

# Preventing the First Cesarean Delivery

*Summary of a Joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, and American College of Obstetricians and Gynecologists Workshop*

*Catherine Y. Spong, MD, Vincenzo Berghella, MD, Katharine D. Wenstrom, MD, Brian M. Mercer, MD, and George R. Saade, MD*

With more than one third of pregnancies in the United States being delivered by cesarean and the growing knowledge of morbidities associated with repeat cesarean deliveries, the Eunice Kennedy Shriver National Institute of Child Health and Human Development, the Society for Maternal-Fetal Medicine, and the American College of Obstetricians and Gynecologists convened a workshop to address the concept of preventing the first cesarean delivery. The available information on maternal and fetal factors, labor management and induction, and nonmedical factors leading to the first cesarean delivery was reviewed as well as the implications of the first cesarean delivery on future reproductive health. Key

*From the Pregnancy and Perinatology Branch, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland; the Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Jefferson Medical College of Thomas Jefferson University, Philadelphia, Pennsylvania; the Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Brown Alpert School of Medicine, Women and Infants Hospital, Providence, Rhode Island; the Department of Obstetrics & Gynecology, MetroHealth Medical Center Case Western Reserve University, Cleveland, Ohio; the Division of Maternal-Fetal Medicine, Department of Obstetrics & Gynecology, University of Texas Medical Branch, Galveston, Texas; and the Publications and Executive Committees of the Society for Maternal-Fetal Medicine, Washington, DC.*

*This article is an executive summary of a Society for Maternal-Fetal Medicine, Eunice Kennedy Shriver National Institute of Child Health and Human Development, and American College of Obstetricians and Gynecologists workshop that was held February 7–8, 2012, in Dallas, Texas.*

*Dr. Spong, Associate Editor of Obstetrics & Gynecology, was not involved in the review or decision to publish this article.*

*Corresponding author: Catherine Y. Spong, MD, Chief, Pregnancy and Perinatology Branch, NICHD, NIH, 6100 Executive Boulevard, Room 4B03 MSC 7510, Bethesda, MD 20892; e-mail: spong@mail.nih.gov.*

## **Financial Disclosure**

*The authors did not report any potential conflicts of interest.*

© 2012 by The American College of Obstetricians and Gynecologists. Published by Lippincott Williams & Wilkins.

ISSN: 0029-7844/12

points were identified to assist with reduction in cesarean delivery rates including that labor induction should be performed primarily for medical indication; if done for nonmedical indications, the gestational age should be at least 39 weeks or more and the cervix should be favorable, especially in the nulliparous patient. Review of the current literature demonstrates the importance of adhering to appropriate definitions for failed induction and arrest of labor progress. The diagnosis of “failed induction” should only be made after an adequate attempt. Adequate time for normal latent and active phases of the first stage, and for the second stage, should be allowed as long as the maternal and fetal conditions permit. The adequate time for each of these stages appears to be longer than traditionally estimated. Operative vaginal delivery is an acceptable birth method when indicated and can safely prevent cesarean delivery. Given the progressively declining use, it is critical that training and experience in operative vaginal delivery are facilitated and encouraged. When discussing the first cesarean delivery with a patient, counseling should include its effect on future reproductive health.

(*Obstet Gynecol* 2012;120:1181–93)

DOI: <http://10.1097/AOG.0b013e3182704880>

Cesarean delivery is the most commonly performed major surgery in the United States. Approximately one in three pregnancies is delivered by cesarean, accounting for more than 1 million surgeries each year.<sup>1</sup> In 2007, 26.5% of low-risk women giving birth for the first time had a cesarean delivery.<sup>2</sup> The Healthy People target for 2020 is a cesarean delivery rate of 23.9% in low-risk full-term women with a singleton, vertex presentation. This is much higher than the never achieved target cesarean delivery rate of 15% for Healthy People 2010.<sup>3</sup> The appropriate rate of



cesarean delivery is not easily determined because it varies according to multiple factors. Although “case mix adjustment” for these factors has been proposed, there are limited data on which variables should be included in the adjustment when evaluating variations between individuals or institutions. The primary cesarean delivery is defined as the first cesarean delivery. Given its effect on subsequent pregnancies, an understanding of the drivers behind the increase in primary cesarean delivery rates, and renewed effort to reduce them, may have a substantial effect on health care.

Although the dramatic rise in the rate of cesarean delivery since 1995 is attributable in part to an increase in frequency of primary cesarean deliveries, it is also the result of a decline in attempted trials of labor after cesarean delivery. Of U.S. women who require an initial cesarean delivery, more than 90% will have a subsequent repeat cesarean delivery. Not only does cesarean delivery increase the risk of maternal complications in the index pregnancy, including intraoperative complications, it has serious implications for future gestations. Adhesions of the uterus, bowel, and bladder can result in trauma at surgery, whereas abnormal placentation (placenta previa, accreta, increta, percreta) and uterine rupture can be catastrophic for both mother and neonate.<sup>4</sup> Given the risks associated with the initial cesarean delivery and its implications for subsequent pregnancies, the most effective approach to reducing overall morbidities related to cesarean delivery is to avoid the first cesarean delivery. Incidences of maternal as well as perinatal morbidity and mortality should be kept to the lowest level achievable.

To synthesize the available information regarding factors leading to the first cesarean delivery, including obstetric, maternal, and fetal indications for cesarean delivery, labor management and induction practices, and nonmedical factors, the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD), the Society for Maternal Fetal Medicine, and the American College of Obstetricians and Gynecologists convened a workshop on February 7–8, 2012. Workshop participants also reviewed the implications of the first cesarean delivery on future reproductive health and considered recommendations for practice, opportunities for patient and community education, and potential areas for research with the goals of determining the scope of the problem and identifying opportunities to reduce unnecessary first cesarean deliveries.

## EXAMINING INDICATIONS FOR PRIMARY CESAREAN DELIVERY

There are numerous obstetric, fetal, and maternal indications for primary cesarean delivery, some of

which may be preventable (Table 1). Importantly, there are very few absolute indications for cesarean delivery such as complete placenta previa, vasa previa, or cord prolapse. Most indications depend on the caregiver’s interpretation, recommendation, or action in response to the developing situation, therefore making them modifiable and likely target to lower the cesarean delivery rate (Tables 2–4). Although each individual indication for cesarean delivery makes a finite contribution to the overall primary cesarean delivery rate, a measurable reduction could result if concerted interventions were adopted to avoid each and all unneeded surgeries.

Patient and physician attitudes as well as their perceptions regarding the risks of vaginal delivery compared with cesarean delivery are other potentially modifiable factors. Undue concern about vaginal delivery coupled with relative indifference regarding the risks of cesarean delivery may lead to a decision that is not based on clinical evidence. Whenever cesarean delivery is planned or performed, the patient should be advised of the short- and long-term risks and benefits of the surgery both for herself and her offspring, in the present and future. The corollary is that the risks associated with vaginal delivery should be presented in an objective and unbiased manner. The indication for the surgery should be included in the consent and documented in the patient record. A cesarean delivery that is performed without an accepted indication should be labeled as such, ie, “nonindicated cesarean delivery.” The term “elective cesarean delivery” should be avoided.<sup>5</sup>

**Table 1. Major Indications for Primary Cesarean Delivery**

Stage	Indication	%
Prelabor	Malpresentation	10–15*
	Multiple gestation	3
	Hypertensive disorders	3
	Macrosomia	3
	Maternal request	2–8
In labor	First-stage arrest	15–30*
	Second-stage arrest	10–25
	Failed induction	10
	Nonreassuring fetal heart rate	10

Some indications may occur both prelabor and in labor.

\* Percentage of all cesarean deliveries that have this as a primary indication.

Data from Zhang J, Troendle J, Reddy UM, Laughon SK, Branch DW, Burkman R, et al. Contemporary cesarean delivery practice in the United States. *Am J Obstet Gynecol* 2010;203:326.e1–10; and Barber EL, Lundsberg LS, Belanger K, Pettker CM, Funai EF, Illuzzi JL. Indications contributing to the increasing cesarean delivery rate. *Obstet Gynecol* 2011;118:29–38.



**Table 2. Selected Potentially Modifiable Obstetric Indications for First Cesarean Delivery**

Indication	Diagnostic Accuracy*	Effect on Prevention of First Cesarean Delivery <sup>†</sup>	Preventive Strategies
Failed induction	Limited	Large	See Table 5 and Figure 1
Arrest of labor	Limited	Large	See Table 5 and Figure 3
Multiple gestation	High	Small	Prevent multiple gestations: encourage single embryo transfer Safe trial of labor: training for vaginal twin delivery, simulation for cephalic version, or breech extraction of second twin
Preeclampsia	High	Small	Education: preeclampsia is not an indication for cesarean delivery
Prior shoulder dystocia	Limited	Small	Improved documentation as to prior shoulder dystocia Education regarding risk of recurrence based on estimated fetal weight Prior shoulder dystocia is not an absolute indication for cesarean delivery
Prior myomectomy	Limited	Small	Improved documentation of prior myomectomy Education regarding impact of myomectomy on delivery
Prior third-degree or fourth-degree laceration, prior breakdown of repair, fistula	High	Small	Education: not an absolute indication for cesarean delivery Education: limited ability to predict recurrence
Marginal and low-lying placentation	High	Small	Education: attempt at vaginal delivery acceptable as long as placenta is 1 cm or more from internal os <sup>38</sup>

\* Diagnostic criteria accuracy: how readily and accurately cases can be diagnosed. For example, the ability to diagnose multiple gestations is high, whereas the ability to identify all cases of shoulder dystocia is limited as a result of subjectivity of the definition.

<sup>†</sup> Effect on prevention of first cesarean delivery: large means that modification of indication (eg, arrest of labor) could lead to a large decrease in cesarean deliveries. Small means that modification of indication (eg, prior shoulder dystocia) could lead to a small decrease in cesarean deliveries.

In addition to monitoring and providing feedback to clinicians regarding their indications for and rates of primary cesarean deliveries, institutions should identify those occurring without an accepted medical indication. Of those with specific indications, attention should be paid to cesarean deliveries occurring after labor inductions, those labeled as for “nonreassuring fetal status,” and those occurring for labor arrest or “failed induction” without meeting accepted criteria (Table 5). A classification system is needed to track cesarean deliveries, compare rates between practices and over time, perform audits, provide feedback, and identify areas for potential intervention.<sup>6</sup> Although not uniquely designed for primary cesarean deliveries, the Robson classification is an example of a simple method that allows comparison of cesarean delivery rates between practices as well as over time.<sup>7–9</sup>

### LABOR MANAGEMENT PRACTICES AND PRIMARY CESAREAN DELIVERY

Antepartum and intrapartum management decisions can have a profound effect on the individual patient’s likelihood of cesarean delivery. The decision to

induce labor for medical or nonmedical indications, labor management style, the diagnosis and management of arrest disorders in the first and second stages of labor, the use of labor neuroaxial anesthesia, the use of operative vaginal delivery, and evaluation of fetal factors as well as nonmedical indications may affect the potential for successful vaginal delivery.

### Induction of Labor

The overall likelihood of vaginal delivery is lower after labor induction than after spontaneous labor, especially when labor induction is attempted in a nulliparous woman with an unfavorable cervix. Institutions should have a clear policy regarding labor induction, including a list of acceptable indications, and should specify the definitions of a favorable cervix, options for cervical ripening in the presence of an unripe cervix, oxytocin infusion protocols, and criteria for the diagnosis of failed induction. Labor induction with an unfavorable cervix should not be undertaken unless delivery is indicated for clear maternal or fetal benefit. Any time induction is undertaken, it should be clear that the goal is vaginal delivery.



**Table 3. Selected Potentially Modifiable Fetal Indications for First Cesarean Delivery**

Indication	Diagnostic Accuracy*	Effect on Prevention of First Cesarean Delivery <sup>†</sup>	Preventive Strategies
Malpresentation Nonreassuring antepartum or intrapartum fetal surveillance	High Moderate	Large Large	External cephalic version Education regarding correct interpretation and management (Fig. 2) Confirmatory tests (eg, scalp stimulation) Intrauterine resuscitative measures (eg, IVF, position change, oxygen, etc)
Macrosomia	Limited	Small	Screen for and treat diabetes; limit weight gain in pregnancy
Malformations, eg, NTD, SCT, EXIT procedure, hydrops	Moderate	Small	Anecdotal for indication Education: cesarean delivery not indicated for abdominal wall defects Multidisciplinary education of subspecialists and counseling of patients

IVF, in vitro fertilization; NTD, neural tube defects; SCT, sacrococcygeal teratoma; EXIT, ex utero intrapartum treatment.

\* Diagnostic criteria accuracy: how readily and accurately cases can be diagnosed. For example, the ability to diagnose malpresentation is high, whereas the ability to identify macrosomia is limited. Moderate accuracy is between high and limited.

<sup>†</sup> Effect on prevention of first cesarean delivery: large means that modification of indication (eg, malpresentation) could lead to a large decrease in cesarean deliveries. Small means that modification of indication (eg, malformations) could lead to a small decrease in cesarean deliveries.

Because an unfavorable cervix can negatively affect the labor course and increase the potential for cesarean delivery, this factor should be considered in decision-making regarding the method of labor induction. However, the decision for induction should be considered first and should be separate from the decision about whether to use cervical ripening.

Pragmatically, although the potential maternal and fetal risks related to induction with an unfavorable cervix should be incorporated into the overall risk-benefit evaluation when considering medically indicated labor induction, the decision to proceed with induction should be made independent of the condition of the cervix and based on the specific indication

**Table 4. Selected Potentially Modifiable Maternal Indications for First Cesarean Delivery**

Indication	Diagnostic Criteria Accuracy*	Effect on Prevention of First Cesarean Delivery <sup>†</sup>	Preventive Strategies
Obesity (BMI greater than or equal to 30 kg/m <sup>2</sup> )	High	Small	Weight loss preconception, and limited weight gain in pregnancy Education: obesity is not an indication for cesarean delivery and is a poor predictor of cesarean delivery
Infection (HSV, HCV, HIV) Cardiovascular disease (acute HTN crisis, cardiomyopathy, pulmonary HTN, cerebral aneurysm, CVA)	High High	Small Small	HIV treatment to minimize viral load Education: not an independent indication for cesarean delivery
Inadequate pelvis	Limited	Small	Education: in general, not an indication for cesarean delivery
Request (no maternal, obstetric, or fetal indication)	Not applicable	Small	Education of patient and provider regarding acute complications and long-term risks, benefits, and effect of cesarean delivery on mother and newborn; specific education on fear of labor

BMI, body mass index; HSV, herpes simplex virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; HTN, hypertension; CVA, cerebrovascular accident.

\* Diagnostic criteria accuracy: how readily and accurately cases can be diagnosed. For example, the ability to diagnose infection is high, whereas the ability to identify inadequate pelvis is limited as a result of subjectivity of the definition.

<sup>†</sup> Effect on prevention of first cesarean delivery: small means that modification of indication (eg, infection) could lead to a small decrease in cesarean deliveries.



**Table 5. Definitions of Failed Induction and Arrest Disorders**

Failed induction of labor
Failure to generate regular (eg, every 3 min) contractions and cervical change after at least 24 h of oxytocin administration, with artificial membrane rupture if feasible
First-stage arrest
6 cm or greater dilation* with membrane rupture and no cervical change for
4 h or more of adequate contractions (eg, >200 Montevideo units) or
6 h or more if contractions inadequate
Second-stage arrest
No progress (descent or rotation) for
4 h or more in nulliparous women with an epidural
3 h or more in nulliparous women without an epidural
3 h or more in multiparous women with an epidural
2 h or more in multiparous women without an epidural

\* Since women may still be in latent labor, additional time and interventions may be needed in order to diagnose an arrest of active labor before 6 cm dilatation (see Figure 1 for suggested management).

(s). There is no single definition used to differentiate a favorable (“ripe”) from an unfavorable (“unripe”) cervix whether in research or in clinical practice. In general, the Bishop’s score has most often been used to describe cervical ripeness. A Bishop’s score greater than 8 generally confers the same likelihood of vaginal delivery with induction of labor as that after spontaneous labor and thus has been considered to indicate a favorable cervix.<sup>10</sup> Conversely, a Bishop’s score of 6 or less has been used to denote an unfavorable cervix in many studies and has been associated with a higher risk of cesarean delivery when labor is induced compared with spontaneous labor. Because the Bishop’s score was originally developed to predict the likelihood of multiparous women at term to enter spontaneous labor, making it less predictive of outcome after labor induction in nulliparas, the effects of maternal parity and gestational age were also considered during the workshop. Cervical ripening may be considered when there is a medical indication for induction. Because inductions without medical indication should not be done with an unripe cervix, cervical ripening would not be an option (Fig. 1). Although cervical ripening agents have generally not been demonstrated to reduce the likelihood of cesarean delivery in prospective interventional trials, their use can affect the duration of labor.

Because the goal of labor induction is vaginal delivery, adequate time to enter into or progress in labor should be allowed, provided the mother and neonate are stable. The prudent use of labor induc-

tion, and the expectation that well-defined criteria be met before cesarean delivery is performed for failure of induction or failure of progress in labor, may actually prevent many unnecessary first cesarean deliveries. During this evaluation, it is important to differentiate between “failed induction” and “arrest of labor” in the first stage. The diagnosis of failed induction should be reserved for those women who have not achieved regular (eg, every 3 minutes) contractions and cervical change after at least 24 hours of oxytocin administration with artificial membrane rupture if feasible (after completion of cervical ripening, if performed; Table 5; Fig. 1). Studies have shown that more than half of the women undergoing labor induction remain in the latent phase for at least 6 hours, and nearly one fifth remain in the latent phase for 12 hours or longer.<sup>11</sup> In a multicenter study, nearly 40% of the women still in the latent phase after 12 hours of oxytocin and membrane rupture successfully delivered vaginally. These data suggest that induction should not be defined to have failed in the latent phase unless oxytocin has been administered for at least 24 hours or for 12 hours after membrane rupture.<sup>12,13</sup> Numerous approaches to induction and cervical ripening have been published, and no single approach is considered superior to all others. Individual circumstances should be considered for each patient. The algorithm offered in Figure 1 provides a general approach once the decision has been made to proceed with labor induction.

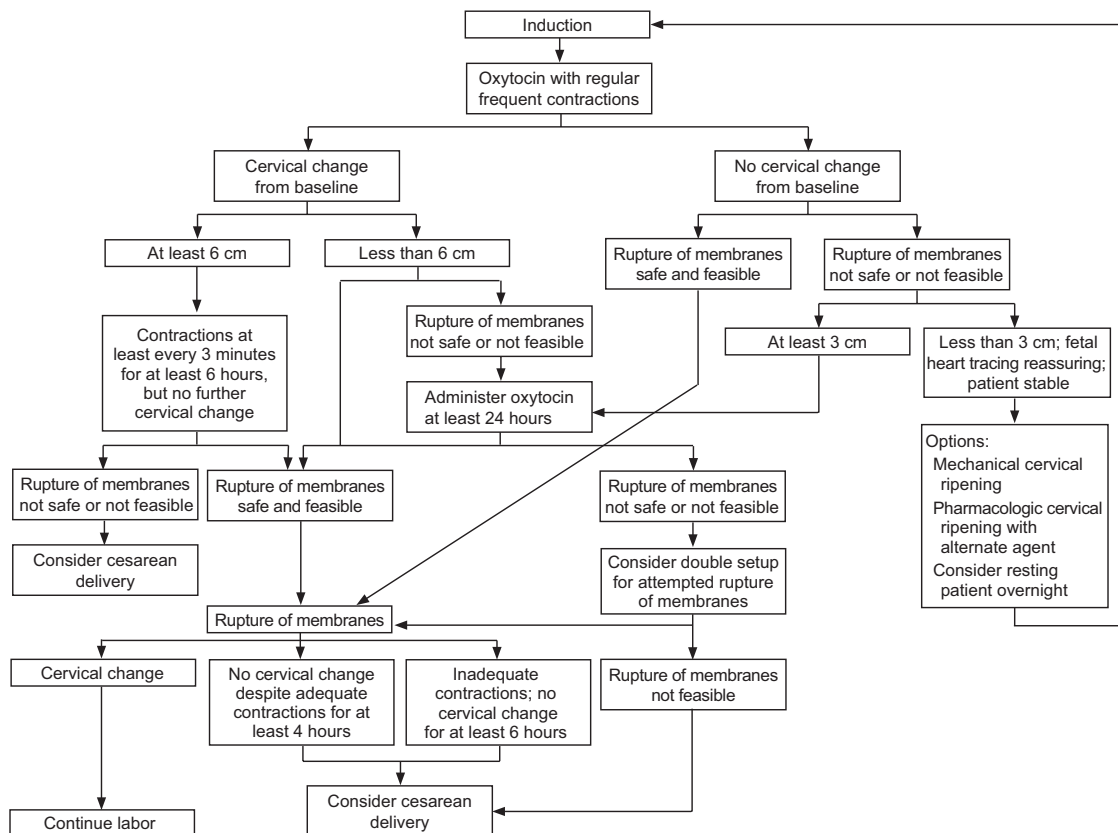
There is much debate as to how long induction should be allowed to continue and whether it is appropriate to “rest” the patient who does not progress after 12 or more hours of induction but who does not otherwise have a maternal or fetal reason for immediate delivery. In cases in which induction is undertaken for

**Box 1. Quality Measures to Track and Provide Feedback for Each Obstetrician–Gynecologist Physician\***

- Rate of nonmedically indicated cesarean delivery
- Rate of nonmedically indicated induction
- Rate of labor arrest or failed induction diagnosed without meeting accepted criteria
- Rate of cesarean deliveries for nonreassuring fetal heart rate by *Eunice Kennedy Shriver* National Institute of Child Health and Human Development category<sup>14</sup>

\*For singleton gestation, vertex presentation, at 37 0/7 to 41 6/7 weeks of gestation.





**Fig. 1.** Algorithm for induced labor.

Spong. *Preventing the First Cesarean Delivery*. *Obstet Gynecol* 2012.

specific maternal or fetal conditions that can worsen with time, stopping the induction is not an appropriate option. Examples of such cases include preeclampsia, fetal growth restriction, diabetes, and ruptured membranes. On the other hand, induction is sometimes undertaken when neither the maternal nor fetal condition is expected to deteriorate rapidly. An example is induction at 41 weeks of gestation. Despite this being a common obstetric dilemma, guidance available from professional organizations does not provide clarity.<sup>15-17</sup> Published trials allowed cervical ripening over a period ranging from a single dose to several doses over days. In a trial of the Maternal-Fetal Medicine Units Network, the study design specified at least 24 hours from start of oxytocin before declaring a failed induction. All trials have found good outcomes in the induction group despite waiting for at least 24 hours before failed induction was declared. It is also important to note that in all induction trials, rupture of membranes was undertaken as soon as feasible and safe. Based on this indirect evidence, it is considered appropriate to temporize before declaring that an induction has failed in women being induced for conditions that are not likely to worsen with

time and whose membranes remain intact (Table 5; Fig. 1). An arrest disorder should not be confused with failed induction. The diagnosis of an arrest disorder in women undergoing induction should not be made unless the woman has entered the active phase of labor, requiring that there be documented cervical change preceding the arrest in dilation (Table 5). Once 6-cm cervical dilation is reached and the active phase is entered, labor progress during induction is similar to the patient in spontaneous labor. However, the duration of the phase before 6-cm dilation is longer in women undergoing induction.<sup>17</sup>

### LABOR-MANAGEMENT STYLE

It has been suggested that the widely varying rates of cesarean delivery among health care providers may be the result of different labor management styles. Admission of women in the early latent phase of labor (eg, less than 3 cm dilated) has been associated with higher cesarean delivery rates. However, it is unclear whether the admission in early labor itself increases the risk for cesarean delivery or if women requiring admission earlier in labor are actually more likely to have an



abnormal labor course (eg, abnormal contraction pattern resulting in excessive pain and slower progress in early labor, foreshadowing a subsequent arrest disorder). Hospital admission does provide more time to monitor labor progress and fetal well-being as well as to implement interventions to facilitate labor. However, early admission could also give the impression of a long labor and result in earlier abandonment if progress is not deemed adequate or because of pressure from the patient or family. Although it is prudent to avoid unneeded admissions (eg, before 3 cm of dilatation) and interventions (eg, augmentation, artificial membrane rupture), there is limited information regarding the direct effect of these practices on primary cesarean delivery rates.

Provider type (eg, physician, certified nurse midwife) may also be related to labor outcomes. Whether this relationship is causal or merely by association is not clear.<sup>19–21</sup> It is possible that differences in the characteristics and expectations of women seeking different health care provider types may also affect the outcome; for example, the woman interested in delivering with a midwife or other low-risk health care provider may have an inherently different risk of cesarean delivery than one who prefers the care of an obstetrician or maternal-fetal medicine subspecialist. Despite this, the same defined criteria for labor arrest and prolonged labor should be used regardless of health care provider or patient type.

## DIAGNOSIS OF ARREST DISORDERS

The concept of a prolonged or “protracted” first or second stage of labor should be considered distinct from that of an arrest disorder. Progress in the first stage should not be based solely on cervical dilation but must also take into consideration change in cervical effacement and fetal station. Similarly, progress in the second stage involves not only descent, but also rotation of the fetal head as it traverses the maternal pelvis. Recognition of arrest of labor in the first or second stage of labor (Table 5) provides an opportunity to reassess the maternal and fetal condition, to counsel the woman about the ongoing potential for successful vaginal delivery, and to address the maternal and perinatal risks of continued labor. However, “protracted labor” alone should not be the sole indication for an operative vaginal or cesarean delivery if progress is being made and the maternal and fetal status are reassuring.

Although the timing of labor onset in the patient entering spontaneous labor at home may be less clear, and the progress of labor before arrival to the hospital cannot be accurately assessed, there is no reason to

differentiate between the diagnostic criteria for arrest disorders that occur after spontaneous labor compared with labor induction. Pragmatically, arrest disorders in spontaneously laboring women are defined by clinical findings noted after admission. In both spontaneous as well as induced labor, the diagnosis of an arrest disorder should not be made before the patient has entered into the active phase. The definitions of arrest disorders outlined in Table 5 vary somewhat from published criteria<sup>10</sup> in recognition of more recent findings regarding labor progress that challenge our long-held practices based on the Friedman curve. For example, the acceleration phase in active labor may not begin until approximately 6-cm dilation rather than the previously recognized 4-cm cutoff, and multiparous women appear to have a steeper acceleration phase than previously thought.<sup>22</sup>

Data needed to establish the normal range for the duration of the latent phase are not readily available because the onset of the latent phase in most women in spontaneous labor occurs outside the hospital and therefore cannot be accurately determined. Available evidence suggests that the duration of the latent phase is not different between nulliparous and multiparous women, a finding that contrasts with the overall length of the first and second stages of labor.<sup>22</sup> Based on data from the safe labor consortium, nulliparous women in spontaneous labor entering the hospital have a median duration of 6 hours (95<sup>th</sup> percentile of 15.7 hours) to reach the active phase of labor (6-cm dilation) if they enter the hospital at 2-cm dilation, and 4.2 hours (95<sup>th</sup> percentile 12.5 hours) if they enter at 3 cm.<sup>22</sup> Nulliparous women admitted in spontaneous labor with a cervix between 2 and 4 cm may not change their cervix for up to 7 to 6 hours, respectively.<sup>22</sup>

The safe labor consortium analyzed the duration of labor in 62,415 women with a term singleton pregnancy and a normal outcome and developed contemporary partograms for labor.<sup>22</sup> Labor in nulliparous women took longer than expected based on the Friedman curves. The investigators found that labor can take more than 6 hours to progress from 4 cm to 5 cm and more than 3 hours to progress from 5 cm to 6 cm. The median duration of the active phase, from 6 cm to complete cervical dilation, was 2.1 hours in nulliparous women and 1.5 hours in multiparous women, with 95<sup>th</sup> percentiles of 8.6 hours and 7.5 hours, respectively. The median and 95<sup>th</sup> percentiles for the cervical change before 6 cm are similar for nulliparous and multiparous women. After 6 cm, multiparous women had a slightly faster labor than nulliparous women. These data suggest that the historical criteria defining normal labor progress—



cervical change of 1.2 cm/h for nulliparous women and 1.5 cm/h for multiparous women—are no longer valid.

As for the second stage of labor, the data from the safe labor consortium showed the median duration (95<sup>th</sup> percentile) with epidural analgesia to be 1.1 (3.6), 0.4 (2.0), and 0.3 (1.6) hours for nulliparous, primiparous, and multiparous women, respectively, and 0.6 (2.8), 0.2 (1.3), and 0.1 (1.1) hours without an epidural.<sup>21</sup> Table 6 shows the median and 95<sup>th</sup> percentile duration for each centimeter change in nulliparous women in spontaneous labor.

## LABOR ANALGESIA

Although it has been suggested that the use of neuraxial analgesia (epidural, spinal, or combined spinal–epidural) may prolong the latent phase of spontaneous labor, numerous trials have failed to find an increase in cesarean delivery with neuraxial analgesia either during labor induction or after spontaneous labor.<sup>23–25</sup> As such, neuraxial analgesia should not be withheld or delayed because of concerns regarding the risk of cesarean delivery.

## OPERATIVE VAGINAL DELIVERY

Forceps and vacuum-assisted operative vaginal delivery may avert a cesarean delivery when maternal expulsive forces are inadequate or expedited delivery is needed.<sup>26</sup> Many studies, including some that followed the offspring up to 18 years of age, have demonstrated that neonates delivered by operative vaginal delivery typically have a normal newborn transition period and normal long-term outcomes.<sup>27–30</sup> Comparing the reported rates of cesarean delivery with operative vaginal delivery among U.S., Canadian, and European practices, it becomes clear that higher rates of operative vaginal delivery are often associated with lower cesarean delivery rates, and vice versa. Although plausible, a cause-and-effect relationship has not been established.

Although operative vaginal delivery is acceptable in appropriate circumstances, it requires an operator who understands the indications and prerequisites and is skilled in the technique. For this reason, the diminishing training and experience in operative vaginal delivery nationally is of concern. Important steps in providing initial training and in maintaining skills include not only increased supervised training during residency and supplemental training and skill maintenance simulations, but recognition by both patients and physicians that operative vaginal delivery is safe and can reduce perinatal morbidities when

**Table 6. Duration of Each Centimeter Change in Cervical Dilatation for Nulliparous Women With Spontaneous Onset of Labor\***

Cervical Change (cm)	Median (h)	95 <sup>th</sup> Percentile (h)
3–4	1.8	8.1
4–5	1.3	6.4
5–6	0.8	3.2
6–7	0.6	2.2
7–8	0.5	1.6
8–9	0.5	1.4
9–10	0.5	1.8

\* Modified from Zhang J, Landy HJ, Branch DW, Burkman R, Haberman S, Gregory KD, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes. *Obstet Gynecol* 2010;116:1281–7.

performed by an experienced health care practitioner. Training programs should have readily available skilled operators to teach these procedures and mechanisms in place to provide training, including in actual cases as well as by simulation.

## EVALUATION OF FETAL STATUS BEFORE AND DURING LABOR

Electronic fetal heart monitoring remains the mainstay for assessment of fetal status during labor and is often used to decide on the mode of delivery in a complicated pregnancy (Fig. 2). Continuous intrapartum fetal heart rate monitoring has been used in more than 85% of deliveries in the United States for more than a decade.<sup>31</sup> However, despite the expectation that continuous intrapartum fetal heart rate monitoring would improve perinatal outcomes and the concomitant rise in cesarean deliveries, there has been no reduction in the rate of cerebral palsy since its introduction in the United States and elsewhere. Although studies have found no benefit of continuous monitoring over intermittent auscultation in low-risk women, intermittent auscultation requires one-to-one nursing throughout labor and may not be appropriate in high-risk women or when there are fetal heart rate abnormalities detected by auscultation. Although it is reasonable to provide intermittent auscultation for low-risk women, guidelines defining appropriate candidates, the required frequency of auscultation, and criteria for conversion to continuous fetal heart rate monitoring should be in place and enforced.

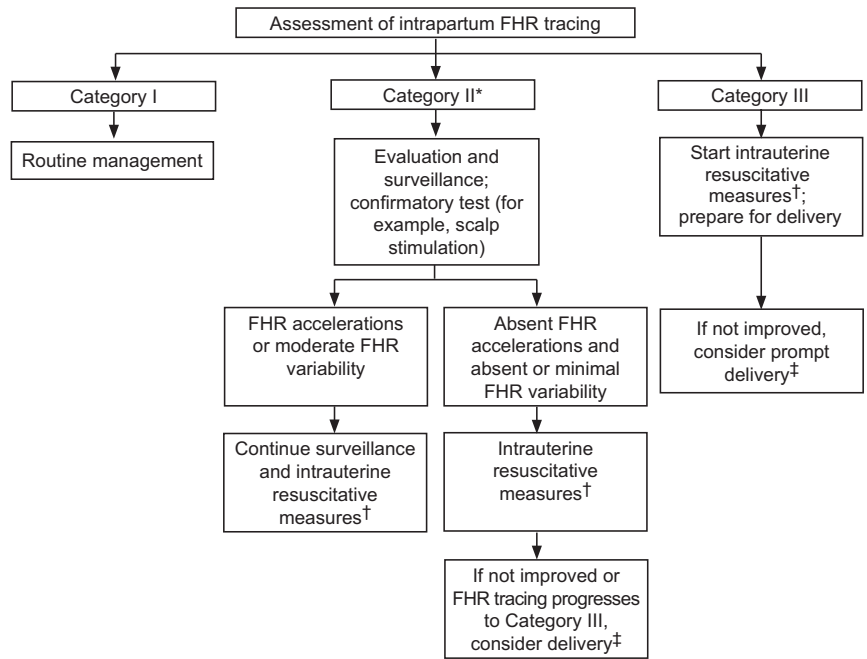
Important limitations in the interpretation of continuous fetal heart rate monitoring include considerable interobserver variability in the identification of fetal heart rate patterns likely to be associated with





**Fig. 2.** Assessment of intrapartum fetal heart rate monitoring. \*Given the wide variation of fetal heart rate (FHR) tracings in Category II, this algorithm is not meant to represent assessment and management of all potential FHR tracings but provide an action template for common clinical situations. †Intrauterine resuscitative measures may include oxygen supplementation, position change, intravenous fluids, stopping oxytocin, tocolysis, and amnioinfusion. ‡Timing and mode of delivery based on feasibility and maternal-fetal status. Modified from Management of intrapartum fetal heart rate tracings. Practice Bulletin No. 116. American College of Obstetricians and Gynecologists. *Obstet Gynecol* 2010;116:1232–40.

Spong. Preventing the First Cesarean Delivery. *Obstet Gynecol* 2012.



fetal acidosis and the fact that many patterns have a low positive predictive value for adverse outcomes. In 2008, the NICHD revised the guidelines for interpretation of fetal heart rate patterns, creating a three-tiered interpretation system. Category I fetal heart rate tracings are strongly predictive of normal fetal acid-base status and are considered “normal.” Category III fetal heart rate patterns are predictive of abnormal fetal acid-base status at the time of observation and are considered “abnormal.” The intermediate Category II fetal heart rate patterns include those that cannot be classified as Category I or III.<sup>14</sup> The NICHD recommendations do not specify any particular intervention for Category I tracings but do support prompt evaluation of Category III heart rate patterns. Although interventions to resolve an abnormal Category III fetal heart rate pattern may help to avoid unneeded cesarean delivery, expeditious delivery is recommended if these efforts are unsuccessful (Fig. 2). The intermediate Category II fetal heart rate pattern requires a heightened level of attention but does not by itself require immediate delivery; rather, evaluation and continued surveillance and re-evaluation are recommended. Maneuvers to improve uteroplacental perfusion (eg, adjustment of oxytocin infusion rate, administration of maternal oxygen, change of maternal position, treatment of maternal hypotension) may result in reversion to a Category I pattern.

Fetal heart rate acceleration in response to fetal scalp stimulation is supportive evidence suggesting the absence of metabolic acidemia. Although fetal scalp sampling was previously used to determine fetal scalp microcapillary pH, the hardware needed for bedside fetal scalp pH assessment is no longer readily available in the United States. The efficacy of other ancillary technologies (eg fetal pulse oximetry, fetal electrocardiographic ST-segment analysis, computerized fetal heart rate pattern interpretation) to improve neonatal outcome has not been confirmed. Until additional effective technologies become available, it is unlikely that the rate of cesarean delivery for fetal heart rate abnormalities will be reduced substantially.

It is important to remember that any test that depends on human interpretation will be subject to the pressures exerted on the individual making the decision and the individual’s responses to the environment. This will lead to either higher false-negative or higher false-positive test results depending on whether the decision-maker fears more the implications of a mistaken diagnosis or the implications of missing a diagnosis, respectively. In the case of electronic fetal monitoring, the major implication of a false-positive interpretation is a potentially unnecessary operative delivery, but the implication of a false-negative interpretation is an adverse outcome for the fetus, along with its associated consequences to the decision-maker and hospital. Even if one believes that continuous fetal heart rate



monitoring may have prevented some adverse outcomes, the evidence is overwhelming that it has caused many more unnecessary interventions overall. The result is a rise in cesarean delivery rates, which has led to an increased incidence of subsequent placenta accreta and associated maternal morbidities and mortality. When discussing continuous fetal heart rate monitoring, the fetus who was “saved” is frequently held as proof of benefit of this technology, but the many more women who underwent unnecessary procedures, had significant morbidity or even died as a result of a false-positive interpretation are rarely mentioned. Importantly, the fact that the risks of cesarean delivery are cumulative over future pregnancies is frequently overlooked.

Given that interpretation of the fetal heart rate can be subjective, it is important that hospitals institute some form of quality control for operative deliveries with nonreassuring fetal heart rate as the indication (Box 1). Including the fetal heart rate category in the indication should be expected. In the case of an indication with a Category II pattern, confirmatory testing, if any, should be documented, such as a negative response to scalp stimulation or minimal variability. Regular audits and reports can be provided to the staff with the rates of operative deliveries according to indications and stage of labor.

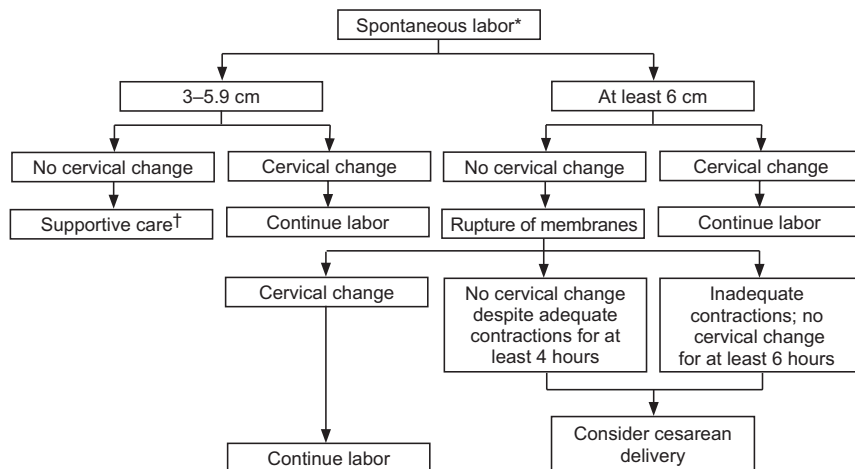
## NONMEDICAL FACTORS

The relative safety of cesarean delivery has lowered both patient and physician apprehension regarding the risk of such surgery, especially in the face of borderline fetal heart rate abnormalities, protracted labor or arrest disorders, or after the development of obstetric or medical complications. In general, the usual concerns regarding major surgery do not seem to apply as emphatically to cesarean delivery as to other operations. This is most evident among patients requesting a nonmedically indicated cesarean delivery and physicians who acquiesce to such requests. Patient perception and education, societal attitudes, and social media all play a role.<sup>32</sup> In addition to considering the risk of the first cesarean delivery, physicians and patients should be made aware of the potential complications resulting from repeated surgeries both for the mother (eg, adhesions, bowel or bladder trauma, abnormal placentation including placenta accreta, uterine rupture, hysterectomy) and the fetus (eg, delayed delivery resulting from extensive adhesions).

### Box 2. Key Points

- A cesarean delivery that is performed without an accepted indication should be labeled as such, ie, “nonindicated cesarean delivery.” The term “elective cesarean delivery” should be avoided.
- Labor induction should be performed only for medical indication; if done for nonmedical indications, the gestational age should be 39 weeks or more, and the cervix should be favorable (Bishop score more than 8), especially in the nulliparous patient.
- The diagnosis of failed induction should only be made after an adequate attempt. Failed induction is defined as failure to generate regular (eg, every 3 minutes) contractions and cervical change after at least 24 hours of oxytocin administration with artificial membrane rupture if feasible.
- Adequate time for normal latent and active phases of the first stage, and for the second stage, should be allowed unless expeditious delivery is medically indicated (Table 5; Figs. 1 and 3).
- In the presence of reassuring maternal and fetal status, the diagnosis of arrest of labor should not be made until adequate time has elapsed. This includes greater than 6 cm dilation with membrane rupture and 4 or more hours of adequate contractions (eg, greater than 200 Montevideo units) or 6 hours or more if contractions inadequate with no cervical change for first-stage arrest. For second-stage arrest, no progress (descent or rotation) for more than 4 hours in nulliparous women with an epidural, more than 3 hours in nulliparous women without an epidural, and more than 2 hours in multiparous women without an epidural should be considered, with no cesarean delivery for this indication before these time limits (Table 5).
- Intermittent auscultation, done appropriately, is an acceptable method for labor management in low-risk patients without heart rate abnormalities.
- In the patient with moderate fetal heart rate variability, other findings have little association with neurologic damage or acidosis.
- Medically indicated operative vaginal delivery is an acceptable birth method. Given the current rates, it is critical that training and experience in operative vaginal delivery are augmented and encouraged.
- Doctors who are salaried and participate in profit-sharing, thus reducing the financial incentive to limit the time spent managing labor, have lower cesarean delivery rates.
- When discussing the first cesarean delivery with a patient, counseling should include its effect on subsequent pregnancy risks such as uterine rupture and placental implantation abnormalities including placenta previa and accreta.





**Fig. 3.** Algorithm for spontaneous labor. \*Consider outpatient management of uncomplicated labor until at least 3 cm dilated or fetal membrane rupture occurs. †Continued observation in latent phase, with augmentation as indicated. Discharge may be appropriate if labor subsides, membranes remain intact, and maternal and fetal status remain stable.

Spong. *Preventing the First Cesarean Delivery*. *Obstet Gynecol* 2012.

Institutional factors, such as time constraints for scheduling on the labor and delivery unit, varying operating room staff availability, and the inability to support prolonged inductions with resources and space that may be scarce all play a role in the decision to proceed to cesarean delivery. Physician factors such as fatigue, workload, and anticipated sleep deprivation likely also affect decision-making. Several studies have suggested that cesarean delivery rates are influenced by the “leisure incentive”; when the health care provider can go to sleep or go home after the delivery, the cesarean delivery rate, especially cesarean deliveries performed for “dystocia” (prolonged or dysfunctional labor) and “fetal intolerance of labor,” increases.<sup>33,34</sup> Financial incentives and disincentives related to work efficiency and staffing workload may also tilt the scale toward more liberal performance of scheduled cesarean deliveries. Given the time required to monitor a complicated labor, there is a financial disincentive to persevere when labor does not proceed efficiently or if borderline fetal heart patterns are present. Evidence suggests that doctors who are salaried and participate in profit-sharing, thus reducing the financial incentive to limit the time spent managing labor, have lower cesarean delivery rates.<sup>14</sup>

The current medical–legal climate has also made waiting for a vaginal delivery less attractive to many physicians when labor is not proceeding smoothly. In many centers, the number of cesarean deliveries performed for “nonreassuring fetal status” has increased more than any other indication despite the fact that the number of women classified as high risk has not increased concomitantly.<sup>35,36</sup> All of these factors are compounded by the belief among many patients that cesarean delivery is safer for the fetus.<sup>37</sup>

Patient expectations, the medical–legal climate, and practice patterns regarding intrapartum management need to be addressed if the rate of primary cesarean delivery is to be reduced. Importantly, the misperception among reproductive-age women that labor and vaginal delivery can harm the neonate, whereas cesarean delivery ensures a normal outcome, must be recognized and corrected. Given the implications of primary cesarean delivery on both pregnancy complications and subsequent deliveries, it is important to institute practice management that limits performance of the first cesarean delivery (Table 5).

## CONCLUSIONS

Although numerous factors contribute to the primary cesarean delivery rate, the clinician’s ability to modify some of these and mitigate others is the first step toward lowering the primary cesarean delivery rate (Tables 2–5; Box 2). The available information on maternal and fetal factors, labor management and induction, and nonmedical factors leading to the first cesarean delivery as well as the implications of the first cesarean delivery on future reproductive health are reviewed and critical key points were identified (Box 2). The implications of a cesarean delivery rate of 30% or more have tremendous effects on the medical system as well as on the health of women and children. It is essential to embrace this concern and provide guidance on strategies to lower the primary cesarean delivery rate. Education regarding the normal labor course and the implications of first cesarean delivery may allow women and their health care providers to avoid practices that increase the potential for unneeded first cesarean deliveries.



## REFERENCES

- Hamilton BE, Martin JA, Ventura SJ. Births: preliminary data for 2009. Vol. 59, no 3. Hyattsville (MD): National Center for Health Statistics; 2010.
- Healthy People 2020, maternal, infant, and child health. Available at: [www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=26](http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=26). Retrieved April 30, 2012.
- Healthy People 2010, Healthy People 2010 operational definition. Available at: [ftp://ftp.cdc.gov/pub/health\\_statistics/nchs/datasets/data2010/focusarea16/O1609a.pdf](ftp://ftp.cdc.gov/pub/health_statistics/nchs/datasets/data2010/focusarea16/O1609a.pdf). Retrieved September 14, 2012.
- Clark EA, Silver RM. Long-term maternal morbidity associated with repeat cesarean delivery. *Am J Obstet Gynecol* 2011;205:S2–10.
- Berghella V, Blackwell SC, Ramin SM, Sibai BM, Saade GR. Use and misuse of the term ‘elective’ in obstetrics. *Obstet Gynecol* 2011;117:372–6.
- Torloni MR, Betran AP, Souza JP, Widmer M, Allen T, Gulmezoglu M, et al. Classifications for cesarean section: a systematic review. *PLoS One* 2011;6:e14566.
- Robson MS. Can we reduce the caesarean section rate? *Best Pract Res Clin Obstet Gynaecol* 2001;15:179–94.
- Brennan DJ, Murphy M, Robson MS, O’Herlihy C. The singleton, cephalic, nulliparous woman after 36 weeks of gestation. *Obstet Gynecol* 2011;117:273–9.
- Brennan DJ, Robson MS, Murphy M, O’Herlihy C. Comparative analysis of international cesarean delivery rates using 10-group classification identifies significant variation in spontaneous labor. *Am J Obstet Gynecol* 2009;201:308.e1–8.
- Induction of labor. Practice Bulletin No. 107. American College of Obstetricians and Gynecologists. *Obstet Gynecol* 2009;114:386–97.
- Simon CE, Grobman WA. When has an induction failed? *Obstet Gynecol* 2005;105:705–9.
- Harper LM, Caughey AB, Odibo AO, Roehl KA, Zhao Q. Normal progress of induced labor. *Obstet Gynecol* 2012;119:1113–8.
- Rouse DJ, Weiner SJ, Bloom SL, Varner MW, Spong CY, Ramin SM, et al; Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units Network (MFMU). Failed labor induction: toward an objective diagnosis. *Obstet Gynecol* 2011;117:267–72.
- Macones GA, Hankins GD, Spong CY, Hauth J, Moore T. The 2008 National Institute of Child Health and Human Development workshop report on electronic fetal monitoring: update on definitions, interpretation, and research guidelines. *Obstet Gynecol* 2008;112:661–6.
- Heimstad R, Skogvoll E, Mattsson LA, Johansen OJ, Eik-New SH, Salvesen KA. Induction of labor or serial antenatal fetal monitoring in postterm pregnancy. *Obstet Gynecol* 2007;109:609–17.
- A clinical trial of induction of labor versus expectant management in postterm pregnancy. The National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units. *Am J Obstet Gynecol* 1994;170:716–23.
- Hannah ME, Hannah WJ, Hellmann J, Hewson S, Milner R, Willan A. Induction of labor as compared with serial antenatal monitoring in post-term pregnancy. The Canadian Multicenter Postterm Pregnancy Trial Group. *N Engl J Med* 1992;326:1587–92.
- Rouse DJ, Weiner SJ, Bloom SL, Varner MW, Spong CY, Ramin SM, et al. Second-stage labor duration in nulliparous women: relationship to maternal and perinatal outcome. *Am J Obstet Gynecol* 2009;201:357.e1–7.
- Hatem M, Sandall J, Devane D, Soltani H, Gates S. Midwife-led versus other models of care for childbearing women. The Cochrane Database of Systematic Reviews 2008, Issue 4. Art. No.: CD004667. DOI: 10.1002/14651858.CD004667.pub2.
- Rooks JP, Weatherby NL, Ernst EK, Stapleton S, Rosen D, Rosenfield A. Outcomes of care in birth centers. The National Birth Center Study. *N Engl J Med* 1989;321:1804–11.
- Davis LG, Riedmann GL, Sapiro M, Minogue JP, Kazer RR. Cesarean section rates in low-risk private patients managed by certified nurse-midwives and obstetricians. *J Nurse-Midwifery* 1994;39:91–7.
- Zhang J, Landy HJ, Branch W, Burkman R, Haberman S, Gregory KD, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes. *Obstet Gynecol* 2010;116:1281–7.
- Anim-Somuah M, Smyth RM, Jones L. Epidural versus non-epidural or no analgesia in labour. The Cochrane Database of Systematic Reviews 2011, Issue 12. Art. No.: CD000331. DOI: 10.1002/14651858.CD000331.pub3.
- Sharma SK, McIntire DD, Wiley J, Leveno KJ. Labor analgesia and cesarean delivery: an individual patient meta-analysis of nulliparous women. *Anesthesiology* 2004;100:142–8.
- Wassen MM, Zuijlen J, Roumen FJ, Smits LJ, Marcus MA, Nijhuis JG. Early versus late epidural analgesia and risk of instrumental delivery in nulliparous women: a systematic review. *BJOG* 2011;118:655–61.
- Gei AF, Belfort MA. Forceps-assisted vaginal delivery. *Obstet Gynecol Clin North Am* 1999;26:345–70.
- Demissie K, Rhoads GG, Smulian JC, Balasubramanian BA, Gandhi K, Joseph KS, et al. Operative vaginal delivery and neonatal and infant adverse outcomes: population based retrospective analysis. *BMJ* 2004;329:24–9.
- Gardella C, Taylor M, Benedetti T, Hitti J, Critchlow C. The effect of sequential use of vacuum and forceps for assisted vaginal delivery on neonatal and maternal outcomes. *Am J Obstet Gynecol* 2001;85:896–902.
- Wesley BD, van den Berg BJ, Reece EA. The effect of forceps delivery on cognitive development. *Am J Obstet Gynecol* 1993;169:1091–5.
- Seidman DS, Laor A, Gale R, Stevenson DK, Mashiach S, Danon YL. Long-term effects of vacuum and forceps deliveries. *Lancet* 1991;337:1583–5.
- Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Munson ML. Births: final data for 2002. *Natl Vital Stat Rep* 2003;52:1–113.
- Murphy M, Hull PM. Choosing cesarean: a natural birth plan. Amherst (NY): Prometheus Books; 2012.
- Klasko SK, Cummings RV, Balducci J, DeFulvio JD, Reed JF 3rd. The impact of mandated in-hospital coverage on primary cesarean delivery rates in a large nonuniversity teaching hospital. *Am J Obstet Gynecol* 1995;172:637–42.
- Spetz J, Smith MW, Ennis SF. Physician incentives and the timing of cesarean sections: evidence from California. *Med Care* 2001;39:536–50.
- Barber EL, Lundsberg LS, Belanger K, Pettker CM, Funai EF, Illuzzi JL. Indications contributing to the increasing cesarean delivery rate. *Obstet Gynecol* 2011;118:29–38.



36. Bailit JL, Love TE, Mercer B. Rising cesarean rates: are patients sicker? *Am J Obstet Gynecol* 2004;191:800-3.
37. Pang MW, Leung TN, Lau TK, Hang Chung TK. Impact of first childbirth on changes in women's preference for mode of delivery: follow-up of a longitudinal observational study. *Birth* 2008;35:121-8.
38. Vergani P, Ornaghi S, Pozzi I, Beretta P, Russo FM, Follesa I, Ghidini A. Placenta previa: distance to internal os and mode of delivery. *Am J Obstet Gynecol* 2009;201:266.e1-5.
39. Management of intrapartum fetal heart rate tracings. *Practice Bulletin No. 116. American College of Obstetricians and Gynecologists. Obstet Gynecol* 2010;116:1232-40.

OBSTETRICS & GYNECOLOGY 

**46,000  
Reasons**

**To Submit Your Article to *Obstetrics & Gynecology***

Fast, easy electronic submission with Editorial Manager™  
at <http://ong.editorialmanager.com>

- Second highest impact factor (4.730) among all 79 obstetrics and gynecology journals; ranked first among all general obstetrics and gynecology journals
- Largest readership in the specialty, with over 46,000 subscribers worldwide
- Most widely read journal in the specialty
- Fast turnaround with average initial disposition in less than 6 weeks
- Expert review, with practical comments from reviewers and editors on ways to improve your manuscript
- Access to web site ([www.greenjournal.org](http://www.greenjournal.org)) with added features and supplemental information

Editorial Office  
Obstetrics & Gynecology  
409 12th Street, SW  
Washington, DC 20024-2188  
Phone: 202-314-2317,  
Fax: 202-479-0830  
E-mail: [obgyn@greenjournal.org](mailto:obgyn@greenjournal.org)  
Web: <http://www.greenjournal.org>

Readership, speed,  
and quality review in  
addition to 46,000 subscribers –  
just a few of the reasons to  
submit your article to the  
Green Journal

rev 9/2012

