MEDICAID EVIDENCE-BASED DECISIONS PROJECT (MED)

Rapid Review

Elective Cesarean Section

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Executive Summary

Background
The national cesarean section rate increased to 32.3 percent of all live births in 2006. The primary, or first, cesarean section rate increased to 20.6 percent in 2006. This increase is not well explained by changes in the population risk profile. There is interest in understanding the factors underlying this increase and to understand to what extent primary planned cesarean sections done without an identifiable medical risk (elective cesarean section (ECS)) and cesarean delivery by maternal request (CDMR) contribute to this rate. The best estimate is that between 4% and 18% of primary cesarean sections in the United States are elective. The issue of elective cesarean raises important ethical questions about patient choice and medical decision making. There is not much known about the decision making process around elective cesarean and how culture, setting, physician factors, patient factors, and socioeconomic factor influence that process.

An AHRQ systematic review was done in 2006 which looked at CDMR and found that most studies described outcomes retrospectively based actual delivery route and not the intended delivery route. Because the intended delivery route is difficult to determine in many data sources, the use of proxies such as intended cesarean for breech have been used for ECS and CDMR. These proxies have methodological problems in terms of their relevance to elective cesarean. The NIH state-of-the-science conference which was informed by the AHRQ report made recommendations for future research that it compare outcomes based on intended route of delivery. After 2006, retrospective cohort studies were designed to compare outcomes based on planned route of delivery. These studies have still needed to approximate the elective cesarean groups in various ways but have improved relevance to the Key Questions below.

Key Questions

1. What are the benefits and harms of elective cesarean delivery compared with spontaneous labor or elective induction of labor?

2. Do the benefits and harms of elective cesarean delivery at term vary by gestational age, or other maternal or fetal characteristics?

3. What are the appropriate medical indications for planned cesarean birth?

Methods
We conducted a comprehensive search of the Cochrane Library, MEDLINE and other core databases for systematic reviews (SR) and meta-analyses of randomized controlled trials (RCTs) and other study designs. We also searched for additional eligible studies published after the search dates of these SRs (after June 2005) and reviewed studies that were designed with intention-to-treat as recommended by the 2006 NIH state-of-the-science conference on elective cesarean. We also included relevant practice guidelines. Included studies and guidelines were assessed for quality and the overall strength of evidence was rated for each key outcome.
Findings
Data, most of it not perfectly relevant to ECS, indicates that there is neonatal morbidity (and potentially mortality) associated with planned elective cesarean compared to intended vaginal delivery. Evidence shows that ECS should not be performed at gestational ages less than 39 weeks in order to decrease neonatal morbidity. There are important downstream risks to repeated cesareans, primarily related to abnormal placentation. Because women may not accurately predict future desired family size, ECS should be approached judiciously by both women and their care providers. Elective cesarean does not appear to confer medical benefit based on our review of the literature. While cesarean delivery is generally safe in the US setting, and given that there are no defined benefits and possible harms, it is important that women, their caregivers and policymakers carefully consider the option and how an elective cesarean will affect future childbearing for a woman considering it.

Limitations
There remains very little research which defines an ECS group accurately. It is not appropriate to compare cesarean delivery to vaginal delivery. Neither women nor clinicians are able to accurately predict actual mode of delivery. The issue under consideration is rather the comparison of intended routes of delivery. However, few studies have done this and most of the research is retrospective. More rare outcomes have likely not been well defined in the available base of literature. The total number of cesarean deliveries performed in the US or other countries without a defined medical indication is unknown. However, currently it appears that CDMR contributes to only a minority of primary cesareans. The role of physician and cultural influences on the election of cesarean as the preferred mode of delivery is not well studied, particularly in the US setting.
Background
According to NCHS statistics, the national rate of cesarean section reached 32.3 percent of all live births in 2006 (Hamilton, 2010). The largest contributions to this rising rate are an increase in primary cesareans to a rate of 20.6 percent in 2004 and a steep decline in the rate of vaginal birth after cesarean (VBAC) from 28.3% in 1996 to 9.2% in 2004. Over ninety percent of women who have had a cesarean section will deliver by repeat cesarean (MacDorman, 2008).

Understanding the complexities behind the increasing primary cesarean rate is important, especially considering our evolving understanding of the risks of multiple cesarean sections and the neonatal risks of cesarean for term neonates before 39 weeks gestation. There has been much attention paid to elective cesarean section (ECS) and cesarean delivery by maternal request (CDMR) in both the medical literature and popular media. However, defining, measuring, and studying the issue of elective and maternal request cesareans is a challenge.

The mode of childbirth is influenced by a complex set of interactions between a patient, her care provider, the setting of her birth (i.e. rural, urban, tertiary care center, community hospital), her health insurer, local culture, local standards of care, and a woman’s class, race, age, pre-pregnancy weight, and ethnic background. There are cesareans which may be generally considered medically necessary such as for severe fetal distress, maternal bleeding, or abnormal fetal position. There are cesareans done for a variety of medical indications which may or may not lead to improved outcomes. There are also cesareans which are done for less clear indications or for controversial indications such as a “large” baby, or a “post-dates” pregnancy. There are medical indications listed for a cesarean which are used to justify (to insurers or other auditors) cesareans which are perhaps done without a “true” medical indication. Additionally, there are cesareans that are done mainly because a patient requests a cesarean as the mode of delivery. In any of these scenarios, there are differing perspectives for each participant. For example, a doctor may perceive that a patient is requesting a cesarean in absence of a medical indication while that same woman may perceive that a cesarean delivery was recommended to her as the best choice. In this report, we define ECS as a planned cesarean with an indication that is not an agreed upon, evidence-based indication for cesarean. This report will also focus on the subset of ECS deliveries which are maternally requested (CDMR) (Viswanathan, 2006).

In 2006 AHRQ published a Systematic Review and Technology Assessment which investigated ECS and CDMR. Also in 2006, the National Institute of Health convened a “State-of-the-Science” conference which was informed by the AHRQ report and also by experts and key stakeholders. The NIH State-of-the-Science position paper on CDMR defines it as “cesarean delivery for a singleton pregnancy on maternal request at term” (NIH 2006). The AHRQ evidence review on CDMR uses this definition and also adds that it is performed “in the absence of any maternal or fetal indication for cesarean delivery” (Viswanathan 2006). There is, however, no consistent way to identify CDMR in studies and no maternal databases identify cesarean deliveries that are done by maternal request (NIH 2006). A term used in some research is “elective cesarean” or “unlabored cesarean” which implies that the cesarean is scheduled ahead of time and
done for a non-medical indication, but isn’t explicit about whether or not it is done by maternal request, at the suggestion of the physician, or by a combination of decision-makers. The term “elective” is problematic because there is little evidence and no national guidelines in the US to help physicians decide what are appropriate indications for cesarean. Therefore, there is wide variation in what may be considered “elective” by both parturients and their health care providers. For example, a cesarean may be classified in research as “elective,” but could have a plausible indication such as herpes, malpresentation, or uterine scar (Viswanathan, 2006). Maternal request cesareans are likely often coded with other indications because of insurance coverage and liability issues (Viswanathan, 2006).

Currently, there is little confidence in any estimate of the ECS rate. In the United States and internationally, it has been estimated that from 4 to 18% of all cesarean deliveries are by maternal request. The cesarean rate in primiparous women with no indicated risk (NIR) and no listed indication identified on either birth certificate data and/or hospital discharge data is an approximation of the relative increase in ECS. Data from the National Vital Statistics System shows that six percent of primiparous women with no indicated risk factor had a cesarean in 1996 and that this rate rose to 11% in 2003 (MacDorman, 2008). The increase in primary cesarean section rates is not associated with changing risk profiles of women and is not related to rising rates of maternal obesity or macrosomia (MacDorman, 2008). The “Listening to Mothers” survey interviewed a national random sample of 1573 mothers who gave birth to a singleton living infant in 2005 with results weighted to represent the national population. There were 252 women who had a primary cesarean section. All but three respondents cited a medical reason for the cesarean. Only one of the three respondents stated that she had requested the cesarean (MacDorman, 2008). Overall, the best estimation is that CDMR is responsible for a minority of primary cesareans. Most elective cesareans are done as planned repeat cesareans instead of a trial of labor after cesarean (TOLAC). The majority of elective cesareans in primiparous women are done because of breech positioning of the fetus.

In the analysis of CDMR, the concept of “choice” and how to determine whether or not a cesarean is performed by maternal request is problematic. The American College of Obstetricians and Gynecologists (ACOG) practice guideline on CDMR supports the concept of maternal request cesarean as an issue of patient autonomy that must be guided by high quality informed consent (AGOG, 2007). A recent review of studies on decision making about cesarean delivery pointed out that no reviewed studies addressed the quality of information given to women when making decisions around route of delivery. There is evidence that, when surveyed, women tend to underestimate the risks of cesarean and have inaccurate expectations about cesarean delivery, including that it is safer for them or their infants (Gamble, 2007).

It is also clear that some cesareans are requested because of unmet needs or worries about inadequate care. Ethnographic research in Latin America reveals that many women’s requests for cesareans are made in order to avoid substandard care they fear will be provided to them during labor and vaginal birth (Behague, 2002). In Brazil, it seems that poor women are more likely to request a cesarean (Behague, 2002), but in
the UK, women in affluent areas are more likely to have an elective cesarean (Alves, 2005). In Scandinavia, research showed that requests for a cesarean were motivated by fears of childbirth. After a supportive therapeutic intervention many women withdrew the request and were ultimately happy with the outcome of their changed decision (Nerum, 2006; Saisto, 2006).

Research describing and investigating outcomes of ECS is largely undertaken with the use of proxies. Primary scheduled cesarean sections among nulliparas after 37 weeks of gestation with NIR (as indicated on birth certificates) is one way to approximate the ideal comparison groups: planned vaginal delivery versus planned cesarean delivery. Primiparous women with scheduled, unlabored primary cesareans at term for breech have also been used in comparison with women having a first vaginal birth. This method has been criticized because breech presentation is often a marker for a more complicated delivery, making this a less than ideal comparison group for ECS among uncomplicated pregnancies. An additional significant drawback to the use of much outcome data in studying ECS is that these studies compare the actual deliveries and not the intended delivery method. When investigating the actual route of delivery and not the intended delivery, measured outcomes are inaccurate as they fail to represent those who may have intended a vaginal delivery but actually had a cesarean. For example, infection rates will be larger in the cesarean group because it is compared to a group of women who had vaginal deliveries, missing the women who intended to have a vaginal birth but had a cesarean delivery after labor (which increases the risk of infection). Also, using intended delivery routes would fail to identify cesareans that are performed on primiparous women who request them after a short and “gentle” trial of labor (Kalish, 2004). There are no RCTs on primary cesarean by maternal request versus intended vaginal delivery. It is unlikely that there ever will be such an RCT, given the poor acceptance of such trials identified in surveys of both potential participants and their caregivers (Lavender, 2005; Lavender, 2009; Turner, 2008).

A unique aspect of CDMR is that it is ethically controversial. There have been a number of papers exploring the ethical issues involved in providing a CDMR. An ACOG guideline on Surgery and Patient Choice recommends that the physician and patient work together to assess how the risks and benefits of elective surgery apply to the individual (ACOG, 2008). A NICE guideline states that a physician has the right to refuse a CDMR but should, as part of “kindly care,” refer the patient for a second opinion (NICE, 2004). Other commentators wonder why such attention is paid to the ethics of CDMR while there is very little written about the ethics of increasingly refusing women access to vaginal delivery as an option after cesarean delivery or vaginal delivery for low risk breech presentations (Leeman, 2006).

**Key Questions**

1. **What are the benefits and harms of elective cesarean delivery compared with spontaneous labor or elective induction of labor?**

2. **Do the benefits and harms of elective cesarean delivery at term vary by gestational age, or other maternal or fetal characteristics?**
3. **What are the appropriate medical indications for planned cesarean birth?**

**Methods**

**Overview**

A full search of the MED clinical evidence core sources was done to identify systematic reviews (SRs), technology assessments (TAs), and clinical practice guidelines (CPGs) using the terms “elective cesarean/caesarean” and “cesarean/caesarean.” We also conducted a hand search of core sources which do not have robust search engines by scanning all pregnancy and childbirth topics within those databases. Searches of MED project core sources were limited to documents published since 1990. The core sources searched included: ECRI Institute Information Service, Hayes, Inc., Cochrane Library (Wiley Interscience), UK National Library for Health (NLH), UK National Institute for Health and Clinical Excellence (NICE), Blue Cross/Blue Shield Health Technology Assessment (HTA) program, Veterans Administration TA program, BMJ Clinical Evidence Group, the Canadian Agency for Drugs and Technologies in Health (CADTH), Washington State HTA, US Preventive Services Task Force (USPSTF), and the Agency for Health Research and Quality (AHRQ). There was an NIH State-of-the-Science conference on Cesarean Delivery on Maternal Request in 2006. The AHRQ SR was completed for the NIH conference, the final conference statement and its supporting articles and references were collected and reviewed.

A MEDLINE (Ovid) search was conducted to identify SRs and meta-analyses (MAs) as well as additional randomized controlled trials (RCTs) and relevant observational studies published after the search dates of included SRs/TAs. We also used the MEDLINE search to identify studies relevant to a Key Question if there was no SR/MA/TA available to address that question. The MEDLINE search used the search terms and combinations of terms listed below in the section on search strategy. The search was limited to publications in English which were not commentaries or editorials and which were published since 1990. We also reviewed the bibliographies of included studies and retrieved any relevant articles that our core source or MEDLINE searches had not identified.

A search for relevant clinical practice guidelines (CPGs) was also conducted, using the following sources: the National Guidelines Clearinghouse, the Institute for Clinical Systems Improvement (ICSI), the Scottish Intercollegiate Guidelines Network (SIGN), the National Institute for Health and Clinical Excellence (NICE), the Veterans Administration/Department of Defense (VA/DOD) guidelines, ACOG, the American Academy of Pediatrics (AAP), the Society of Obstetricians and Gynaecologists of Canada (SOGC), the Royal College of Obstetricians and Gynaecologists (RCOG), the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZOG), the International Federation of Gynecology and Obstetrics (FIGO), the American College of Nurse-Midwives (ACNM), and the Royal College of Midwives (RCM).
Inclusion criteria
The PICO for Key Questions 1, 2, and 3 are:

**Population:** Pregnant women at term (>37 weeks of gestation) with normal, singleton pregnancies.

**Intervention:** Scheduled elective cesarean birth at term *(by maternal request)*.

**Comparator:** Expectant management until spontaneous onset of labor unless a medical indication for induction of labor or cesarean delivery occurs.

**Outcome:** Any measure of maternal/fetal/neonatal mortality and morbidity, including, but not limited to: mode of delivery, maternal use of anesthesia/analgesia, admission to neonatal intensive care unit (NICU), maternal and neonatal length of stay, costs of alternative care strategies or other clinically important outcomes.

*Other Inclusion criteria for Key Question 1 and 2*
Systematic reviews and TAs were included which specifically addressed ECS, including cesarean by maternal request. Preference was given to studies that compared women's first vaginal or cesarean deliveries when directly comparing outcomes since this most effectively controlled for how prior vaginal or cesarean deliveries may affect outcomes.

In answering Key Question #1 for primary ECS, the downstream risks of multiple cesareans are described. This is particularly important because currently few women are offered a trial of labor after cesarean (TOLAC) limiting the number who will have vaginal births after cesarean (VBAC). The available SRS and TAs for ECS, including CDMR, were used when they mentioned the downstream risks of repeated cesareans for both women and neonates. Also, a recent AHRQ SR on vaginal birth after cesarean (VBAC) was used in order to describe the downstream risks (Guise 2010, NIH 2006).

In 2006, the NIH State-of-the-Science report on CDMR suggested that future research use an intention to treat analysis in looking at CDMR by comparing outcomes between intended birth routes (vaginal versus cesarean) (NIH, 2006). Studies from the Medline search were included if they had an appropriate intention to treat analysis and with comparison groups that best approximate ECS.

*Other Inclusion criteria for Key Question 3*
Systematic reviews and TAs which judged the quality and strength of evidence in support of various commonly used indications for cesarean.

We also used the recent MED Rapid Review Report *Cesarean Reduction Strategies* (King, 2010) which included Key Question #3.

*Exclusion criteria for Key Question 1, 2 and 3*
Studies, SRs and TAs were excluded if they:
- were not published in English,
- were conducted in locations where clinical practice and culture were very different from the US unless they provided relevant background.
• included pregnant women whose pregnancies were significantly medically complicated such that they provided inappropriate study groups or proxies for ECS
• included pregnant women with conditions that are generally considered indications for cesarean delivery EXCEPT for healthy breech pregnancies as this is a common proxy for assessing risk in ECS;
• included women in the ECS or ECS proxy group who had a prior cesarean;
• did not report on one or more of our outcomes of interest or where we were unable to abstract data on outcomes;
• SRs were excluded if they did not describe their methodology (i.e. if they did not seem to be truly systematic in their review of the literature); or
• Retrospective cohort studies published after 2006 were excluded if they did not analyze outcomes by intended mode of delivery.

Commentaries, letters, case reports, editorials, and case series were also excluded.

Studies identified by the Medline search starting from the search dates for included SRs were reviewed and studies were excluded if they did not designate intended birth route as recommended by the NIH State-of-the-Science conference in 2006. They were also excluded if the comparison groups did not approximate ECS such as if the intended cesarean group were composed of only breech presentations or if gestational ages under 37 weeks were included.

Search strategy
Core sources were searched using the terms “cesarean” and “elective cesarean” (or “caesarean” or “elective caesarean”) depending on the country of origin. The responses for cesarean/caesarean were searched by hand to avoid the possibility of missing information on CDMR because of the different ways that CDMR is described. Databases with few items or inadequate search engines were searched by hand.

MEDLINE was searched using a strategy that combined terms for CDMR, NIR cesarean, or elective cesarean. The search was limited to studies published in English between 1990 and March 2010. The full MEDLINE search strategy is detailed in Appendix A. The resulting citations were reviewed and citations dated before June 2005, (the search cutoff for the most comprehensive systematic review by Viswanathan published in 2006) were excluded. Studies that did not report patient-oriented outcomes were also excluded.

Quality assessment
Studies were assessed for their risk of bias using instruments developed by the MED project by modifying instruments in use by SIGN and NICE. Guidelines were appraised for quality using an instrument adapted from the AGREE (Appraisal of Guidelines Research and Evaluation) Collaboration. All studies and guidelines were assessed by two independent and experienced raters. In cases where there was not agreement about the quality of the study or guideline the disagreement was resolved by conference or the use of a third rater.
Findings
Many of the sources below provided data that addressed both Key Question #1 and Key Question #2. Information on downstream effects of multiple repeat cesareans was also provided from the 2010 NIH position statement on VBAC as well as the AHRQ evidence report that informed it. Any significant updates from the publishing date of SRs or TAs are also included in the sections below.

The core source search revealed 21 citations of which seven were excluded and 14 included: nine SRs and five guidelines. The Medline search produced 1994 citations which were reviewed by two reviewers. Ultimately, 7 studies were included (see Appendix C). Three of the studies found that elective cesarean had neonatal outcomes that were modified by gestational age and, therefore addressed both Key Question #1 and Key Question #2 (Clark, 2009; Hansen, 2008). The remaining four studies addressed Key Question #1 (Declercq, 2007; Geller, 2010a; Geller, 2010b; Kolas, 2006).

Key Question #1: What are the benefits and harms of elective cesarean delivery compared with spontaneous labor or elective induction of labor?

Systematic reviews and technology assessments
We identified no research which directly compared ECS with elective induction of labor (EIOL). In this section we describe the available evidence on the benefits and harms of ECS compared with spontaneous labor and/or vaginal delivery.

While CDMR is only a subset of ECS there was an NIH State-of-the-Science conference in March 2006 which addressed this topic. An evidence report and technology assessment by AHRQ on CDMR was published in 2006 as part of the scientific background for that conference. The SR included 67 studies published between 1990 and 2005. Our review identified several subsequent relevant SRs and TAs from our core sources (see Appendix B) and from Medline that were published after the AHRQ evidence report. In addition, AHRQ published an updated TOLAC/VBAC report in March 2010 as part of the background for another NIH Consensus Conference on TOLAC. This AHRQ report was used to update the maternal and neonatal downstream effects from repeat cesareans given that most women with a primary elective cesarean will have a repeat cesarean for any subsequent deliveries.

There is currently no accurate and consistent way of defining a study group for ECS. Knowledge about ECS in general and CDMR in specific is informed by indirect evidence from proxies such as planned cesareans for breech, planned “elective” cesareans (which may include women or fetuses with a variety of medical conditions which can potentially effect outcomes), cesareans performed with “no indicated risk”, “unlabored” cesareans (cesareans performed before labor for a variety of indications, including maternal request), and cesareans performed without a defined medical indication. The ideal study group is one which uses the intention to treat principle and compares planned primary ECS to planned primary vaginal delivery among low risk groups, as this reduces bias from uncontrolled confounders. In an ideal comparison between intended treatments, each group could have outcomes that would vary in response to the treatment, but could also potentially vary by underlying differences between the groups.
themselves. For example, an intended ECS group will include some women who go into labor before their scheduled delivery date and an intended vaginal delivery group will have some women who ultimately have a cesarean birth. In groups compared according to their outcomes, there may be a larger difference between outcomes such as infection rates given that women who have cesareans performed after labor and rupture of membranes have higher infection rates than those who have vaginal deliveries or scheduled ECS. The only research included in the AHRQ CDMR SR with an intention to treat design is from the international, multicenter, Term Breech Trial where women were randomized to either cesarean or vaginal birth when presenting to labor and delivery with a breech presentation (Hannah 2000). This research has questionable applicability to ECS as women were in labor for a variety of lengths of time before presentation and because a breech fetal position can influence the risk of cesarean rate, as well as both maternal and neonatal complications with vaginal delivery. In addition, there were marked differences among the centers participating in this international trial. For example, some centers did not routinely employ continuous fetal monitoring during labor and availability of a full range of anesthesia choices varied among centers.

The AHRQ CDMR report (2006) presented an assessment of the various ways that the safety of a cesarean done with no maternal indication has been studied and provided relevance ratings to CDMR. We used the same relevance rating when assessing the more recent observational studies we found which were published after the AHRQ TA/SR on CDMR (2006). The relevance ratings are summarized below. No studies evaluating maternal or neonatal outcomes for cesarean delivery were given a relevance rating of “high.”

Table 1. Relevance Ratings for AHRQ TA/SR on CDMR

<table>
<thead>
<tr>
<th>Degree of relevance to CDMR</th>
<th>Definition of cesarean group</th>
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<tbody>
<tr>
<td>High (H)</td>
<td>CDMR</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>Cesarean planned for maternal or neonatal indications, can include labored and unlabored</td>
</tr>
<tr>
<td>Low (L)</td>
<td>Unspecified “elective” cesarean delivery which can be a mix of planned, unplanned, unlabored, labored or with no clear indication of labor status</td>
</tr>
<tr>
<td>Trials of delivery for neonatal indications (T)</td>
<td>Compares intended mode of delivery (planned cesarean vs. vaginal birth)</td>
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</table>

The AHRQ CDMR SR (2006) presented a summary of included studies for a variety of maternal and neonatal outcomes. All studies had either moderate or low relevance to CDMR and most had a moderate, weak or lower strength of evidence. All of the outcomes studied are summarized in Table 2. There are only a few things that research informs us about CDMR with some degree of confidence. We know that women with planned cesareans stay in the hospital longer than women who give birth vaginally, are less likely to have a postpartum hemorrhage, are more likely to have abnormal placentation in subsequent pregnancies, and have no differences in rates of maternal
mortality (although this is a rare outcome overall). It is also clear that babies are more likely to have respiratory problems after cesarean birth and that this adverse outcome is more likely with gestational ages less than 39 weeks. The findings on neonatal respiratory morbidity are also supported by the systematic review by Hansen and colleagues (Hansen, 2007).

Table 2 summarizes the findings from the AHRQ CDMR review (2006). In the column which details the effect, we included numeric estimates where possible. However, it was difficult to pool outcomes data due to lack of consistency in definitions, pooling of infectious and noninfectious outcomes, and variation among comparison groups.

The repeat cesarean rate is currently very high. A woman who has a primary cesarean delivery would likely have any subsequent births by cesarean (although this hasn’t been directly studied). Therefore, in considering Key Question #1 it is important to consider the downstream effects of primary and repeat cesarean deliveries. This was addressed in the AHRQ SR on TOLAC/VBAC (Guise, 2010) in more depth than the AHRQ SR on CDMR (2006).

Women with prior cesarean deliveries are more likely to have placenta previa, where the placenta partially or completely covers the opening of the uterus at the cervix compared to women with no prior cesarean. This rate increases with increasing number of prior cesarean deliveries (OR 1.48-3.95) (Guise, 2010). Women who have had prior cesareans also have a higher likelihood of placenta accreta, an abnormally deep attachment of the placenta into the muscular part of the uterus. The likelihood of placenta accrete in a woman undergoing her first cesarean delivery is 3.3-4% compared to a woman having her fourth or higher, where the rate increases to 50-67% (Guise, 2010). Placenta accreta can cause severe bleeding problems and can lead to hysterectomy (OR 43-99.5) (Guise, 2010). Women with placenta previa are more likely to have significant morbidity with increasing numbers of prior cesarean compared to women who have previa and no or fewer prior cesarean operations. Women who have had prior cesareans and who have placenta previa are much more likely to have concurrent placenta accrete (Guise, 2010).

Surgical adhesions are more likely with each cesarean (25.6% after one cesarean, 46-49% after two or more cesareans). Adhesions are associated with increased intraoperative time and increased perioperative complications (Guise, 2010). Other outcomes such as hemorrhage or transfusion, bowel and bladder injury, are more likely with increased numbers of cesareans. There is evidence, although limited and conflicting, that there is an increased risk of unexplained stillbirth in subsequent pregnancies after a cesarean delivery compared to women who only had vaginal births: 3.8 versus 2.3 per 1000 (Viswanathan, 2006) or 0.24% versus 0.16% (Guise, 2010). It has been proposed that a primary cesarean delivery may decrease pelvic floor morbidity and decrease the rate of urinary or fecal incontinence or incontinence of flatus. Nelson and colleagues performed a systematic review that included 27 studies which showed that there was no overall benefit of primary cesarean delivery for these outcomes (Nelson, 2010).
Table 2. AHRQ CDMR SR (2006) Summary of Findings

<table>
<thead>
<tr>
<th>Outcome (evidence rating)</th>
<th>Effect</th>
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<tbody>
<tr>
<td><strong>Maternal outcomes relevant to CDMR</strong></td>
<td></td>
</tr>
<tr>
<td>Maternal mortality (moderate)</td>
<td>No evidence of difference between cesarean (CD) and vaginal delivery (VD). Low rate of maternal mortality overall (1/10,000).</td>
</tr>
</tbody>
</table>
| Infection (weak) | - Lower with planned cesarean than unplanned cesarean, higher risk with cesarean overall compared to vaginal birth  
- Endometritis- 0.4% for spontaneous vaginal delivery (SVD), 1.8% for “attempted VD” vs. 3% for “primary pre-labor” CD or 4.1 or ECS  
- Wound infections- 0.9-1.5 for elective CD vs. 0.4-0.7% for VD  
- Rates as high as 6% for emergency CD |
| Anesthetic complications (weak) | - Lower rate with planned vaginal compared to planned cesarean  
- Possible confounders included emergency cesarean  
- 4% rate of post-spinal HA in elective cesarean group  
- Total anesthetic complications per 1000 women:  
  o SVD 90  
  o Assisted VD 160  
  o Unplanned CD 360  
  o ECS 390 |
| Hemorrhage/blood transfusion (moderate) | - Lower risk with planned cesarean than vaginal birth or unplanned cesarean  
- Most studies used measured volume of blood loss instead of more clinically meaningful measure of need for blood transfusion  
- Different outcomes defined hemorrhage  
- Postpartum hemorrhage:  
  o 1.3% planned VD vs. 1% planned CD (term breech trial)  
  o 2.7% primary pre-labor CD vs. 5% SVD  
- Need for transfusion  
  o 0-0.3% planned CD vs. 0.6%-1% planned VD |
| Hysterectomy (moderate) | - No difference |
| Thromboembolism (weak) | - Weak evidence |
| Surgical complications (weak) | - Search did not capture studies on perineal, vaginal trauma from SVD  
- Lower risk with unlabored or elective cesarean compared to labored or emergency cesareans  
  o Bladder injury- 0.1% elective CD, 0.2% emergency CD, 0 VD  
  o “Intraoperative trauma” (pool of serious surgical complications: 0.1% CD w/o labor, 0.1% SVD, 2.6% CD in labor (emergency CD)  
- Lower risk of perineal trauma with elective cesarean compared to SVD and assisted VD |
<table>
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<tr>
<th>Outcome (evidence rating)</th>
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<tbody>
<tr>
<td><strong>Breastfeeding (weak)</strong></td>
<td>• Studies difficult to compare for this outcome: mixture of composite and individual outcomes</td>
</tr>
</tbody>
</table>
| **Postpartum pain (weak)** | • No evidence of difference  
• Breech trial data might have overestimated the rate of pain in vaginal birth group as they were more likely to have perineal interventions (e.g. episiotomy) or instrumental deliveries  |
| **Psychological outcomes, postpartum depression (weak)** | • No evidence of difference  |
| **Psychological outcomes, other (weak)** | • No studies in SR looked at maternal satisfaction for birth  
• Some showed that worst psychological outcome is in women who had unplanned cesarean or instrumented cesarean  |
| **Maternal length of stay (moderate)** | • Length of stay longer for cesarean (planned or otherwise)  
  o 2-2.8 days “attempted VD” vs. 4-4.9 days planned CD  |
| **Urinary incontinence (weak)** | • Lower risk with primary elective cesarean  
  o At 6 wks 4% ECD, 23% SVD, 35% forceps  
  o At 1 yr postpartum, 10.3% SVD, 23% CD in labor, 3.4% ECD  
• Protective effect may decrease with increasing age, parity, and BMI  
• Preexisting incontinence or incontinence during pregnancy may modify effect  
• Problems with definitions, consistency, use of validated tools in studies, and timing of questions  |
| **Anorectal dysfunction (weak)** | • Lower risk of decreased anorectal function with planned cesarean compared to unplanned or instrumented vaginal delivery  
  o New anal incontinence 3.8% ECS, 5.8% emergency CS, 8% vaginal delivery  
  o ECS more likely to have “severe” anal incontinence than vaginal delivery  
• Inconsistent evidence about planned cesarean vs. vaginal delivery  
• Issues with definitions, consistency, use of validated tools in studies  |
| **Pelvic organ prolapsed (absent)** | • No evidence available  |
| **Sexual function (weak)** | • No evidence of difference  |

**Maternal outcomes relevant to downstream effects after cesarean deliveries**

| Subsequent fertility (absent) | • No reliable evidence  |
| Subsequent uterine rupture (moderate) | • No difference in uterine rupture that is asymptomatic  
• Symptomatic uterine rupture higher with TOL compared to elective repeat cesarean (2.7/1000 deliveries)  |
| Subsequent placenta previa (moderate) | • Higher risk with cesarean  
  o OR ranged between 1.32 (95% CI, 1.04-1.68) and 4.7 (95% CI, 1.9-11.4)  
• Increasing age, parity, and number of prior cesareans all elevate risk  |
| Subsequent stillbirth (absent) | • Higher risk with all cesareans  |

**Neonatal outcomes**

<p>| Fetal mortality (absent) | • No evidence available  |
| Neonatal mortality (weak) | • Higher risk for cesarean (all types) than vaginal delivery  |</p>
<table>
<thead>
<tr>
<th>Outcome (evidence rating)</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>o 1/10,000 neonatal deaths for SVD vs. 8/10,000 for cesarean delivery</td>
</tr>
<tr>
<td></td>
<td>• No difference between emergency cesarean and ECS</td>
</tr>
<tr>
<td></td>
<td>• No adjustment for underlying maternal or neonatal indications affecting survivability</td>
</tr>
<tr>
<td>Unexpected prematurity (absent)</td>
<td>• No evidence available</td>
</tr>
<tr>
<td>Respiratory morbidity (moderate)</td>
<td>• Higher risk with cesarean</td>
</tr>
<tr>
<td></td>
<td>o RDS 0.2%-2.26% in ECS vs. 0.11%-0.49% in VD</td>
</tr>
<tr>
<td></td>
<td>• Less risk as GA at term increases</td>
</tr>
<tr>
<td>Transition issues (weak)</td>
<td>• Insufficient evidence to judge effect</td>
</tr>
<tr>
<td>Neonatal asphyxia/encephalopathy (weak)</td>
<td>• Inconsistent evidence for elective cesarean</td>
</tr>
<tr>
<td></td>
<td>• Higher risk for operative vaginal deliveries and emergency/unlabored cesarean compared to SVD</td>
</tr>
<tr>
<td></td>
<td>o OR = 2.34; 95% CI, 1.16-4.70, and OR = 2.17, 95% CI, 1.01-4.64, respectively</td>
</tr>
<tr>
<td>Intracranial hemorrhage (weak)</td>
<td>• No difference between pre-labor cesarean and SVD</td>
</tr>
<tr>
<td></td>
<td>• Higher risk for forceps and combined vacuum with forceps</td>
</tr>
<tr>
<td>Facial nerve injury (weak)</td>
<td>• No difference between pre-labor cesarean delivery and SVD</td>
</tr>
<tr>
<td></td>
<td>• No difference with use of vacuum device</td>
</tr>
<tr>
<td></td>
<td>• Higher risk with forceps (OR 13.6; 95% CI, 10.0-18.4); combined vacuum and forceps (OR 8.5; 95% CI, 3.9-18.0) compared to either vaginal cesarean delivery</td>
</tr>
<tr>
<td>Brachial plexus injury (weak)</td>
<td>• Lower risk for pre-labor cesareans compared to SVD</td>
</tr>
<tr>
<td></td>
<td>o OR 0.5; 95% CI, 0.3-1.0</td>
</tr>
<tr>
<td></td>
<td>Higher risk when vacuum, forceps, or vacuum plus forceps than for vaginal delivery</td>
</tr>
<tr>
<td></td>
<td>o Vacuum OR 2.3; 95% CI, 1.8-2.9</td>
</tr>
<tr>
<td></td>
<td>o Forceps OR 3.2; 95% CI, 2.3-4.6</td>
</tr>
<tr>
<td></td>
<td>o Vacuum plus forceps OR 6.0; 95% CI, 3.3-10.7</td>
</tr>
<tr>
<td>Fetal lacerations (weak)</td>
<td>• Lower risk for elective cesarean than unplanned CS</td>
</tr>
<tr>
<td></td>
<td>• OR calculated compared to laceration rate for ALL cesareans:</td>
</tr>
<tr>
<td></td>
<td>o Emergency cesarean OR 1.7</td>
</tr>
<tr>
<td></td>
<td>o Unscheduled cesarean 0.57</td>
</tr>
<tr>
<td></td>
<td>o Scheduled cesarean OR 0.34</td>
</tr>
<tr>
<td>Neonatal length of stay (weak)</td>
<td>• Higher risk with elective cesarean compared to vaginal delivery</td>
</tr>
<tr>
<td></td>
<td>o 6 days vs. 4 days</td>
</tr>
<tr>
<td>Long term outcomes (absent)</td>
<td>• No evidence available</td>
</tr>
</tbody>
</table>
Because a key aspect of ECS is that a woman has requested the procedure or her physician has offered it, it would be difficult to design a study of ECS that is ethical. There are no randomized controlled trials comparing planned cesarean section versus planned vaginal birth for non-medical reasons at term (Lavender, 2009). Surveys show that a randomized controlled trial comparing planned cesarean to planned vaginal birth at term would be unacceptable to a majority of patients and caregivers and will likely never be done (Lavender, 2005; Lavender, 2009; Turner, 2008).

Observational studies with groups compared by intended route of delivery
The NIH state-of-the-science statement commented on the paucity of studies on CDMR and how proxy study groups compared outcomes based on actual instead of planned route of delivery. The panel suggested that future research include “large multicenter, multidisciplinary prospective cohort studies enrolling participants early in the first pregnancy and monitoring mothers and children long-term” in order to “develop information about the relative benefits and risks of planned vaginal delivery versus planned cesarean delivery” (NIH, 2006).

Since that conference, a number of observational studies (see Appendix C) have been done which take large cohorts of women and group them into planned vaginal and planned cesarean groups. We included seven retrospective studies of this type in this review. We excluded studies that, for example, contained cesarean groups that only consisted of breech presentations since this is a poor proxy for ECS and CDMR as most women are not given the option to choose a vaginal breech delivery. Some studies, however, included women whose babies were breech. There have still been no studies which can accurately identify a subgroup with planned ECS. Using information from medical charts, questionnaires, health care system databases, and vital statistics, study participants are grouped by intention regarding route of delivery (which is either assumed or directly measured). The table in Appendix C summarizes how each study defined the comparison groups. Changing study designs to capture intent or plans without directly and prospectively gathering information about indications for planned cesarean maintains the same challenges originally seen in the AHRQ SR (2006) because most of the observational studies include cesareans that were planned for a variety of indications as well as by maternal request. Also, relevance to ECS is variable as some include only primiparous women, while others include women of mixed parity status. Most studies were graded fair or poor.

Overall, the outcomes of these studies are similar in direction and magnitude to the AHRQ CDMR SR (2006). Only one (Geller, 2010a) was able, through chart review, to identify deliveries that were by maternal request although they admitted that it was likely that they had missed cases of CDMR which were not well documented in the chart notes. The CDMR rate in this study (from a hospital database from University of North Carolina) was 1.7%.

The observational studies consistently found that the ECS proxy group was more likely to have babies with respiratory problems, NICU admission, and longer overall neonatal hospital stays. There was also an increased risk of hospital re-admission in the ECS groups. One study looking at linked birth and death certificates found that cesarean
delivery with NIR was associated with an increased risk of neonatal death with an OR of 1.93 (95% CI 1.67-2.24) when excluding congenital anomalies (MacDorman, 2008). All studies which controlled for gestational age found better neonatal outcomes overall for increasing gestational age from 37-41 weeks.

Other observational studies
There were several observational studies identified in our Medline search which deserve mention because they looked at outcomes which are important to women, but have not been well addressed by existing SRs. One prospective study used a validated questionnaire on postpartum depression to compare its incidence between intended vaginal and planned cesarean groups and found that there was no difference (Patel, 2005).

A prospective study looking at fatigue and quality of life found that women who had a vaginal birth generally recovered to their baseline by three weeks after delivery while women who had a planned cesarean took six weeks to recover. Women who had an emergency cesarean remained fatigued and had lower quality of life beyond six weeks postpartum (Jansen, 2007).

The Listening to Mothers’ survey investigated postpartum pain and found that significant proportions of mothers reported postpartum pain and that these difficulties were more common after cesarean. Incision pain was experienced by 79% of women two months after delivery and was described as a “major problem” by 33%. Eighteen percent of women reported pain up to six months after cesarean. By contrast, almost half of women with vaginal births (without episiotomy) reported perineal pain two months after delivery, but only 2% of these women had persistent pain six months after their deliveries. Episiotomy was used 61% of the time for assisted vaginal delivery, 42% of the time for vacuum delivery, 31% of the time in unassisted primiparous deliveries and 19% of the time in unassisted multiparous deliveries. An increased proportion of women who had episiotomy reported perineal pain in the first two months after delivery compared to women who had no episiotomy (82% compared to 67% in primiparous women, 18% compared to 5% in multiparous women). At six months, women with assisted delivery (and thus more likely to have had episiotomy) were more likely to have pain (17%) while only 1% of all women with unassisted delivery reported pain in the perineum (Declercq, 2008).

Overall summary of evidence
Overall, the research summarized in this report show that if a study were ever designed that accurately measured ECS and prospectively investigated outcomes, that these outcomes would likely be associated with ECS:

- longer hospital stays;
- increased NICU admissions;
- increased neonatal respiratory problems; and
- maternal urinary or fecal incontinence is less likely in the short term, with no difference in longer term follow up.

The differences between an intended vaginal delivery group and an intended cesarean group are less marked for these outcomes at 39 or more weeks of gestation.
Elective cesarean delivery likely has no benefit for urinary or fecal continence in the longer term, although immediate postpartum outcomes may favor ECS.

There are important downstream effects to consider in the performance of ECS, most notably in maternal morbidity due to abnormal placentation.

There are some important issues around quality of life such as post partum pain, recovery time, and postpartum mood which are important, but which have not been well studied as they apply to ECS.

**Strength and limitations of the evidence**
The major limitations of the evidence are the challenge in accurately identifying women who actually have an elective primary cesarean. The use of proxies can only approximate outcomes for ECS. Also, the question of patient choice is difficult. The concept is sociologically bound and likely has significant diversity based on individual and cultural values. Regional variation, even within the US could introduce confounding factors into research.

Since an RCT will likely never be done, the best studies are the most recent ones done after 2006 which investigate intended route of delivery (Clark, 2009; Declercq, 2007; Geller, 2010a; Geller, 2010b; Hansen, 2008; Kolas, 2006; MacDorman, 2007).

**Key Question #2: Do the benefits and harms of elective cesarean delivery at term vary by gestational age, or other maternal or fetal characteristics?**
The SRs and TAs above indicate that the most significant modifier of neonatal outcomes in ECS is gestational age. It is increasingly clear that risks of neonatal respiratory morbidity and neonatal mortality significantly increase as gestational age decreases from 39 weeks. This is likely because of important physiologic changes in lung fluid which occurs nearer to term and during labor (Ramachandrappa, 2008).

The AHRQ SR on CDMR (2006) also describes the effect of maternal obesity on outcomes. Obese women are more likely to have a cesarean section without medical indication (although it is unclear whether these are by maternal request, physician suggestion, or other influence) and are more likely to suffer postpartum complications from cesarean delivery, such as infection and thromboembolism (Poobalan, 2009).

There is evidence that women of color are less likely to deliver infants who suffer from preterm respiratory morbidity, including transient tachypnea of the newborn (TTN). These infants had the lowest rates of TTN seen from 38 weeks and above in racial groups described in this UK study as “blacks and South Asian” while white neonates reached their lowest rates of TTN only after 39 weeks of gestational age (Balchin, 2008).

Another retrospective cohort study indicated that there is a lower risk of uterine rupture in a subsequent trial of labor if a woman had experienced labor before her primary cesarean delivery. Uterine rupture along the prior surgical scar is an emergent complication of a trial of labor after cesarean (TOLAC). A subsequent delivery after a labored cesarean has a uterine rupture rate of 1/460 (0.2%) while women who have a
trial of labor after an unlabored cesarean have a uterine rupture rate of 1/95 (1%) (Algert, 2008).

**Overall summary of evidence**
Elective cesarean performed at gestational ages less than 39 weeks is associated with poorer neonatal outcomes compared to intended vaginal delivery but this is likely less marked for women of color. Downstream effects on TOLAC outcomes may be modified by women experiencing labor prior to their primary cesarean delivery. Obesity may negatively impact maternal outcomes.

**Strength and limitations of the evidence**
These data are limited by the use of proxies to approximate ECS since it is not consistently defined and retrospective identification is difficult. It is possible that other outcomes are associated with ECS or that there are effect modifiers that have not been studied and reported. Overall, increasing availability of prospective research, perhaps using population-based registries, would be useful to more fully define actual harms and benefits associated with ECS.

**Key Question #3: What are the appropriate indications for cesarean birth?**
Our findings for Key Question #3 are presented below. This information is also presented in the 2010 MED Rapid Review report *Cesarean Reduction Strategies* (King, 2010).

**Systematic reviews and meta-analyses**
In the developed world, approximately 30% of cesarean sections performed are repeat operations, 30% are performed for labor dystocia, and about 10% each are performed for fetal indications and for breech presentation (Penn, 2001). In the US, there is currently over a 90% repeat cesarean rate (MacDorman, 2008). There are few rigorous studies of indications for cesarean birth and our search identified one SR by NICE on cesarean delivery which discussed indications for planned CS (NICE, 2004). The named indication and the NICE grade of recommendation assigned to it are summarized in Table 3 below. In this NICE SR the strength of evidence for recommendations is graded A, B, C, D and GPP (Good Practice Point). Grades of recommendation are based on the underlying quantity and quality of individual studies. A grade of “A” is given when the evidence base is composed of systematic reviews or meta-analyses of RCTs or at least one RCT; a “B” is based on controlled (but not randomized) studies and/or prospective cohort studies and quasi experimental studies; a “C” grade is indicative of well-designed comparative, correlative, case-control and case series studies; a “D” recommendation is based on expert opinion only or indirect extrapolation from higher level study type. The “GPP” recommendation is based upon the consensus view of the guideline development group and is based on expert opinion. This designation is used after insufficient evidence is found to address the point in the SR and it is unlikely that evidence from good quality studies will ever be available to answer the point. The GPP represents the current consensus when clinicians generally agree on a particular course of action, education, or treatment. It should be noted that this NICE SR and guideline were published in 2004 and are currently being updated with an expected publication date in 2011.
Table 3. Indications for Planned Cesarean Delivery (NICE, 2004)

<table>
<thead>
<tr>
<th>NICE Indication and Grade of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breech presentation</strong>&lt;br&gt;Pregnant women with a singleton breech presentation at term, for whom external cephalic version is contraindicated or has been unsuccessful, should be offered CS as it reduces perinatal mortality and neonatal morbidity. <strong>[A]</strong></td>
</tr>
<tr>
<td><strong>Multiple pregnancy</strong>&lt;br&gt;In otherwise uncomplicated twin pregnancies at term where the presentation of the first twin is cephalic, perinatal morbidity and mortality is increased for the second twin. However, the effect of planned CS in improving outcome for the second twin remains uncertain and therefore CS should not routinely be offered outside a research context. <strong>[C]</strong></td>
</tr>
<tr>
<td>In twin pregnancies where the first twin is not cephalic the effect of CS in improving outcome is uncertain but current practice is to offer a planned CS. <strong>[GPP]</strong></td>
</tr>
<tr>
<td><strong>Preterm birth</strong>&lt;br&gt;Preterm birth is associated with higher neonatal morbidity and mortality. However, the effect of planned CS in improving these outcomes remains uncertain and therefore CS should not routinely be offered outside a research context. <strong>[C]</strong></td>
</tr>
<tr>
<td><strong>Small for gestational age</strong>&lt;br&gt;The risk of neonatal morbidity and mortality is higher with ‘small for gestational age’ babies. However, the effect of planned CS in improving this outcome remains uncertain and therefore CS should not routinely be offered outside a research context. <strong>[C]</strong></td>
</tr>
<tr>
<td><strong>Placenta praevia</strong>&lt;br&gt;Women with a placenta that partly or completely covers the internal cervical os (grade 3 or 4 placenta praevia) should be offered CS. <strong>[D]</strong></td>
</tr>
<tr>
<td><strong>Mother to child transmission of HIV</strong>&lt;br&gt;HIV-positive women who are pregnant should be offered a planned CS because it reduces the risk of mother-to-child transmission of HIV. <strong>[A]</strong></td>
</tr>
<tr>
<td><strong>Mother to child transmission of Hepatitis B</strong>&lt;br&gt;Mother-to-child transmission of hepatitis B can be reduced if the baby receives immunoglobulin and vaccination. In these situations pregnant women with hepatitis B should not be offered a planned CS because there is insufficient evidence that this reduces mother-to-child transmission of hepatitis B virus. <strong>[B]</strong></td>
</tr>
<tr>
<td><strong>Mother to child transmission of Hepatitis C</strong>&lt;br&gt;Women who are infected with hepatitis C should not be offered planned CS because this does not reduce mother-to-child transmission of the virus. <strong>[C]</strong>&lt;br&gt;Pregnant women who are co-infected with hepatitis C virus and HIV should be offered a planned CS as this reduces the mother-to-child-transmission of both hepatitis C virus and HIV. <strong>[C]</strong></td>
</tr>
</tbody>
</table>
| **Mother to child transmission of Herpes simplex virus (HSV)**<br>Women with primary genital herpes simplex virus (HSV) infection occurring in the third
NICE Indication and Grade of Recommendation

trimester of pregnancy should be offered planned CS because it decreases the risk of neonatal HSV infection. [C]

Pregnant women with a recurrence of HSV at birth should be informed that there is uncertainty about the effect of planned CS in reducing the risk of neonatal HSV infection. Therefore, CS should not routinely be offered outside a research context. [C]

Maternal request
Maternal request is not on its own an indication for CS and specific reasons for the request should be explored, discussed and recorded. [GPP]

When a woman requests a CS in the absence of an identifiable reason, the overall benefits and risks of CS compared with vaginal birth should be discussed and recorded. [GPP]

When a woman requests a CS because she has a fear of childbirth, she should be offered counseling (such as cognitive behavioural therapy) to help her to address her fears in a supportive manner, because this results in reduced fear of pain in labour and shorter labour. [A]

An individual clinician has the right to decline a request for CS in the absence of an identifiable reason. However the woman’s decision should be respected and she should be offered referral for a second opinion. [GPP]

The NICE SR (2004) does not provide a detailed review of indications for unplanned CS. However, the report does say that women should be given information during antenatal care on indications for CS including “presumed fetal compromise,” and “failure to progress” in addition to indications for planned CS such as breech presentation. The guideline also recommends classifying the urgency of cesarean deliveries into the following four categories in order to improve communication between health professionals:

1. immediate threat to the life of the woman or fetus;
2. maternal or fetal compromise which is not immediately life-threatening;
3. no maternal or fetal compromise but needs early delivery; and
4. delivery timed to suit woman or staff.

Most cesarean surgeries performed are either repeat operations, are for indications of failure to progress in labor, or for fetal intolerance of labor (NICE, 2004; Penn, 2001). Both labor dystocia and fetal intolerance of labor exist along a continuum of severity and have high degrees of associated uncertainty. There is little evidence to guide providers about exactly how long is long enough or too long for a labor to last or exactly when a the risks to the fetus of continuing labor outweigh the risks of a cesarean delivery. As one might expect, professional judgment and local custom play a large role in these grey areas of decision-making.
Overall summary of evidence
Most indications for cesarean delivery do not have a strong evidence base. However, this is true of many surgical procedures. It is clear that many commonly used indications would benefit from more rigorous study. At present, it would be reasonable to assume that many or most women with breech presentation, HIV infection, and concurrent Hepatitis C/HIV infection would be best served by planned cesarean delivery. This group likely includes women with a complete previa as well, although research evidence is lacking for this indication. Hepatitis B infection is not a substantiated indication for cesarean delivery. There is at least a moderate strength of evidence to support these indications. It is clear that in many cases of twin gestation, even with a cephalic first twin, a trial of vaginal delivery is not being offered in the US. Similarly, in cases of prematurity or small for gestational age, it is not clear that any benefit is obtained with routine versus selective cesarean delivery.

Strength and limitations of the evidence
The list of indications from NICE only rates breech presentation and maternal HIV as having the strongest evidence for performing a cesarean delivery. The recommendation on cesarean for breech presentation at term is primarily based on the results of one large RCT which showed evidence of increased short term neonatal harm with vaginal breech delivery. Longer term follow up studies of that cohort have not found lasting harm to either mother or infant and so the tide of professional opinion is beginning to turn. Some international professional societies and individual institutions are beginning to resume planned vaginal breech deliveries. Some indications, for example complete placenta previa, are supported by a strong clinical experience rather than strong study evidence. It would be considered unethical to mount an RCT of vaginal birth for complete placenta previa.

A full updated systematic review of each indication for planned cesarean was not done for this review. This data might change the conclusions presented above. Similarly, a full review of indications for non-planned cesarean delivery was beyond the scope of this present review and might offer additional information for decision-makers.

Guidelines
Given the paucity of evidence, none of the guidelines listed below in Table 5 recommend indications for ECS. Most agree that a cesarean delivery with no medical indication should not be done before the 39th week of gestation. Interestingly, the ACOG guideline states that CDMR is not recommended for women desiring “several children.” There is also evidence from a prospective study that women do not accurately predict their future desire for childbearing (Keeton, 2008). This may argue against ECS unless a woman concurrently desires sterilization or another form of long-acting contraception.
<table>
<thead>
<tr>
<th>Guideline, Date Quality Rating</th>
<th>Elective Cesarean Recommendations</th>
<th>Indications and Contraindications for ECS or CDMR</th>
</tr>
</thead>
</table>
| **NICE, 2004 Good**           | • Maternal Request is not alone an indication for CS, specific reasons for cesarean should be explored and well documented  
• When CS requested w/o identifiable reason, risks/benefits should be discussed and well documented  
• Women describing fear of childbirth should be offered counseling  
• A practitioner has a right to decline a request for CS by maternal request but should refer a woman for a second opinion | • No specific indication for CDMR is recommended  
• No specific contraindications except that CDMR should not be done because of maternal request alone |
| **ACOG, 2004 Poor**           | • Implied indication is maternal request but no other specific indication appropriate  
• ECS should not be performed 39 weeks of gestation, with accurate dating | • CDMR should not be motivated by unavailability of effective pain management  
• ECS is not recommended for women desiring several children because of the possibility of placental complications (previa, accreta) and risk of cesarean hysterectomy |
| **VA/DOD, 2009 Good**         | • Insufficient evidence rating to make a recommendation about CDMR  
• “Until quality evidence becomes available, any decision to perform a cesarean delivery on maternal request should be carefully individualized and consistent with ethical principles. Given that the risks of abnormal placentaion and associated morbidity rise with each cesarean delivery, cesarean delivery on maternal request is not recommended for women desiring several children (NIH Consensus, 2006).” | • Evidence is insufficient to recommend for or against ECS/CDMR  
• A relative contraindication is wanting to have several children |
Guideline, Date Quality Rating | Elective Cesarean Recommendations | Indications and Contraindications for ECS or CDMR
---|---|---
RANZCOG, 2009 Poor | Guidance re timing of ECS:  
- Neonatal considerations: transfer to NICU in planned cesarean birth is twice that of planned vaginal birth and admission rate to NICU is inversely proportional to GA at term  
- Maternal considerations: waiting for labor increases the incidence of unplanned cesarean section which has its own risks; 10% of women will go into labor before the 39th week  
- Elective cesarean should be scheduled in approximately the 39th week | No elective cesarean before 39 weeks

Summary
Data, most of it not perfectly relevant to ECS, indicates that there is neonatal morbidity (and potentially mortality) associated with planned elective cesarean compared to intended vaginal delivery. Evidence shows that ECS should not be performed at gestational ages less than 39 weeks in order to decrease neonatal morbidity. There are important downstream risks to repeated cesareans related to abnormal placentation. Because women may not accurately predict future desired family size ECS should be approached judiciously by both women and their care providers. Elective cesarean does not appear to confer medical benefit based on our review of the literature. While cesarean delivery is generally safe in the US setting, given that there are no defined benefits and possible harms it is important that women, their caregivers and policymakers carefully consider the option.

Limitations of the Evidence
There remains very little research which defines an ECS group accurately. It is not appropriate to compare cesarean delivery to vaginal delivery. Neither women nor clinicians are able to accurately predict actual mode of delivery. The issue under consideration is rather the comparison of intended routes of delivery. However, few studies have done this and most of the research is retrospective. More rare outcomes have likely not been well defined in the available base of literature. The total number of cesarean deliveries performed in the US or other countries without a defined medical indication in unknown. However, currently it appears that CDMR contributes to only a minority of primary cesareans. The role of physician and cultural influences on the election of cesarean as the preferred mode of delivery is not well studied, particularly in the US setting.
Appendix A. Updated Search Strategy

Core sources were primarily searched using the terms “cesarean” and “elective cesarean” (or “caesarean” or “elective caesarean”) depending on the country of origin. The responses for cesarean/caesarean were searched by hand to avoid the possibility of missing information on CDMR because of the different ways that CDMR is described. Databases with few items or inadequate search engines were searched by hand.

Medline was searched with the strategy below. The resulting citations were reviewed, citations dated before June 2005, the cutoff for the most comprehensive systematic review (Viswanathan) were excluded. Articles that did not focus on patient oriented outcomes were excluded.

Database: Ovid MEDLINE(R) and Ovid OLDMEDLINE(R) <1948 to March Week 2 2010>
Search Strategy:

1 exp Cesarean Section/ (29436)
2 exp Surgical Procedures, Elective/ (5566)
3 1 and 2 (574)
4 limit 3 to English language (500)
5 ((elect$ or choos$ or choice$ or demand$ or desir$ or request$ or wish$ or want$ or prefer$ or schedul$ or recommend$ or plan or plans or planned or planning) adj5 (cesarean$ or caesarean$)).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier] (4802)
6 limit 5 to English language (4144)
7 exp "Delivery of Health Care"/ (616264)
8 6 and 7 (443)
9 px.fs. (565818)
10 6 and 9 (221)
11 exp Decision Making/ (88307)
12 6 and 11 (165)
13 exp Communication/ (292988)
14 6 and 13 (19)
15 exp psychology, social/ or exp ethics/ (603967)
16 6 and 15 (192)
17 exp Sociology/ (840178)
18 6 and 17 (267)
19 exp Data Collection/ (1079885)
20 6 and 19 (605)
21 exp Economics/ (416443)
22 ec.fs. (264741)
23 21 or 22 (492937)
24 6 and 23 (121)
25 exp "Quality of Health Care"/ (3703502)
26 6 and 25 (1988)
27 ((medic$ or treat$ or therap$ or surger$ or surgic$ or cesarean$ or caesarean$) adj5 (appropriat$ or indicat$ or necessar$ or inapprop$ or unnecessar$ or
overus$).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier] (171005)
28 6 and 27 (317)
29 exp Hospital Administration/ (184065)
30 6 and 28 (317)
31 exp "health care economics and organizations"/ (1015048)
32 6 and 31 (326)
33 exp Medical Errors/ (65235)
34 exp risk/ (598527)
35 exp Postoperative Complications/ (345105)
36 exp Intraoperative Complications/ (29059)
37 exp pregnancy complications/ (290447)
38 exp hysterectomy/ (21000)
39 exp Mortality/ (216082)
40 mo.fs. (319749)
41 advers$.mp. (203497)
42 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 (1740380)
43 6 and 42 (2283)
44 exp time factors/ (836926)
45 exp age factors/ (344586)
46 44 or 45 (1147946)
47 6 and 46 (416)
48 4 or 8 or 10 or 12 or 14 or 16 or 18 or 20 or 24 or 26 or 28 or 30 or 32 or 43 or 47 (3362)
49 limit 48 to yr="1990 -Current" (2885)
50 limit 49 to yr="2000 -Current" (1994)
51 from 50 keep 1-1994 (1994)
## Appendix B. Summary of Findings for Systematic Reviews and Technology Assessments
(SRs and TAs list alphabetically by last name of first author)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Design and Number of Studies &amp; Subjects</th>
<th>Interventions and Comparators</th>
<th>Outcomes Evaluated and Main Findings</th>
<th>Quality Assessment and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guise, 2010 (AHRQ TOLAC</td>
<td>For the sections on downstream effects of prior cesarean delivery:</td>
<td>Trial of labor after cesarean (TOLAC), compared for maternal and neonatal outcomes to elective repeat cesarean delivery (ERCD).</td>
<td>Downstream effects from multiple ERCDs:</td>
<td>Quality: Good</td>
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<tr>
<td>Review)</td>
<td>- Adhesions: 3 studies</td>
<td>Outcomes of interest for longer term maternal outcomes from repeat cesarean delivery E (RCD).</td>
<td>- Adhesions: Statistically increased risk of adhesions at subsequent CS or hysterectomy associated with increased perioperative complications, time to delivery, and total operative time. 1 prior cesarean: 25.6% incidence adhesions Greater than 2 prior cesarean: - 48.8% incidence of prior cesarean - 46.1% incidence with OR compared to no prior 2.5 (95% CI 1.8, 3.4) Greater than 3 prior cesarean: - 18.2% incidence of adhesions w OR compared to no prior 8.1 (95% CI 2.7-23.8) - Fertility: 2 studies demonstrated statistically significant decreased ability to conceive or time to conceive a subsequent pregnancy. 1 study found an increased risk of early menopause among women with multiple repeat cesarean deliveries. - Hemorrhage or transfusion: Rates under 5%, but appear to increase with each subsequent repeat CS - Surgical injury: Bowel, bladder and ureteral injury are uncommon (overall incidence &lt; 1.2%), but increase with</td>
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<tr>
<td></td>
<td>- Fertility: 2 studies</td>
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<td>Authors rate the strength of the body of evidence on CS versus VBAC outcome as moderate.</td>
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<td></td>
<td>- Hemorrhage/transfusion: 3 cohort studies</td>
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<td></td>
<td>- Surgical injury: 2 studies evaluating bladder injuries</td>
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<td></td>
<td>- Wound complications: 2 studies</td>
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<td>- Hysterectomy: 7 studies</td>
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<td></td>
<td>- Abnormal placentation:</td>
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<td>- 19 articles: 8 cohort studies, 7 case control, 4 case series</td>
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<td>- Perinatal outcomes: two studies</td>
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<tr>
<td>Reference</td>
<td>Study Design and Number of Studies &amp; Subjects</td>
<td>Interventions and Comparators</td>
<td>Outcomes Evaluated and Main Findings</td>
<td>Quality Assessment and Comments</td>
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| Hansen, 2007 | Systematic Review | 9 eligible studies, including 1 case-control, 8 observational (1 prospective, 7 historical follow-up studies) | - Elective cesarean and vaginal delivery (2 studies had “intended vaginal delivery”)  
- Elective CS and repeat elective cesarean included.  
- Combined Respiratory Morbidity less well defined than the other outcomes (TTN and RDS) | Overall risk for respiratory morbidity generally 2-3 times that of vaginal delivery, some studies significantly higher.  
RDS: 2/4 included studies showed statistically significant difference, OR 5.9 (95% CI 2.3-32.4), 7.1 (95% CI 2.6-19.3)  
TTN: 3/6 included studies showed statistically significant difference, OR 2.3 (95% CI 1.5-3.5), 2.6 (95% CI 1.5-4.5), 2.8 (95% CI 2.1-3.8)  
CM: All 6 studies showed statistically significant differences | Quality: Poor  
Wide variation in risk with OR less than 2 to 7. Gestational age not controlled for in the same way each study.  
Different comparison groups for each study. |
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</thead>
<tbody>
<tr>
<td>Horey, 2008</td>
<td>looked at different outcomes so numbers are repeated:</td>
<td>significant difference, CM defined differently ea study (but all included RDS and TTN) OR 2.3 (95% CI 1.4-3.8), OR 2.6 (95% CI 1.4-5.9), OR 2.8 (95% CI 1.4-5.9), OR 6.8 (95% CI 5.2-8.9) Other findings: RR 4 (p &lt; 0.01, 95% CI 2.8-5.6) and RR 20.7 (p &lt; 0.0001 95% CI 4.9-86.7)</td>
<td>Studies that did not have statistical significance may have been underpowered.</td>
<td>Quality: Good</td>
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</tbody>
</table>
- No difference in cesarean rates for both studies.  
**Cesarean rates:**  
  - Fraser 51.1% (control) vs. 47.1% (intervention)  
  - Saisto 48.4%(control) vs. 43.5% (intervention)  
Neither statistically significant | - Neither study measured outcomes that directly assessed the intervention  
- Pts perception in ability to participate in decision making not measured or evaluated in either study. |                                                      |
| Kingdon, 2006   | Cochrane Systematic Review.  
2 RCTs, results not pooled because of clinical heterogeneity  
One study of women eligible for TOLAC/VBAC (Fraser 1997), another study of women identified as “fearful of vaginal birth” (Saisto 2001)  
Sample size = 1275 (TOLAC/VBAC candidates) and 176 (fear of vaginal birth) | Information given to pregnant women about cesarean birth.  
Verbal information plus pamphlet vs. pamphlet only. | Analysis of surveys of women's preferences for their first childbirth. Data gathered antenatally.  
Two studies w very high rates of stated preference for cesarean; likely because inclusion criteria was either “fear of childbirth” or “requesting cesarean delivery”: | Quality: Fair  
Authors found methodological, conceptual, cultural issues that would have influenced why |
<table>
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</thead>
<tbody>
<tr>
<td>Lavender, 2006 (Cochrane Review)</td>
<td>8170 women, 3964 nulliparous</td>
<td></td>
<td>- 100% preference for cesarean in 5 nulliparous women, after therapy 3/5 ended up with cesarean - 59% of 90 nulliparous women preferred cesarean, 32% finally chose it</td>
<td>pregnant nulliparous women in the study populations may have expressed a preference for cesarean birth—no enough attention paid to cultural issues. Some surveys did not assess women's preference for cesarean in absence of medical risk (e.g. one study. gave women hypothetical situations with medical indications for cesarean birth to assess their preference) Study questionnaire content not included or summarized.</td>
</tr>
<tr>
<td>Nelson, 2010 (Cochrane Review)</td>
<td>Systematic review 21 studies: N = 31,698 (6028 CD and 25,170 VD) 2 RCTs (one randomizing women to vaginal birth and cesarean, other randomizing women to perineal massage with a subgroup analysis relevant to anal incontinence.</td>
<td>Vaginal delivery (VD) compared with cesarean delivery (CD)</td>
<td>Primary outcome: anal incontinence. No benefit to CD: both ANY CD and CDMR Wide variation in ORs: 1.14% to 25.7% to 48%. Calculated NNT for all studies: number of cesarean sections/vaginal deliveries needed to prevent fecal incontinence relative to vaginal delivery/cesarean</td>
<td>Quality: Good Breech/twins included. Variations in how studies controlled for parity, age. Wide variation in ORs</td>
</tr>
<tr>
<td>Reference</td>
<td>Study Design and Number of Studies &amp; Subjects</td>
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<tr>
<td>Poobalan, 2009</td>
<td>Cohort/cross sectional 19 studies</td>
<td>Elective and emergency cesarean rates in obese compared to non-obese woman with degree of obesity measured by BMI</td>
<td>Meta Analysis: Compared with women with normal BMI, OR (all types cesarean): overweight (BMI 25-30) = 1.53 (95% CI 1.48, 1.58) obese (BMI 30-35) = 2.26 (95% CI 2.04, 2.51) morbidly obese (BMI &gt; 35) = 3.38 (95% CI 2.48, 4.57) OR (elective cesarean): overweight (BMI 25-30) = 1.32 (95% CI 1.21, 1.45) obese (BMI &gt; 30-35) = 1.87 (95% CI 1.64, 2.12) OR (emergency cesarean): overweight (BMI 25-30) = 1.64 (95% CI 1.55, 1.73) obese (BMI &gt; 30-35) = 2.23 (95% CI 2.07, 2.42)</td>
<td>Quality: Good Maternal characteristic that may make nulliparous elective cesarean more likely, including overweight/obese status. Unclear what role maternal request has among this group of studies. Definition of ECS not clear.</td>
</tr>
<tr>
<td>Viswanathan, 2006</td>
<td>AHRQ, Systematic Review 69 articles (65 studies)</td>
<td>Cesarean delivery on maternal request (CDMR) vs. vaginal delivery</td>
<td>Primary Outcomes: - Incidence and trends of CDMR: - Outcomes of CDMR: proxies used for CDMR group (proxies used include elective cesarean, cesarean for breech, cesarean with no indicated risk, planned cesarean scheduled cesarean) - Modifiers CDMR: proxies used</td>
<td>Quality: Good - Paucity of studies comparing planned VD with planned cesarean. Studies focused on actual route of delivery. - No evidence directly compares effect modifiers in a population with planned CDMR with planned</td>
</tr>
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<td>Reference</td>
<td>Study Design and Number of Studies &amp; Subjects</td>
<td>Interventions and Comparators</td>
<td>Outcomes Evaluated and Main Findings</td>
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<td>Outcomes (see Table 2 in text)- - No difference in maternal mortality in CDMR compared to vaginal delivery - Neonatal respiratory problems likely increased in CDMR but this more important in GA &lt; 39 weeks - Longer maternal hospital stays for CDMR - Downstream effects: abnormal placentation (i.e. previa), subsequent stillbirth.</td>
<td>vaginal deliveries. Proxies used i.e. planned cesareans for breech which has significant limitations because breech is often marker for more complicated delivery thus affecting outcomes. Strength of evidence poor overall because of use of proxies and outcomes data w/o intention to treat analysis</td>
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</tbody>
</table>
## Appendix C. Summary of Findings for Observational Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Location and/or Setting</th>
<th>Year(s) of Study</th>
<th>Study Design</th>
<th>Study Inclusion and Exclusion Criteria</th>
<th>Interventions and Baseline Characteristics of Study Population</th>
<th>Outcomes Assessed and Results</th>
<th>Study Quality and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clark, 2009</td>
<td>United States 27 hospitals in 14 states which are part of the Hospital Corp. of America system</td>
<td>May through July 2007; Prospective case series</td>
<td>Multiparous and nulliparous with planned elective delivery at term. Subpopulations with elective induction at 37, 38 and 39-41 weeks analyzed. Inclusion criteria: Elective delivery without an indication as defined below. Exclusion criteria: Indication for delivery as determined by the admitting physician or the nurse who collected data. Indications included greater than 41 weeks,</td>
<td>EIOL at 37 wks = 112 EIOL at 38 wks = 678 EIOL at 39-41 wks = 2004 Primary method of induction for total induction of labor population (EIOL and indicated induction): Oxytocin—72% Prostaglandin E2—15% Misoprostol—8% Amniotomy—4%</td>
<td>NICU admissions among infants of women with elective primary cesarean (%): 37 wks: 5/24 (20.8%) P = not significant compared to 38 wk group 38 wks: 16/97 (16.5%) P = non significant compared to 39-41 wk group 39-41 wks: 12/153 (7.8%) Higher than elective induction group, comparable to elective repeat cesarean except 38 wk group which is higher in primary elective cesarean. Length of labor (start of induction to delivery), hours (SD) Nulliparous—13.6 (7.9) Multiparous—8.2 (5.0)</td>
<td>Quality: Fair Mixed parity groups Prospective case series of elective deliveries without a control group.</td>
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<td>Declercq, 2007</td>
<td>United States Linked birth death certificates and birth-related discharge data in Massachusetts.</td>
<td>1998-2003</td>
<td>Inclusion: - 37-41 weeks - singleton - vertex - no prior cesarean - “no documented prior risk” on both birth cert and hospital discharge data Exclusion: - prior cesarean</td>
<td>Planned vaginal births (240,754) vs. cesarean deliveries with no documented labor risk (n=3,334) Planned cesarean births approximated using mothers with no documented labor risk on birth certificate or discharge data and cesarean performed Planned vaginal birth</td>
<td>Rehospitalization, costs, length of stay Longer hospital stays, higher rate of rehospitalization, higher costs in planned cesarean group compared to planned vaginal birth. Hospital stays: Planned vaginal 2.4 d (95% CI 2.43-2.44)</td>
<td>Quality: Fair Provides information about the baseline characteristics of the groups and this reveals some differences. Did make adjustments for age, race, ethnicity, parity.</td>
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<tr>
<td>Reference</td>
<td>Location and/or Setting</td>
<td>Year(s) of Study</td>
<td>Study Design</td>
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<td>Geller, 2010a</td>
<td>United States UNC Chapel Hill- Hospital Database 1995-2005</td>
<td>&quot;Neonates born to healthy term primiparas with singleton pregnancies.&quot; Retrospective cohort design</td>
<td>Inclusion- - primiparous deliveries - singletons - breech ok Exclusion- - multiparity - multiple gestation - &gt; 37 weeks GA - Major comorbid: DM/GDM, HTN, inflammatory disorder, &quot;etc.&quot; - fetal anomaly or comorbidity</td>
<td>approximated using vaginal births with and without documented labor risk plus cesarean deliveries with a documented labor risk 10% cesarean rate in the combined mothers w no documented risk prior to labor Maternal characteristics vary by group: - Primary cesareans much more likely to occur in: primiparous women, women &gt; 40, African-American mothers. 1.3 % overall are cesarean w no labor complications or procedures</td>
<td>Planned cesarean vs. planned vaginal birth Planned cesarean: intent to deliver by cesarean before the onset of labor despite actual route of delivery. Assessed intent by review of chart and coding tools to categorize documented intent of delivery. Intent also assessed by searching key words such as &quot;augmentation&quot; &quot;cervical dilatation&quot; etc. and including those cases in intended vaginal delivery.</td>
<td>Neonatal outcomes NICU admission overall= 6.6% Favors planned vaginal NICU Admission: Favors planned vaginal OR 0.42 (95% CI 0.27, 0.65) P value &lt; 0.001 Jaundice: Favors planned vaginal OR 0.44 (95% CI 0.30, 0.63) Oxygen Resuscitation Favors planned vaginal OR 0.41 (95% CI 0.27, 0.65) Length of stay: longer in planned cesarean Planned vaginal- 2.6 +/- 1.1 Planned cesarean- 3.2 +/- 0.7 P value &lt;0.001</td>
<td>Quality: Fair Pros: - limiting gestations to low risk is appropriate as proxy for CDMR since it is, by definition, a cesarean in absence medical indication - intention is assessed, probably incompletely - using only primiparous women excludes potential bias of multiparity and repeat cesarean The choice of proxy may not be generalizable to CDMR. Source of data birth/death certificates and discharge data.</td>
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<tr>
<td>Reference</td>
<td>Location and/or Setting</td>
<td>Year(s) of Study</td>
<td>Study Design</td>
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<td>3868 planned vaginal = planned vaginal + emergency cesarean</td>
<td>Favors planned cesarean</td>
<td>Cons/critiques:</td>
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<td>180 planned cesarean = planned cesarean + precipitous vaginal before planned cesarean (0 of these)</td>
<td>Meconium passage:</td>
<td>- majority of planned</td>
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<td>Cesarean rate overall: Planned/not planned- 37%</td>
<td>OR 4.35 (2.35, 8.05)</td>
<td>cesareans done because of breech,</td>
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<td>In planned vaginal group- 35%</td>
<td>1 min Apgar &lt;= 5</td>
<td>problems with this</td>
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<td>Planned cesarean indication:</td>
<td>OR 2.41 (1.12, 5.18)</td>
<td>as proxy to CDMR</td>
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<td>CDMR = 1.7%</td>
<td>No difference:</td>
<td>- sig differences in</td>
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<td>Breech = 68.9%</td>
<td>5 min Apgar &lt;=5</td>
<td>age, race, gestational age</td>
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<td>Macrosomia = 7.9%</td>
<td>Major respiratory morbidity</td>
<td>- planned cesarean</td>
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<td>Prev. myomectomy = 4.5%</td>
<td>composite, planned cesarean:</td>
<td>group's mean gestational age &lt; 39 weeks, not</td>
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<td>Abnormal fetal lie 2.8%</td>
<td>OR 0.81 (0.32, 2.01) P value</td>
<td>according to ACOG</td>
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<td>Planned vaginal vs. Planned c/s</td>
<td>0.81</td>
<td>guidelines</td>
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<td>*Age  25.1 (+/- 601) vs. 28.4</td>
<td>Major neurological morbidity</td>
<td>- only v small percentage of cases found to be CDMR by chart review,</td>
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<td>(+/- 6.3)</td>
<td>composite- no neurological</td>
<td>questionable relevance of proxy to CDMR</td>
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<td>Race</td>
<td>morbidity in planned cesarean</td>
<td>- inc rates of NICU</td>
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<td>*White 43.4% vs. 59.0%</td>
<td>Rate of sepsis</td>
<td>admission in planned</td>
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<td>Black 14.6% vs. 10.1%</td>
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<td>cesarean group but similar</td>
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<td>Hispanic 36.7% vs. 21.3%</td>
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<td>rates of sepsis and</td>
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<td>Asian 5.3% vs. 9.6%</td>
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<td>inc rates chorioamnionitis, low</td>
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<td>*GA 39.4 (+/- 1.2) vs. 38.7</td>
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<td>1 min Apgar in planned</td>
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<td>(+/- 1.1)</td>
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<td>vaginal group: probable</td>
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<td>Mat obesity (&gt;200# pre-pregnancy weight) 30.1% vs. 34.3%</td>
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<td>confounder = presence of NICU</td>
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<td>* sig diff</td>
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<td>team in ea cesarean</td>
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<td>delivery</td>
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<td>Reference</td>
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<td>Geller, 2010b</td>
<td>United States UNC Chapel Hill- Hospital Database 1995-2005</td>
<td>1995-2005</td>
<td>Retrospective cohort.</td>
<td>Inclusion- - primiparous deliveries - singletons - breech ok Exclusion- - multiparity - multiple gestation - &gt; 37 weeks GA - Major comorbid: DM/GDM, HTN, inflammatory disorder, &quot;etc.&quot; - fetal anomaly or comorbidity</td>
<td>Planned cesarean vs. planned vaginal birth Also: Planned cesarean vs. induction of labor Planned cesarean: intent to deliver by cesarean before the onset of labor despite actual route of delivery. Assessed intent by review of chart and coding tools to categorize documented intent of delivery. Intent also assessed by searching key words such as &quot;augmentation&quot; &quot;cervical dilatation&quot; etc. and including those cases in intended vaginal delivery. 3868 planned vaginal = planned vaginal + emergency cesarean 180 planned cesarean = planned cesarean + precipitous vaginal before planned cesarean (0 of these) Cesarean rate overall: Planned/not planned- 37% In planned vaginal group- 35% Planned cesarean indication: CDMR = 1.7% Breech = 68.9% Macrosomia = 7.9%</td>
<td>Maternal Outcomes Analysis of planned cesarean vs. planned vaginal delivery--- Favors planned vaginal Length of hospital stay (mean difference with 95% CI of difference): OR 1.58 (1.27, 2.17) Favors planned cesarean Chorioamnionitis: OR 34.85 (4.87, 249.25) Postpartum hemorrhage: OR 5.59 (1.38, 22.68) Prolonged rupture of membranes: OR 9.24 (3.42, 24.97) Uterine atony: OR 12.08 (1.69, 86.60) No difference: (planned vaginal vs. planned cesarean) Blood transfusion (1.9% vs. 1.7%) Cesarean hysterectomy (0.1% vs. 0.6%) Wound infection (0.00% vs. 0.01%) Endometritis (1.3% vs. 1.7%) No cases of: PE Maternal death The following are results after logistic regression model adjusting for age, race, obesity, gestational age, prolonged rupture of membranes---</td>
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<td>Companion paper to neonatal outcomes paper (Geller, 2010a). &quot;Neonates born to healthy term primiparas with singleton pregnancies.&quot;</td>
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<td>Quality: Fair Pros: - limiting gestations to low risk is appropriate as proxy for CDMR since it is, by definition, a cesarean in absence of medical indication - intention is assessed, probably incompletely - using only primiparous women excludes potential bias of multiparity and repeat cesarean Cons/critiques: - majority of planned cesareans done because of breech, problems with this as proxy to CDMR - sig differences in age, race, gestational age - planned cesarean group’s mean gestational age &lt; 39 weeks, not according to ACOG guidelines - only v small percentage of cases found to be CDMR by chart review, questionable relevance of proxy to</td>
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<td>Hansen, 2008</td>
<td>Denmark</td>
<td>1998-2006</td>
<td>Data = Birth registration forms filled out by midwives, Inclusion- Liveborn singletons 37-41 wks gestation, Exclusion- Congenital malformations, Exclusion for low risk</td>
<td>Elective cesarean vs. Intended vaginal delivery, Elective cesarean: cesarean which occurs before labor as defined by rupture of membranes and/or cervical dilatation.</td>
<td>Neonatal outcomes: - Pooled respiratory morbidity- any respiratory distress, TTN, persistent pulmonary hypertension. - Serious respiratory morbidity- requires treatment for &gt;= 3 days with continuous oxygen</td>
<td>Quality: Poor</td>
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<td>Aarhus Birth Cohort Aarhus</td>
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<td>Favors planned cesarean 1) Chorioamnionitis OR 0.15 ( CI 0.05 to 0.40) Chorioamnionitis also decreased with white race (OR 0.46, 95% CI 0.32 to 0.65), increased w increasing maternal age (OR 1.04, 95% CI 1.03 to 1.07), gestational age (OR 1.31, 95% CI 1.19 to 1.43), and prolonged rupture of membranes (OR 2.72, 95% CI 2.14 to 3.45) 2) PP hemorrhage OR 0.23, 95% CI 0.06 to 0.94. PPH also decreased w maternal age (OR 0.97, 95% CI 0.95 to 0.99), increased w gestational age (OR 1.25, 95% CI 1.11 to 1.40). Subanalysis on induction of labor to provide alternative comparison group: IOL had higher rate of chorioamnionitis, PPH, prolonged ROM, uterine atony, increased length of stay compared with planned cesarean</td>
<td>CDMR - interesting because more maternal short term primary and secondary adverse outcomes with planned vaginal for this analysis and more neonatal adverse outcomes for planned cesarean in same analysis</td>
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<td>structured coding sheet from neonatologists and discharge data.</td>
<td>Prospective cohort looking at a variety of pregnancy-related issues.</td>
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<td>subgroup- - IU2G (birthweight &lt; 2500 in babies born after 36 weeks) - DM and GDM - Preeclampsia - hypertension Sub group analysis excluded newborns with meconium aspiration syndrome, sepsis, and pneumonia.</td>
<td>Emergency cesarean: cesarean occurring after labor. Labor: regular uterine contractions with progression of cervical dilatation. Stratified analysis by gestational age in order to look at effect modification. Logistic regression used to evaluate potential confounders: smoking, alcohol, parity, maternal pre pregnancy BMI, maternal age, marital status, education. Baseline characteristics of each group not completely described. 34,458 pregnancies before higher risk exclusion Elective cesarean- 2681 (7.7%) Intended vaginal- 31,771 (92%) 32,580 pregnancies after higher risk exclusion Elective cesarean- 2497 (7.6%) Intended vaginal- 30,083 (92%)</td>
<td>supplementation, nasal CPAP, any period of mechanical ventilation - comparison made to intended vaginal delivery at 40 weeks &quot;modified intention to treat analysis&quot; - calculated OR for &quot;low risk&quot; pregnancy as sub group which ended up w slightly higher risk estimates Favors Intended vaginal - Respiratory morbidity in all and low risk pregnancies - Serious respiratory morbidity in all and low risk pregnancies - Relative risk most marked at 37 weeks. Favors elective cesarean - no neonatal resp. morbidity advantage for elective cesarean Not significantly different (compared to 40 weeks): - respiratory morbidity at 39 weeks - serious respiratory morbidity at 19 weeks - difference between all pregnancies and low risk pregnancies not significant Respiratory morbidity compared to intended vaginal delivery at 40 weeks (all pregnancies, adjusted for confounders), including all infants, low risk subgroup.</td>
<td>Cons/critiques: - Some baseline characteristics of population not well described in this paper: number of cesareans, indication for cesarean, breech, etc. - Definition of elective cesarean may include cesareans done for a variety of indications. - Different indications for elective cesarean not described - Data collected prospectively but study not designed specifically for question asked here- really a retrospective study - Table 1 reveals missing data especially for: smoking, alcohol intake, BMI, marital status, education - Could have controlled for multiparity and multiple cesarean sections by excluding multiparas</td>
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Percent, OR with 95% CI n = 32580

| 37 wks | 10%, 4.2 (2.4, 7.4) vs. 1.6% 3.2 (0.8, 13) |
| 38 wks | 5.1%, 3.3 (2.3, 4.8) vs. 0.8%, 4.2 (1.6, 11) |
| 39 wks | 0.8%, 4.2 (1.6, 11) vs. 0.2 %, 2.7 (0.5, 14) |
| 40 wks | 1.6%, 1.0 (0.2, 4.0) vs. 0 |
| 41 wks | 2.2%, 1.5 (0.2, 11) vs. o |

during initial data collection instead of by logistic analysis.
- Multiple cesareans not controlled for.
- Excluded infants with meconium aspiration syndrome and pneumonia “because these conditions may cause respiratory symptoms unrelated to delayed transition from fetus to newborn but are associated with intended vaginal delivery.” This exclusion increased the difference between the two groups.
- We are told that the low risk pregnancies are not significantly different than all pregnancies but not shown this.
- ORs comparing to intended vaginal delivery at 40 weeks when stratifying for GA. Would be interesting to know how intended vaginal delivery at each GA would also compare.
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<td>Kolas, 2006</td>
<td>Norway</td>
<td>Inclusion: - term &gt;= 259 days - singleton 18,742 eligible deliveries (17,828 planned vaginal, 825 planned cesarean sections) Exclusion: - congenital malformations (n=546) - unspecified mode of delivery (n=89)</td>
<td>planned cesarean vs. planned vaginal deliveries at term Overall cesarean rate 13.6 Emergency cesarean - cesarean performed pre labor or in labor after planned vaginal delivery Planned cesarean- cesarean performed more than 8 hrs after decision for operation</td>
<td>Neonatal outcomes: Differences in neonatal outcome seen between group 1 and group 2 as per below. These findings not changed by modifying group 2 to exclude high risk pregnancies. Favoring planned vaginal: NICU transfer 5.2% vs. 9.8% RR 1.87 (1.51-2.32) Pulmonary disorders (TTN, RDS) 0.8% vs. 1.6%; RR 2.07 (95% CI 1.17-3.63) Intracranial hemorrhage 5 births (0%) vs. 0.1% RR 4.32 (0.51-37) Favoring planned cesarean: Apgar 5 min &lt; 7 1% vs. 0.5% RR 0.37 (0.12-1.16) Abnormal neurological status (cerebral irritation, cerebral depression, encephalopathy) 0.2% vs. 0.1% RR 0.55 (0.08-4.03) Neonatal convulsions 0.2% vs. 0.1% RR 0.75 (0.10-5.46) Bacterial infections 08% vs. 0.5% RR 0.63 (0.23-1.69) No difference: 5 min Apgar &lt; 4</td>
<td>Quality: Poor Major and impactful differences in baseline characteristics between groups: parity, gestational age, maternal age, prior cesarean, birthweight and breech positioning all have sig potential to confound the results. Also- not clear if there were any vaginal deliveries (i.e. precipitous deliveries) in the planned cesarean group and, if so, how they were classified. Cesarean rates v different from current US cesarean statistics.</td>
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*Nulliparas 46% vs. 29%
*Mat. Age 28.8 vs. 31.4
*Gestational age 39.7 vs. 38.5
*Prior c/s 5.1% vs. 40.1%
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<td>MacDorman, 2007</td>
<td>United States</td>
<td>Linked birth and death certificates all states</td>
<td>1999-2002</td>
<td>Retrospective cohort.</td>
<td>Inclusion: - 37-41 weeks - singleton - vertex Exclusion: - prior cesarean - placenta previa - any of 16 medical risk factors: anemia, cardiac disease, acute or chronic lung disease, diabetes, genital herpes, Cesarean with no mention of labor complications or procedures (n = 271,179) vs. planned vaginal delivery (n = 7,755,236) medically elective or planned cesarean delivery is approximated by using: births identified on the birth certificate as &quot;cesarean with no labor complications or procedures&quot; planned vaginal delivery = vaginal births + cesarean sections with labor complications or procedures 11% cesarean rate in these term singleton, vertex patients @ 37-41 wks gestation. 3.4 % are cesarean w no labor complications or procedures</td>
<td>Neonatal mortality: Logistical regressions run for three different groups. Adjusted odds ratios computed to compare neonatal mortality rates by method of delivery against planned vaginal delivery group. All models adjusted for maternal age, race/ethnicity, education, parity, maternal smoking, infant birthweight, gestational age. Model 1- Dependent variable = total neonatal mortality OR 2.34 for increased neonatal mortality rate in primary cesareans w/no labor complications or procedures (95% CI 2.13-2.58) Model 2- Dependent variable = neonatal mortality excluding congenital anomalies OR 1.93 for increased neonatal mortality rate in primary cesareans w/no labor complications or procedures (95% CI 1.67-2.24)</td>
<td>Quality: Poor Problems with birth certificate data in general. The choice of proxy may not be generalizable to ECS. Not much described about the baseline characteristics of the groups and how they might differ (i.e. parity, age, gestational age, etc.) In Model 3 neonates with Apgar score &lt; 4 excluded, assumption made is that this is a poor outcome specific to vaginal birth but article does not specifically discuss why excluded. Appropriate that the study population is limited to lower risk</td>
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<td>Model 3- Dependent variable = neonatal mortality excluding congenital anomalies and events with Apgar score &lt; 4 (excluded data from CA and TX because they don’t report on Apgars in birth certificates) OR 1.69 for increased neonatal mortality rate in primary cesareans w/no labor complications or procedures (95% CI 1.35-2.11)</td>
<td>term vertex singletons w/o prior cesarean. Large number (N=???)</td>
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