[13,14,15] In the study of Sze et al., 94 nulliparous women were evaluated for POP at their 36-week antepartum and 6-week postpartum visits using the International Continence Society (ICS) staging system.[9,14] A change in the ICS stage from 36 weeks antepartum to six weeks postpartum was considered POP that developed during childbirth. Their data suggested that elective cesarean was only partially effective in preventing POP under these defined conditions. O'Boyle et al.

evaluated pelvic organ support during pregnancy and following delivery in a prospective observational study.[15] POP quantification examinations were performed during each trimester of pregnancy and in the postpartum. One hundred thirty-five nulliparous women underwent 281 pelvic organ support evaluations. During both the third trimester and postpartum, POP-Q stage was significantly higher compared to the first trimester ($p<0.001$). In the postpartum, POP-Q stage was significantly higher in women delivered vaginally compared to women delivered by cesarean ($p=0.02$). In nulliparous pregnant women, POP-Q stage appears to increase during pregnancy and does not change significantly following delivery.

There have been a number of papers over the last decade describing patterns of injury observed on MRI, although no comparative study of ante- and postpartum levator anatomy has been published to date. From studies in parous women, it has been speculated that the change of the typical H-shape appearance of the vagina may be due to traumatic loss of paravaginal support uni- or bilaterately.[16,17] Hoyte et al. have shown significant differences in levator muscle volume and hiatal dimensions between normal women and women with prolapse.[18] Most recently, Kearney et al. performed magnetic resonance imaging on the pelvic floor of 160 women 9–12 months after first-term vaginal delivery.[19] Increased odds ratios for levator defects were found in women who had forceps used at the time of delivery, 14.7 (95 percent confidence interval (CI)=4.9–44.3); anal sphincter rupture, 8.1 (95 percent CI,=3.3–19.5); and episiotomy, 3.1 (95 percent CI=1.4–7.2). Women with levator injury were older and had a longer second stage of labor. This finding is important as risk factors noted on epidemiologic retrospective, and prospective cohort studies and case control studies may correlate with actual levator muscle injury sustained at the time of pregnancy or vaginal delivery.

With the data above, one can conclude that there are known modifiable risk factors that may impact on the development of POP. The majority of data on POP permit risk calculation for parity, not for specific mode of delivery. Certainly, prospective studies specifically stratifying by mode of delivery would be important for the further understanding of those risk factors for the development of POP. As pregnancy itself appears to have a role in the development of POP, this should also be studied in a rigorous fashion. Whether elective cesarean is totally protective of the pelvic floor is unclear, but there may be women at high risk for sustaining pelvic floor injury at the time of vaginal delivery, and this may be a reasonable option.

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Neonatal Consequences Associated With Cesarean Delivery on Maternal Request Versus Planned Vaginal Delivery

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The evidence on the balance of risks and benefits of Cesarean Delivery on Maternal Request (CDMR) versus planned vaginal delivery is unclear. We undertook a systematic review to examine outcomes associated with planned route of delivery—one of the four Key Questions (KQ) specified by the Planning Committee for the National Institutes of Health State-of-the-Science Conference: Cesarean Delivery on Maternal Request.

We searched MEDLINE,® Cochrane Collaboration resources, and Embase (1990 to June 2005). We excluded studies that: (1) did not report on women of reproductive age; (2) were published in languages other than English; (3) did not report information pertinent to the key clinical questions; (4) had fewer than 50 subjects for randomized controlled trials (RCTs) or 100 subjects for observational studies; or (5) were not original studies. Additionally, we excluded studies that did not provide data on both planned cesarean delivery and planned vaginal delivery. All eligible studies were reviewed, and relevant data were extracted, entered into evidence tables, and summarized by descriptive methods.

The comparison groups varied widely. We developed a four-tier classification system of relevance to CDMR based on the following criteria: (1) whether studies analyzed outcomes by planned route of delivery (trials of route of delivery); (2) whether CDMR was included as a comparison group (high relevance); (3) whether comparison groups comprised planned cesareans (moderate relevance); and (4) whether studies involved undefined "elective" or a mix of planned and unplanned, unlabored cesareans (low relevance). We summarized the strength of evidence for each outcome, judging the evidence to be strong for results that are clinically important, consistent, and free from serious doubts about generalizability, bias, or flaws in research design. We judged evidence to be moderate for studies of strong design, with some inconsistencies or concern about generalizability, bias, research design flaws, or for studies of weaker design with consistent evidence. We judged evidence to be weak for studies of weaker design with inconsistent results, or studies of strong design with inconclusive results.

From our review of 1,406 abstracts, 54[1–54] addressed maternal and neonatal short- and long-term outcomes.

KQ 2: Outcomes of Cesarean Delivery on Maternal Request

Overall, few moderately relevant studies were available, and the strength of evidence is weak for nearly all outcomes.

Neonatal Outcomes

Fetal mortality. We found no studies that addressed fetal (in utero) deaths.

Neonatal mortality. Two studies provided weak evidence on neonatal mortality. The studies suggested a higher risk for all cesareans (planned or unplanned) than for spontaneous

vaginal delivery. The studies did not control for underlying maternal or neonatal indications for cesarean or were underpowered for such a rare outcome, leading to limited ability to draw conclusions on this outcome.

Unexpected (iatrogenic) prematurity. We found no study that addressed unexpected prematurity and allowed comparisons by type of cesarean with intended or actual vaginal birth.

Respiratory morbidity. Measures of respiratory morbidity range from transient tachypnea of the newborn (TTN) to severe respiratory distress syndrome (RDS) with long-term sequelae. Nine articles yielded moderate evidence that the risk of variably defined "respiratory morbidity" was higher for all cesarean births than for vaginal deliveries. This risk reduces with advancing gestational age. Studies did not assess meconium aspiration syndrome by mode of delivery.

Transition issues. One study reported on this outcome, but the significant issues of appropriate categorization in this study make interpreting the data difficult. We consider the available evidence insufficient to judge the direction of effect.

Neonatal asphyxia or encephalopathy. Two studies provided weak evidence of a higher risk of neonatal encephalopathy associated with operative vaginal deliveries and "emergency" or "labored" cesareans than with spontaneous vaginal delivery.

Intracranial hemorrhage. One study provided weak evidence on intracranial (subdural/cerebral, intraventricular, and subarachnoid) hemorrhage. The prelabor cesarean deliveries included those done for maternal or neonatal indications, so they likely involved cesareans for placenta previa and fetal anomalies, which may independently increase the risk of intracranial hemorrhage. Despite the higher theoretical risk for prelabor cesarean deliveries, this study did not find any significant difference between spontaneous vaginal delivery and prelabor cesarean deliveries. It did show consistently higher rates of intracranial hemorrhage for assisted vaginal deliveries and cesarean deliveries in labor.

Facial nerve injury. One study provided weak evidence that the risk of facial nerve injury varies by mode of delivery; the risk is higher for forceps and the combined use of forceps and vacuum delivery than for spontaneous vaginal delivery. These findings suggested that CDMR posed no risk for facial nerve injury greater than that associated with planned vaginal delivery.

Brachial plexus injury. One study provides weak evidence that the incidence of brachial plexus injury is lower in cesarean delivery than in vaginal delivery.

Fetal laceration. Two studies provided weak evidence on fetal lacerations based on data limited to cesarean deliveries. They reported a higher rate of fetal lacerations among emergency and labored cesarean than among elective cesarean delivery.

Neonatal length of hospital stay. One study provided weak evidence that the neonatal length of hospital stay is higher for "elective" cesarean delivery than for vaginal delivery.

Long-term neonatal outcomes. We did not find any evidence on long-term neonatal outcomes.

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Cesarean Section on Request at 39 Weeks: Impact on Shoulder Dystocia, Fetal Trauma, Neonatal Encephalopathy, and Intrauterine Fetal Demise

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Purpose: The purpose of this analysis was to determine the impact on specific forms of neonatal morbidity and mortality of allowing women to opt for delivery by cesarean section at 39 weeks Estimated Gestational Age (EGA). Using National Vital Statistics Reports as summarized by Demissie,[1] over 70 percent of deliveries in the United States annually are at gestational ages ≥39 weeks. Assuming over 4,000,000 deliveries annually in the United States, this would yield approximately 3,000,000 pregnancies wherein the woman might exercise her choice for either primary or repeat cesarean section at 39 weeks of gestation, or at the point that labor is clearly established.

Methods: A search was conducted using Ovid Medline spanning 10 years using the following key words: fetal trauma, shoulder dystocia, brachial plexus palsy, neonatal skull fracture, obstetrical trauma, traumatic delivery, intrauterine fetal demise, stillbirth, fetal demise, and neonatal encephalopathy. The search was not restricted on the basis of language. Using this search technique, over 2,100 articles were identified, and the abstracts printed and reviewed, in order to narrow the scope to articles pertinent to this review. The thus-identified articles were obtained, and, where applicable, references contained in those articles were also obtained for inclusion in the review. Because the number of reviews was so extensive, preference was given to publications on or after the year 2000—with the exception being classical or sentinel articles, which were included without regard to year of publication.

Results: The results for each of the four major categories will be discussed individually:

- **Shoulder dystocia**—A review of the literature shows the frustration of clinicians with their failure to accurately predict the occurrence of shoulder dystocia before its actual occurrence.[2–8] To date, all prediction models have shown a very low positive predictive value for shoulder dystocia, and the cost of implementation of strategies based upon conditions such as fetal macrosomia has been judged by clinicians to be excessive. Accepting that we do not have a good means of predicting or preventing shoulder dystocia, the real question for the pregnant woman becomes "What is the chance that my baby will sustain a permanent brachial plexus injury at birth?" Additionally, is there a significant protective effect of cesarean section in reducing the risk of brachial plexus palsy? The occurrence rate of brachial plexus palsy at the time of delivery and by route of delivery is shown below.

		Obstetrical Brachial Plexus Palsy		
Author	**Country**	**Vaginal**	**Cesarean**	**Both**
Perlow	U.S.A.	0.11%	-	-
Graham	U.S.A.	0.12%	0.035%	-
Herbst	U.S.A.	0.18%*	-	-
Mollberg	Sweden	0.2%	-	-
Ouzounian	U.S.A.	0.6%	-	-
Chauhan	U.S.A.	0.1%†	-	-
Evans-Jones	UK & Ireland	0.047%	0.0042%	0.042%
Gherman	U.S.A.	-	0.0947%‡	-
Christopherson	Sweden	-	-	0.1938△

* 0.067% permanent
† 0.01% permanent
‡ Vtx 2 difficult deliveries and 6 atraumatic deliveries
△ only 17.6% had diagnosis of shoulder dystocia

Using a composite estimate of the risk of an obstetrical brachial plexus palsy of 0.15 percent and applying to 3 million deliveries ≥39 weeks EGA would yield 4,500 cases of brachial plexus palsy if all these women delivered vaginally. Assuming that only 15 percent of these will remain as permanent injuries[9] would yield 675 permanent brachial plexus palsies annually. Alternatively, and accepting the risk of permanent injury as reported by Chauhan[5] at 1 in 10,000, this would still result in 300 permanent brachial plexus palsies annually in the United States that would, for the most part, be avoided with cesarean section on request. The range, then, for permanent brachial plexus injury would appear to vary between 1 in 5,000 or 1 in 10,000 vaginal births, the risk clearly being higher for some specific groups, such as the infant of a diabetic mother, and the very large for gestational age infant.

- **Fetal trauma**—In tabular form below is the stated incidence of significant birth trauma in a recent review by Uhing.[10] Specific references for each article are contained within the review article.

	Per Live Births	Type of Delivery
Subgaleal hemorrhage	3.4/1,000	Vacuum deliveries
	0.8/1,000	Overall deliveries
Symptomatic ICH	5.1–5.9/10,000	Live births
Subdural hemorrhage	2.9/10,000	Spontaneous vaginal deliveries
	8–10/10,000	Operative vaginal deliveries
Subarachnoid hemorrhage	1.3/10,000	Spontaneous vaginal deliveries
	2–3/10,000	Operative vaginal deliveries
Facial nerve palsy	0.6-7/1,000	
Phrenic nerve injury	-	Usually with brachial plexus palsy
Laryngeal nerve injury	0.14/10,000	Often with shoulder dystocia
Nasal septal dislocation	6–9/1,000	
Significant ocular injuries	1–2/1,000	Usually forceps
Femoral or humeral fracture	0.5–1.3/1,000	

In many instances the data is reported specific to a form of delivery, such as vacuum or forceps. The literature also clarifies that use of sequential instruments (vacuum followed by forceps or forceps followed by vacuum)[11–13] is associated with an unacceptably high injury rate. A report from the Netherlands documented 9 neonatal deaths, 12 cases of cerebral damage, and 5 cases of permanent brachial plexus injury among 25 vacuum deliveries performed at 0 station or higher. Similarly, O'Mahony,[13] in a review of intrapartum related neonatal deaths with singleton fetuses presenting as vertex with birth weights >2,500 grams, identified 37 cases where the dominant feature was traumatic cranial or cervical spine injury secondary to the use of the vacuum or forceps to achieve vaginal delivery. O'Mahony concluded that some injuries occurred apparently without evidence of unreasonable force, but poorly judged persistence with attempts at vaginal delivery in the presence of failure to progress or signs of fetal compromise where the main contributory factor is regardless of which instruments were used.

One can conclude from the literature that the frequency of significant fetal injury is significantly greater with vaginal delivery, and especially with operative vaginal delivery, than occurs with cesarean section. This would be particularly true when compared to scheduled elective cesarean section for the woman not in labor at 39 weeks, or for cesarean sections performed near term at the point that the woman is demonstrated to be in early labor.

- **Neonatal encephalopathy**—In a series of articles, Badawi and colleagues[14,15] analyzed risk factors for moderate or severe neonatal encephalopathy according to the occurrence prior to conception, in the antepartum period, and in the intrapartum period. These investigators identified the birth prevalence of moderate to severe newborn encephalopathy as 3.8/1,000 term live births. The neonatal fatality rate was 9.1 percent in these cases. They noted that in 4 percent of cases the etiology appeared to be pure intrapartum hypoxia. This number is lower than the 10 percent estimate by the International Consensus Conference[16] as well as the 8 percent estimate of Blair

and Stanley.[17] Badawi's group also noted that, while antepartum risk factors existed, the possibility of intrapartum hypoxia superimposed upon these risk factors may have accounted for up to 25 percent of the moderate to severe encephalopathies in their cohort. They concluded that, while pure intrapartum hypoxia was rarely etiologic in development of moderate to severe neonatal encephalopathy, in as many as 25 percent some degree of hypoxia may have been superimposed upon the previously compromised, injured, or predisposed infant.

A disconnect in their data is the fact that infants born to women who had not undergone labor, which would necessitate a scheduled delivery by cesarean section, had an 83 percent reduction in moderate to severe encephalopathy. Accepting the birth prevalence of moderate to severe neonatal encephalopathy as 0.38 percent,[14,15] and applying this to the 3,000,000 deliveries which will occur at or beyond 39 weeks of gestation in the United States annually, would yield 11,400 cases of moderate to severe encephalopathy. The much lower rate of encephalopathy in infants delivered by cesarean section would yield 1,938 cases. The net difference in moderate to severe encephalopathy, based upon route of delivery as extrapolated from Badawi, would represent 9,462 cases annually in the United States. Importantly, moderate to severe encephalopathy are the categories which put the newborn or the neonate at risk for long-term neurologic injury in the form of cerebral palsy with or without mental retardation and seizure disorders. It is important to acknowledge that Badawi's data has not been tested in a prospective fashion. While cesarean delivery may be protective from the development of neonatal encephalopathy, to date it has not been shown to be protective of long-term neurologic injury.

- **Intrauterine fetal demise**—Copper reported the rate of stillbirth to be consistent from 23–40 weeks of gestation, with a rate of about 5 percent of all stillbirths per week of gestation.[18] Somewhat in contrast, Yudkin and associates[19] reported a fairly stable rate of 0.6 stillbirths per 1,000 live births from 33–39 weeks of gestation. At 39 weeks, a significant increase in the stillbirth rate was reported (1.9 per 1,000 live births). Other investigators[20] reported significant increase in both explained and unexplained intrauterine fetal demise commencing at 36–37 weeks of gestational age. Fretts[21] published on fetal deaths per 1,000 live births from 37–41 weeks gestational age by each week of gestation. At 37 weeks, the rate was 1.3 per 1,000 live births, thereafter increasing as follows: 38 weeks: 2.0, 39 weeks: 2.9, 40 weeks: 3.8, 41 weeks: 4.6. Using the data extracted from each of these reports,[22] one can conservatively estimate that delivery by scheduled cesarean section at 39 weeks would prevent 2 fetal deaths per 1,000 ongoing living pregnancies. This would translate into the prevention of as many as 6,000 intrauterine fetal demises annually in the United States; an impact that far exceeds any other strategy thus far advanced.

Conclusion: It is reasonable to inform pregnant women of the risk of each of the above categories. It is also clear that cesarean section may pose acute risk for the woman and subsequent reproductive risks for both the woman and future pregnancies. The clinician's role should be to provide the best evidence-based counseling possible to the woman, and to respect her autonomy and decision-making. Until prospective randomized trials are conducted, we are unlikely to be able to precisely answer all questions of risk:benefit as applied to the current pregnancy, and perhaps equally important, for subsequent pregnancies.

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Neonatal Mortality/Morbidity and Developmental Outcomes

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A number of competing risks and benefits influence the rates of neonatal morbidity and mortality in elective cesarean section versus attempted vaginal delivery. Multiple chance events may influence outcome. For example, an elective cesarean section may result in the delivery of an iatrogenically premature infant at risk for respiratory dysfunction; on the other hand, a continuing pregnancy may end with unexplained stillbirth, or spontaneous labor with intrapartum complications may compromise fetal or neonatal well-being. Decision analysis is a quantitative methodology for evaluating competing strategies under conditions of uncertainty.[1]

We constructed a decision tree to model the expected outcomes among hypothetical cohorts of 1,000,000 pregnancies undergoing elective cesarean section versus 1,000,000 comparable pregnancies undergoing routine pregnancy management. We made the following assumptions: (1) all women had uncomplicated singleton pregnancies at 39 weeks, 0 days gestation defined by ACOG criteria;[2] (2) fetuses did not have major anomalies; (3) all women opting for elective section received the procedure at 39 weeks, 0 days or immediately upon request, therefore the risk of fetal death was zero; (4) liveborn infants whose stillbirth was prevented by elective section have the same risk of neonatal death and morbidity as other fetuses delivering at the same point in gestation; (5) women assigned to expectant management might change their mind later and request a section; and (6) all women still pregnant were electively delivered when they reached 41 weeks, 0 days.

A separate decision tree was created for each outcome of interest: neonatal death, respiratory morbidity (including respiratory distress syndrome and transient tachypnea of the newborn), persistent pulmonary hypertension (PPHN), intracranial hemorrhage, brachial plexus injury, facial nerve injury, suspected and confirmed neonatal sepsis, and fetal laceration. Probability estimates for the model were retrieved from relevant publications identified with MEDLINE searches and from the bibliographies of selected reports. Key probabilities used in the model are shown in table 1. The decision trees were constructed and analyzed with TreeAge Pro 2005 (TreeAge Software, Boston, MA).

For each decision tree, cumulative probabilities for each terminal branch were computed, yielding a total probability for occurrence of the outcome of interest versus nonoccurrence of the outcome. These probabilities were then applied to the hypothetical cohorts to calculate the expected numbers of each outcome among women delivered by elective cesarean section and women managed expectantly. Results are shown in figures 1–3. Neonatal deaths are increased among infants delivered by elective cesarean; however, overall perinatal mortality is increased with expectant management, due to the occurrence of antepartum and intrapartum fetal deaths (figure 1). Under the assumption that the study probabilities represent causal associations, approximately 1,500 elective cesareans would have to be performed to prevent one perinatal death; however, unmeasured confounding would tend to favor elective cesarean. Respiratory morbidity is substantially more common among infants delivered by elective cesarean (figure 2), while neurologic injuries such as intracranial hemorrhage and brachial plexus injury are less common with elective cesarean (figure 3). We were unable to find data on the occurrence of

cerebral palsy and other neurodevelopmental abnormalities following elective cesarean section, so no formal analysis was performed.

For each decision tree, we are currently conducting sensitivity analyses. However, based on our initial analyses, we conclude that the fetal/neonatal impact of elective cesarean at 39 weeks is mixed, but that any improvement in perinatal health is likely to be small.

Table 1. Probability Estimates*

Variable	Baseline Estimate	Range	References
Inaccurate dating	0.025	0.00–0.09	3–5
Fetal death at 39–40w	0.0006 per week	0.0001–0.001	6, 7
Spontaneous labor at 39w	0.25 per week	0.10–0.5	6, 8
Spontaneous labor at 40w	0.445 per week	0.25–0.85	6, 8
Undelivered at 41w if still pregnant at 40w	0.45	0.05–0.645	6, 8
Spontaneous vaginal delivery in uncomplicated patient	0.80	0.60–0.90	9, 10
Operative vaginal delivery in uncomplicated patient	0.10	0.05–0.20	9, 11
Cesarean section in labor	0.10	0.05–0.30	10, 12
Neonatal death			
Elective cesarean	0.0008	0.0001–0.0015	13–15
Expectant mgmt	(0.0002–0.0044)**	0.0002–0.0044	13–15
Respiratory morbidity			
Elective cesarean	0.01	0.01–0.05	16–18
Expectant mgmt	(0.001–0.018)**	0.001–0.018	16–18
Intracranial hemorrhage			
Elective cesarean	0.00049		14
Expectant mgmt	(0.00053–0.00357)**	0.00053–0.00357	14
Brachial plexus injury			
Elective cesarean	0.00041	0.00041–0.0008	14
Expectant mgmt	0.00018–0.00202**	0.00018–0.00202	14, 19

*Conditional probabilities for pregnancies, fetuses, or neonates at risk.
**Range of probabilities used to account for possible conditions arising during expectant management.

Figure 1. Perinatal Mortality in Term Pregnancies Managed Expectantly Versus Delivered by Elective Cesarean Section

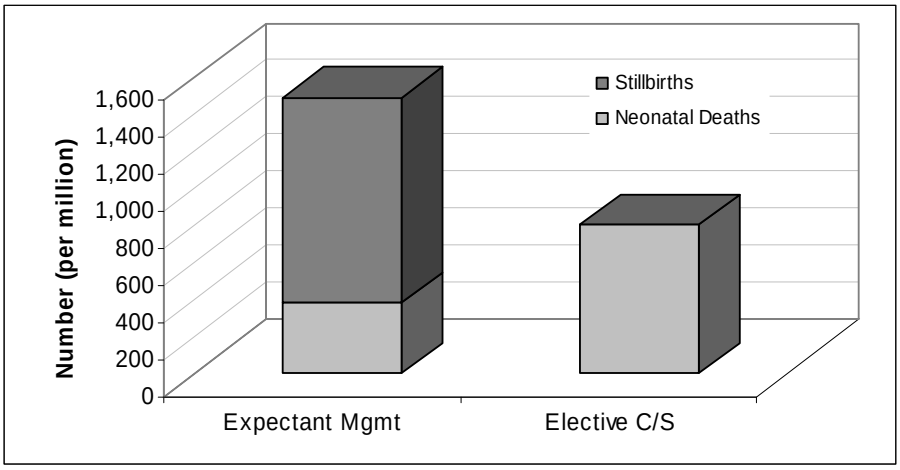


Figure 2. Outcomes in Term Pregnancies Managed Expectantly Versus Delivered by Elective Cesarean Section

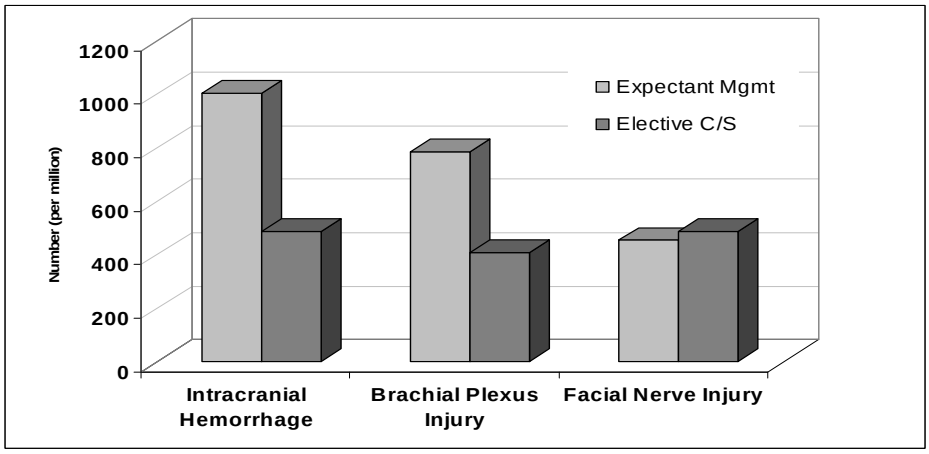
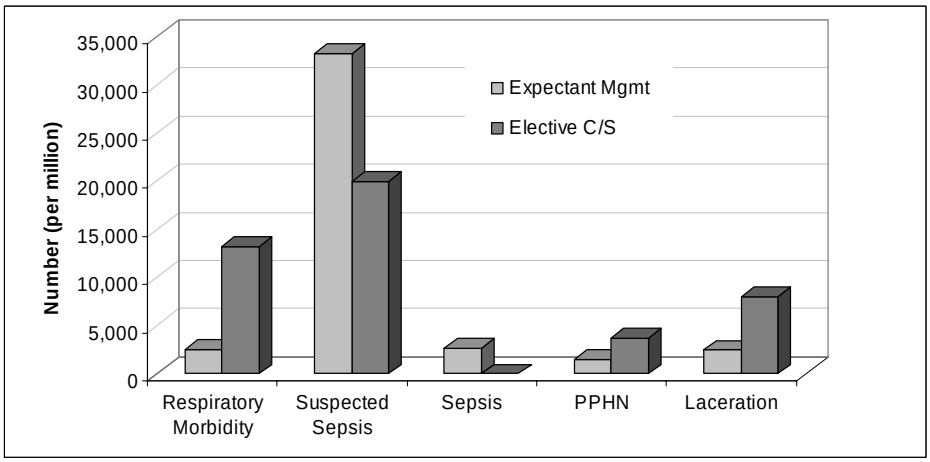


Figure 3. Additional Outcomes in Term Pregnancies Managed Expectantly Versus Delivered by Elective Cesarean Section



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Implications of Labor on Neonatal Outcome

Lucky Jain, M.D., M.B.A.

Respiratory morbidity in term and near-term infants delivered by elective cesarean section (ECS) without a trial of labor has been well documented in the literature, and accounts for a significant number of admissions to intensive care units worldwide.[1–3] Given the high rates (10–15 percent) of ECS in the United States and much higher rates in certain other parts of the world, the public health and economic impact of this potentially preventable morbidity is considerable. There is evidence to show that onset of spontaneous labor is accompanied by changes in the hormonal milieu of the fetus and its mother, resulting in rapid maturation and preparation of the fetus for delivery and neonatal transition.[4] A surge in endogenous steroids and catecholamines accompanies normal labor and vaginal delivery, and is responsible for some of the maturational effects.[5] When infants are delivered by elective cesarean section (repeat or primary) before the onset of spontaneous labor, the fetus is deprived of these hormonal changes, making the neonatal transition more difficult.

Respiratory Morbidity in Newborns Delivered Without Labor

Causes of respiratory distress in the infants delivered before the onset of spontaneous labor include transient tachypnea of the newborn (TTNB), surfactant deficiency related to iatrogenic prematurity, and pulmonary hypertension.[2,6] As a result, these infants have been reported to have higher rates of Neonatal Intensive Care Unit (NICU) admissions, mechanical ventilation, oxygen therapy, Extracorporeal Membrane Oxygenation (ECMO), and death.[7,8] Since ECS is commonly performed between 37 and 40 weeks gestation, it was believed that much of respiratory morbidity in newborns delivered by ECS was secondary to iatrogenic prematurity, and surfactant deficiency in these patients.[9–11] To minimize the occurrence of iatrogenic respiratory distress syndrome (RDS), fetal lung maturity testing was initially recommended prior to elective cesarean delivery, but this is seldom done. The American College of Obstetricians and Gynecologists (ACOG) recommends delaying elective section to 39 weeks and this has been shown to decrease the risk of respiratory distress; however this recommendation is not uniformly followed,[12] given the risk for maternal complications in repeat ECS if the patient goes into spontaneous labor.[13] Further, it is clear that in addition to RDS, infants delivered by elective cesarean are at higher risk for developing transient tachypnea of the newborn (Type II RDS, wet lung syndrome), and persistent pulmonary hypertension unrelated to their gestational age at the time of delivery. While most of these neonates develop transient respiratory distress and recover without any long-term consequences, a significant number progress to severe respiratory failure. These infants not only require prolonged hospitalization, but also are at increased risk for chronic lung disease and death. In addition, there is a higher incidence of respiratory depression at birth (low Apgar scores) thought to be related to fluid logged lungs, making the transition to air breathing more difficult.[14]

Physiology of Fetal Lung Fluid Clearance

The ability of a neonate to self-resuscitate itself at birth after remaining "submerged" in fluid for much of its life is truly remarkable. The lungs are key players in this process, engineering the switch from placental to pulmonary gas exchange.[4] For effective gas exchange to

occur, alveolar spaces must be cleared of excess fluid, and pulmonary flow increased to match *ventilation* with *perfusion*. Failure of either of these events can jeopardize neonatal transition and signal the need for help. We are still far from a complete understanding of the mechanism(s) by which fetal lungs are able to clear themselves of excessive fluid at birth. It is clear though that traditional explanations which relied on "Starling forces" and "vaginal squeeze" can only account for a fraction of the fluid absorbed.[5] Amiloride-sensitive sodium transport by lung epithelia through epithelial sodium channels (ENaC) has emerged as a key event in the transepithelial movement of alveolar fluid.[15] Disruption of this process has been implicated in several disease states including transient tachypnea of the newborn and hyaline membrane disease. In later life, pulmonary edema can result either from excessive movement of water and solute across the alveolar capillary membrane, or from failure of reabsorption of lung fluid.

Studies have shown that in fetal lambs, lung water content remains fairly constant at 90–95 percent of total lung weight through much of the third trimester but fetal lung fluid production begins to decrease a few days prior to spontaneous vaginal delivery and alveolar fluid volume decreases from approximately 25 to 18 ml/kg.[16,17] Preterm delivery and operative delivery without prior labor has been shown to result in excessive retention of lung fluid in preterm rabbits and fetal lambs. More recently, a study evaluating the effect of lung liquid volume on respiratory performances after cesarean section found that lambs born with reduced lung liquid volume improved their arterial blood gas and acid base status quicker than those lambs born without a prenatal decrease in their lung liquid volume.[18] This study also confirmed that the experience of vaginal delivery greatly enhances respiratory performance, and this effect is greater than that achieved by simple reduction of lung liquid volume to half in fetuses delivered without enduring labor. Removal of lung fluid thus started before birth continues postnatally with fluid being carried away by several possible pathways including pulmonary lymphatics, blood vessels, upper airway, mediastinum, and pleural space.

Role of Amiloride Sensitive Epithelial Sodium Channels in Fetal Lung Fluid Clearance

Our basic science investigations have focused on physiologic changes that trigger the change in lung epithelia from a chloride secretory to a sodium reabsorption mode.[4,19–22] While several endogenous mediators including catecholamines, vasopressin, and prolactin have been proposed to increase lung fluid absorption, none explains this switch convincingly. Mechanical factors like stretch and exposure of the epithelial cells to air interface are other probable candidates that have not been well studied. We have shown that alveolar expression of highly selective sodium channels in the lung epithelia is regulated by the lung microenvironment, especially the presence of glucocorticoids and air interface.[21] Key factors in the lung "microenvironment" are steroids, catecholamines, and oxygen. Of these factors, based on our animal data (and human data from previous studies dealing with preterm gestations), it appears that the most effective strategy for accelerating reabsorption of fetal lung would be the administration of exogenous glucocorticoids.[23]

In summary, physiologic events in the last few days of pregnancy, coupled with the onset of spontaneous labor, play a critical role in fetal maturation and preparation of the fetus for neonatal transition. Rapid fetal lung fluid clearance is mediated by transepithelial sodium absorption through amiloride sensitive sodium channels, with only a minimal contribution from mechanical factors and Starling forces. In infants delivered before the onset of spontaneous

labor, the fetus is often deprived of these hormonal changes making the transition more difficult. There is urgent need for therapeutic strategies that can facilitate normal neonatal transition when elective delivery without labor is anticipated.

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Cesarean Delivery on Maternal Request: Wise Use of Finite Resources? View From the Trenches

Maurice L. Druzin, M.D.

Cesarean section rates are rising in the United States and were at an all time high of 29 percent in 2004.[1] Within this context, the issue of cesarean section on maternal request has been described as being part of a "perfect storm" of medical, legal and personal choice issues, and the lack of an opposing view.[2]

The data in figure 1 demonstrate the progressive increase in the cesarean section rate at Lucile Packard Children's Hospital at Stanford, a busy tertiary-level hospital. An increasing cesarean section rate adds an economic burden on already highly stressed medical systems. The incremental costs of cesarean section compared to vaginal delivery are illustrated in table 1.

However, the issue of cost must also be considered more broadly. The following data, also from Lucile Packard Children's Hospital at Stanford, demonstrate that a rising cesarean section rate is associated with a longer length of stay (figure 2) and a higher occupancy rate (figure 3). This high occupancy rate has led to the unfortunate diversion of critical care obstetric transports (table 2), and has dramatically reduced patient satisfaction (figure 4). These diversions, and the resultant inability to provide needed care to pregnant women, represent a profound societal cost. It goes without saying that these critical care diversions and reduced patient satisfaction also negatively impact a healthcare institution's financial bottom line and competitiveness.

The impact of a rising cesarean section rate on both short *and* term maternal *and* neonatal complications, and their associated costs, must also be taken into account. A recent study in the American Journal of Obstetrics and Gynecology showed how the incidence of placenta accreta is increasing in conjunction with the rising cesarean section rate.[6] The added costs associated with this complication (MRI, Interventional Radiology, transfusion, hysterectomy, and intensive care admission) can be prohibitive. It has also been demonstrated that infants born by scheduled cesarean delivery are more likely to require advanced nursery support (with all its associated expense) than infants born to mothers attempting vaginal delivery.[7]

My comments are as a non-economist, practicing obstetrician. However, it strikes me that we are increasingly being asked to embrace a practice of maternal request cesarean section, with limited good data and obvious inherent risk and expense. Patient autonomy and a woman's right to choose her mode of delivery should be respected. However, in my opinion, based on the current evidence regarding cesarean delivery on maternal request, promotion of primary cesarean section on request as a standard of care or as a mandated part of patient counseling for delivery will result in a highly questionable use of finite resources. As of 2004, nearly 46 million Americans did not have basic health insurance.[1] It is critical that we not allow ourselves to be dragged into the eye of a "perfect storm." This conference is an important step in the rational and objective analysis of this issue.

Figure 1. Increasing number of cesarean sections[3]

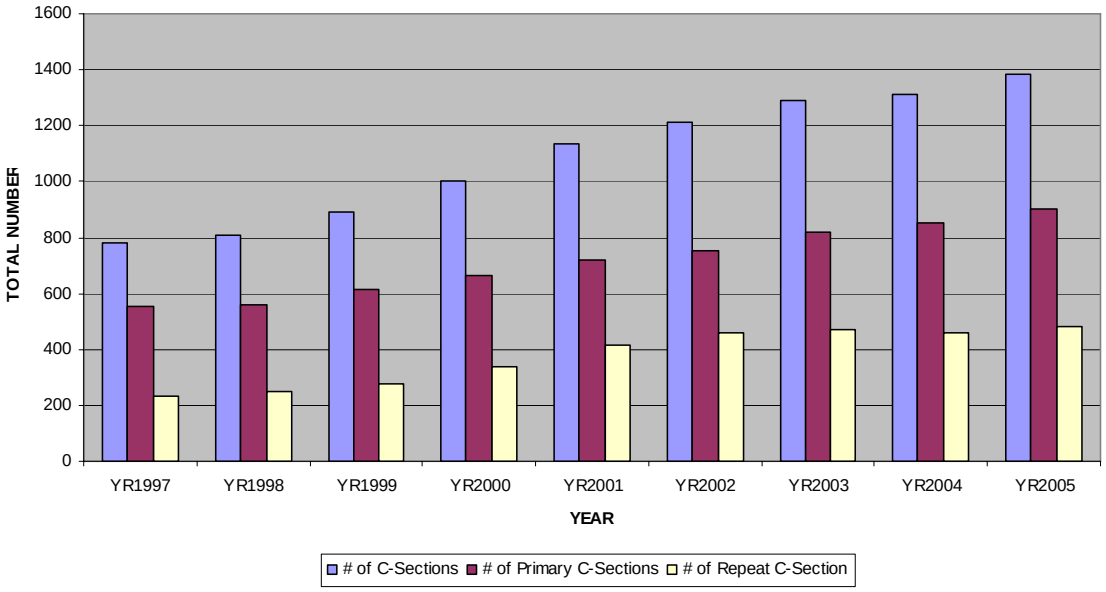


Table 1. Costs of Cesarean Section versus Trial of Labor[4,5]

COSTS	
Vaginal delivery without complications	$4,490 (2,245–6,735)
Vaginal delivery with complications	$5,560 (2,780–8,340)
C-Section without complications	$6,946 (3,473–10,419)
C-Section with complications	$8,553 (4,277–12,830)

Figure 2. Other Associated Costs: Length of Stay[3]

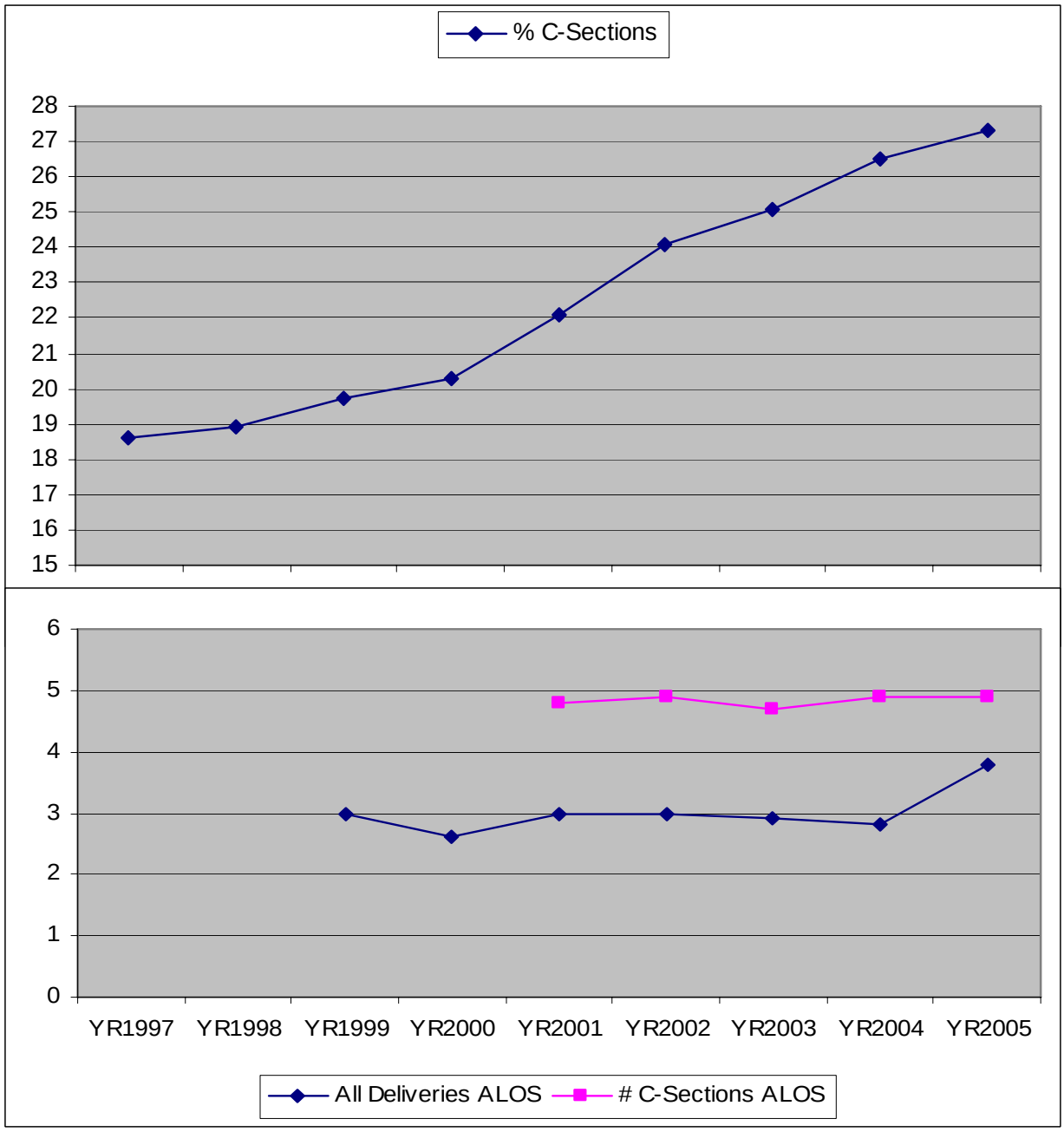


Figure 3. Other Associated Costs: High Occupancy[3]

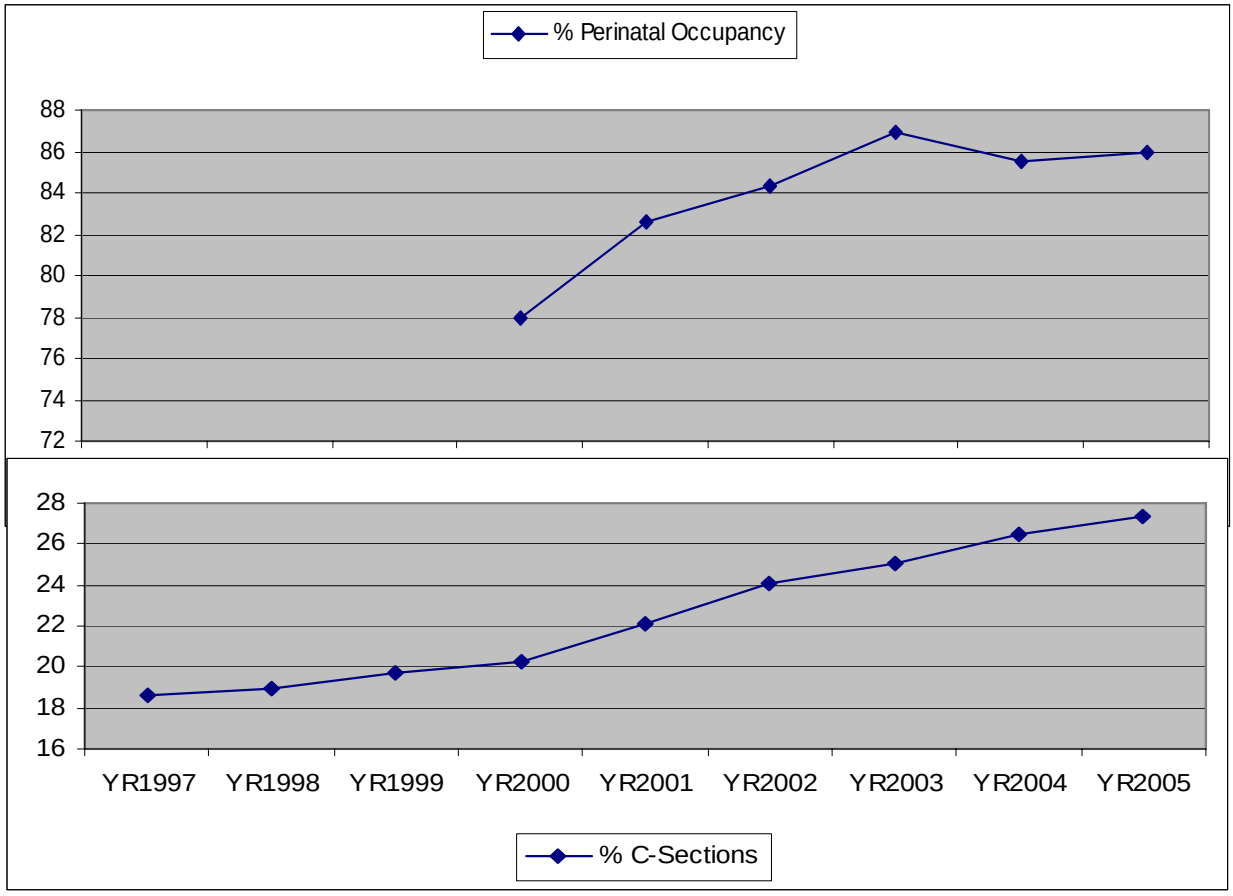
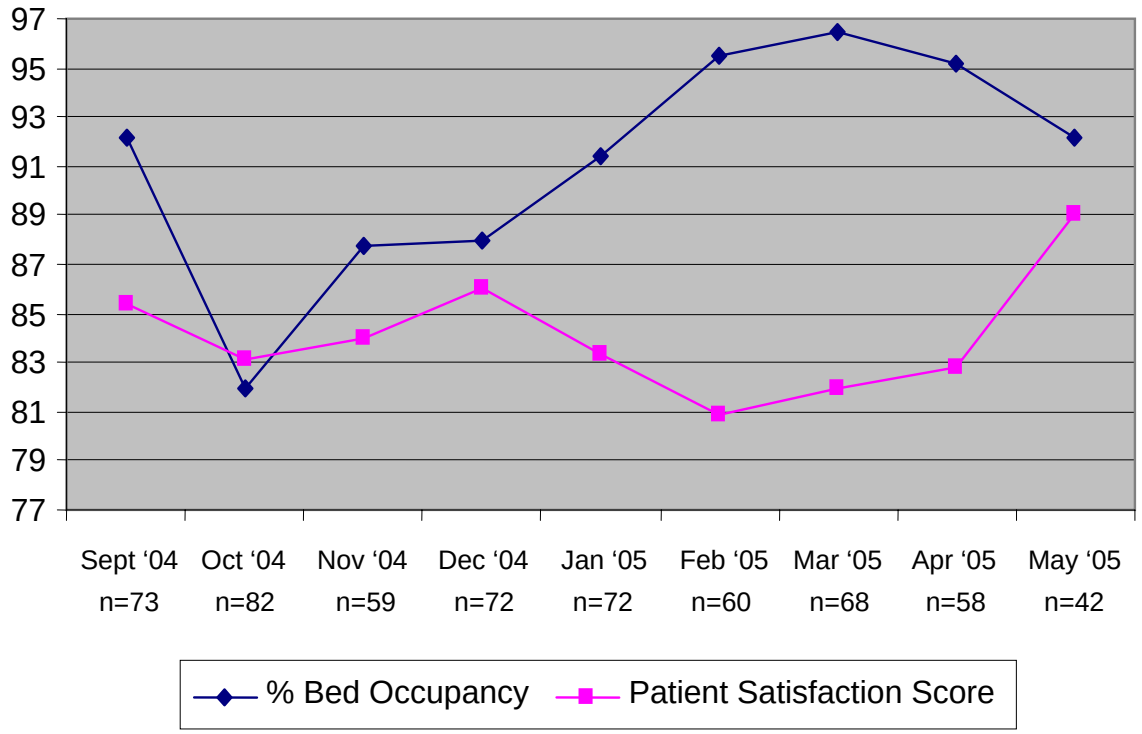


Table 2. Other Associated Costs: OB Critical Care Transport Diversion[3]

2003 86.9% Occupancy rate; Diversion n=78
2004 85.5% Occupancy rate, Diversion n=46.
2005 86% Occupancy rate, Diversion n=46.

Figure 4. Other Associated Costs: Satisfaction versus Occupancy[3]



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Ethics of Permitting or Limiting Choice of Method of Delivery

Howard Minkoff, M.D.

Mounting evidence of the safety of cesarean section, combined with increasing publicity about its possible benefits, and the facts and mythologies regarding the relationship between the failure to perform cesarean sections and obstetricians' legal jeopardy, have all contributed to an escalating cesarean section rate. More than one in four women who do not have a cesarean section by choice will end up having one anyway,[1] 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.

While there is a rich literature detailing benefits and burdens of cesarean section for both the mother and the fetus,[2] the obstetrician's responsibility in this regard is not merely to demonstrate proficiency in evidence-based medicine. Rather, obstetricians must supplement their understanding of the medical "facts" with an appreciation of those underlying tenets of obstetrical ethics that should guide conversations between physicians and patients regarding surgical options, particularly when those options are shaded by medical uncertainty.

The obstetrician has autonomy and beneficence-based obligations to the mother, and the mother and the obstetrician have beneficence-based obligations to the fetus; these outline the geography of ethical communications. While each of these can serve as a useful guiding principle, the physician's deference to maternal autonomy is usually accepted as the most compelling ethical canon.[3] That deference allows a woman to be assured that no actions will be undertaken on her behalf or on behalf of her fetus without her full, uncoerced consent. However, it does not follow, *a priori*, that a mother's right to refuse is matched by an equally unassailable right to demand. In fact, the physician has a countervailing right to refuse.[4] The illusory right to demand often serves as a straw man in discussions of cesarean section by choice; physicians, by citing ethical and legal precedents denying the existence of that right, can countervail any woman's request to forego a trial of labor.

However, unless a clinician finds the arguments against a cesarean section incontrovertible and overwhelming, s/he should be hesitant to foreclose on patient-initiated conversations regarding her right to choose a mode of delivery. While there are circumstances in which physician advice should be directive, unambiguous, and decidedly unbalanced (e.g., "don't smoke"), in more common clinical circumstances conversations with patients should be more nuanced. The counseling models that have been suggested include paternalistic, informative, interpretive, and deliberative.[6] It has been suggested that the deliberative model, in which the physician tries to guide his/her patient in choosing the optimal values and the medical interventions that go along with those values, is generally the best approach for a physician to take. Though in that model physicians provide direction, they do not *impose* values; rather, they use their knowledge of medicine and the patient in order to *persuade*. The provider can provide information about the advantages and disadvantages of surgery for both mother and fetus and can nurture in the mother the values of beneficence and self-interest. The physician, however, should be careful to avoid any coercion in these encounters and to recognize that ultimately the patient's values may not be the same as his/her own, and that the patient's values may evolve over time.

For example, a woman's ability to take time off from work or her need to have a distant relative in the home around the time of the birth may vary with the financial state of the family.

In addition to choosing a model for their relationship with their patients, clinicians must also determine whether they should incorporate the subject of mode of delivery into routine prenatal counseling. Physicians might choose to do so either as a means to recommend a cesarean section, or in order to offer choices similar to the manner in which other childbirth options, for example Lamaze or epidural, are discussed. An alternative tact would be for the physician not to routinely raise the issue but, rather, to discuss it only if the patient raises it. The physician could then attempt to dissuade the patient. If despite those attempts the patient remained steadfast in her request, the physician could either acquiesce, or, feeling that professional conscience would not allow him/her to honor that request, refuse. Which of these various strategies (recommend, offer, acquiesce, refuse) is employed should reflect the provider's belief about the strength of the supporting data. In fact, physicians choose among these options regularly, though an intuitive, rather than a formal process for choosing a strategy, is most often the norm. For example, physicians may routinely recommend smoking cessation, offer prenatal diagnostic tests, acquiesce to an anxious woman's request for an amniocentesis even if the risk of aneuploidy is low, and refuse a patient's request for an elective induction at 35 weeks gestation. Given the need to recognize patient autonomy, to respect patient values even as one tries to motivate patients to work toward the highest health values, and to acknowledge women's primacy as fetal champions, a physician should be loathe to take the latter approach (refusal) unless the data regarding cesarean section by choice are wholly tilted away from maternal–child interests. If the data are in the realm of equipoise, even if not at the tipping point, discussing options, attempting to dissuade patients, but ultimately acquiescing to their judgment, would not be incompatible with appropriate obstetrical ethics. Through these strategies, the physician fulfills his/her professional obligation to guide individuals into the best medical care, while still honoring the women's primacy as the guardian of her own, and her child's well-being.

In this presentation, the way in which data, counseling methods, and obstetrical ethics intersect, will be discussed in a manner that should guide considerations of when and whether to allow choice as to mode of delivery in the absence of traditional medical or obstetrical indications. Maternal and fetal interests will be considered separately as well as who would be the most appropriate guardian of each of those interests. The argument will be made that physicians should be hesitant to assert their right to refuse an informed woman's request for a cesarean by choice if she has been fully informed and is not under misapprehensions about the good that will derive for her and her fetus, the risks attendant to scheduled surgery, and the steps that can be taken to minimize the discomforts of vaginal deliveries.

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