Ontario
Health Quality Ontario

Caesarean Delivery Rate Review: An Evidence-Based Analysis

N DEGANI, N SIKICH

MARCH 2015

Ontario Health Technology Assessment Series; Vol. 15: No. 9, pp. 1–58, March 2015

Suggested Citation

This report should be cited as follows:

Degani N, Sikich N. Caesarean delivery rate review: an evidence-based analysis. Ont Health Technol Assess Ser [Internet]. 2015 March;15(9):1–58. Available from: http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations/ontario-health-technology-assessment-series/caesarean-delivery-rate-review.

Permission Requests

All inquiries regarding permission to reproduce any content in the *Ontario Health Technology Assessment Series* should be directed to EvidenceInfo@hqontario.ca.

How to Obtain Issues in the *Ontario Health Technology Assessment Series*

All reports in the *Ontario Health Technology Assessment Series* are freely available in PDF format at the following URL: http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations/ontario-health-technology-assessment-series.

Conflict of Interest Statement

The authors at Health Quality Ontario are impartial. There are no competing interests or conflicts of interest to declare.

Indexing

The *Ontario Health Technology Assessment Series* is currently indexed in MEDLINE/PubMed, Excerpta Medica/Embase, and the Centre for Reviews and Dissemination database.

Peer Review

All reports in the *Ontario Health Technology Assessment Series* are subject to external expert peer review. Additionally, Health Quality Ontario posts draft reports and recommendations on its website for public comment prior to publication. For more information, please visit: http://www.hqontario.ca/en/mas/ohtac_public_engage_overview.html.

About Health Quality Ontario

Health Quality Ontario is the provincial advisor on the quality of health care in Ontario, evaluating the effectiveness of health care technologies and services, providing evidence-based recommendations, reporting to the public on the quality of the health system, and supporting the spread of quality improvement throughout the system.

Health Quality Ontario's research is published as part of the *Ontario Health Technology Assessment Series,* which is indexed in MEDLINE/PubMed, Excerpta Medica/Embase, and the Centre for Reviews and Dissemination database. Corresponding Ontario Health Technology Advisory Committee recommendations and other associated reports are also published on the Health Quality Ontario website. Visit http://www.hqontario.ca for more information.

About the *Ontario Health Technology Assessment Series*

To conduct its comprehensive analyses, Health Quality Ontario and its research partners review the available scientific literature, making every effort to consider all relevant national and international research; collaborate with partners across relevant government branches; consult with expert advisory panels, clinical and other external experts, and developers of health technologies; and solicit any necessary supplemental information.

In addition, Health Quality Ontario collects and analyzes information about how a health intervention fits within current practice and existing treatment alternatives. Details about the diffusion of the intervention into current health care practices in Ontario add an important dimension to the review.

The Ontario Health Technology Advisory Committee uses a unique decision determinants framework when making recommendations to the Health Quality Ontario Board. The framework takes into account clinical benefits, value for money, societal and ethical considerations, and the economic feasibility of the health care intervention in Ontario. Draft Ontario Health Technology Advisory Committee recommendations and evidence-based reviews are posted for 21 days on the Health Quality Ontario website, giving individuals and organizations an opportunity to provide comments prior to publication. For more information, please visit: http://www.hqontario.ca/evidence/evidence-process/evidence-review-process/professional-and-public-engagement-and-consultation.

Disclaimer

This report was prepared by Health Quality Ontario or one of its research partners for the Ontario Health Technology Advisory Committee and was developed from analysis, interpretation, and comparison of scientific research. It also incorporates, when available, Ontario data and information provided by experts and applicants to HQO. The analysis may not have captured every relevant publication and relevant scientific findings may have been reported since the development of this recommendation. This report may be superseded by an updated publication on the same topic. Please check the Health Quality Ontario website for a list of all publications: http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations.

ABSTRACT

Background

In 2007, caesarean deliveries comprised 28% of all hospital deliveries in Ontario. Provincial caesarean delivery rates increased with maternal age and varied by Local Health Integration Network. However, the accepted rate of caesarean delivery in a low-risk maternal population remains unclear.

Objectives

To review the literature to assess factors that affect the likelihood of experiencing a caesarean delivery, and to examine Ontario caesarean delivery rates to determine whether there is rate variation across the province.

Data Sources

Data sources included publications from OVID MEDLINE, OVID MEDLINE In-Process and Other Non-Indexed Citations, OVID Embase, EBSCO Cumulative Index to Nursing & Allied Health Literature (CINAHL), and EBM Reviews, as well as data from the Canadian Institute for Health Information Discharge Abstracts Database and the Better Outcomes and Registry Network.

Review Methods

A mixed-methods approach was used, which included a systematic review of the literature to delineate factors associated with the likelihood of caesarean delivery and an analysis of administrative and clinical data on hospital deliveries in Ontario to determine provincial caesarean delivery rates, variation in rates, and reasons for variation.

Results

Fourteen systematic reviews assessed 14 factors affecting the likelihood of caesarean delivery; 7 factors were associated with an increased likelihood of caesarean delivery, and 2 factors were associated with a decreased likelihood. Five factors had no influence. One factor provided moderate-quality evidence supporting elective induction policies in low-risk women. The overall Ontario caesarean delivery rate in a very-low-risk population was 17%, but varied significantly across Ontario hospitals.

Limitations

The literature review included a 5-year period and used only systematic reviews. The determination of Robson class for women is based on care received in hospital only, and the low-risk population may have included data from women with obstetrical conditions that warranted a caesarean delivery.

Conclusions

There is moderate-quality evidence that—compared with expectant management—an induction policy is associated with a decrease in caesarean delivery rates in low-risk women. There is significant caesarean delivery rate variation among Ontario hospitals.

PLAIN LANGUAGE SUMMARY

A caesarean delivery is a surgical procedure to deliver 1 or more babies. It can be done when a vaginal delivery would be risky for the mother or baby. There are concerns that the mother and/or the baby may have serious complications from a caesarean delivery. It is important to know what factors increase the chance of having a caesarean delivery. It is also important to know how many caesarean deliveries are done in Ontario. This review found 14 factors, of which 9 were associated with either an increased or decreased chance of having a caesarean delivery. Of these, a policy of inducing labour lowered the rate of having a caesarean delivery compared with a policy of expectant management in low-risk women. An analysis of a registry for Ontario hospital births found a caesarean delivery rate of about 17% among women at very-low risk for complications. This rate varies among Ontario hospitals.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AMSTAR	Assessment of Multiple Systematic Reviews
BORN	Better Outcomes & Registry Network
CI	Confidence interval(s)
CTG	Cardiotocography
GDM	Gestational diabetes mellitus
GRADE	Grading of Recommendations Assessment, Development, and Evaluation
IADPSG	International Association of the Diabetes in Pregnancy Study Group
ICES	Institute for Clinical Evaluative Sciences
ICSI	Intracytoplasmic sperm injection
IVF	In vitro fertilization
LHIN	Local health integration network
MOMBABY	Mother-Baby Linked Database
NICE	National Institute for Health and Clinical Excellence
OECD	Organisation for Economic Co-operation and Development
PCMCH	Provincial Centre for Maternal and Child Health
RCT	Randomized controlled trial
RR	Relative risk
WHO	World Health Organization

BACKGROUND

Objective of Analysis

The objective of this analysis was to review the literature to assess factors that affect the likelihood of experiencing a caesarean delivery, and to examine Ontario caesarean delivery rates to determine whether there is rate variation across the province.

Clinical Need and Target Population

A caesarean delivery is a surgical procedure to deliver 1 or more babies. In most cases, a caesarean delivery is performed when a vaginal delivery would put the baby's or mother's life or health at risk.

Accepted indications for caesarean delivery include but are not limited to difficult or non-progressing labour, breech or other abnormal fetal position or size, non-reassuring fetal heart rate, and/or previous caesarean delivery, (1;2) but the benefits of a caesarean delivery compared with a vaginal delivery for a low-risk population continues to be debated. (3) In 2008, the Society of Obstetricians and Gynaecologists of Canada and other related Canadian professional organizations released a joint policy statement advocating for normal childbirth in a low-risk population. (4) According to these recommendations, as well as guidelines from the American (1) and British medical organizations, (5) caesarean deliveries should be offered only when vaginal delivery poses an increased risk to either the mother or the baby. These guidelines lack specificity, however, due to debate around indications for caesarean deliveries and appropriate rates at the population level. The accepted rate of caesarean delivery in a low-risk maternal population remains unclear.

Maternal, infant, and obstetrical factors have all been cited as affecting the likelihood of having a caesarean delivery. (6) Maternal factors may include but are not limited to age, pre-existing health conditions (such as diabetes), obesity, hypertension, previous caesarean delivery, pregnancy-related health conditions (including gestational diabetes), pre-eclampsia, eclampsia, and maternal preference. Infant factors include antenatal problems preceding the intrapartum period (such as fetal anomalies and/or intrauterine growth restriction), and suspected macrosomia, malposition, or multiple births. Obstetrical factors are conditions brought about by the presence of the current intrauterine pregnancy, such as placental abruption, placenta accreta, placenta previa, prolapsed cord, and non-reassuring fetal heart tracing.

Technology/Technique

Rates of caesarean delivery as a percentage of all live births have increased in all Organisation for Economic Co-operation and Development (OECD) countries in recent decades. (7;8) Caesarean delivery rates now exceed 30% in several industrialized countries, including Canada, the United States, and Australia. (7;8) Studies have reported concerns about increased maternal and infant mortality after caesarean delivery, as well as maternal morbidity in deliveries subsequent to the primary caesarean procedure. (3;9) These concerns, combined with the greater financial cost of a caesarean birth, (10;11) raise the challenging question of the appropriate rate for caesarean delivery. The World Health Organization (WHO) has proposed a rate guideline of 10% to 15% for low-risk, singleton, vertex, full-term pregnancies, and the United States Public Service has proposed a guideline of 10.5%, (7) but these have been criticized for not adjusting for changing obstetrical practices and attitudes among both health care providers and patients. Reflecting these issues, the U.S. Healthy People 2020 initiative revised its recommended rates from 15% of all births in 2000 to a new target of 23.9% among

nulliparous, singleton, vertex, full-term pregnancies with no previous caesarean delivery; this is a 10% decrease from the 2007 baseline rate of 26.5%. (12)

Impact on the System

Of every $10 (Cdn) spent on inpatient care in Canada, $1 (Cdn) is spent on childbirth and newborn care. (11) Compared to vaginal births, caesarean deliveries cost hospitals twice as much in obstetrical care for both mothers and babies. (11) The average hospital inpatient cost per delivery for typical patients is $4,930 (Cdn), and national estimates suggest that a primary caesarean delivery costs approximately $2,265 (Cdn) more than a typical vaginal delivery with no other interventions. (11) In 2008/2009, the total costs for all primary caesarean hospitalizations were estimated to be $292 million (Cdn). (11) However, health care providers are currently operating without an agreed-upon benchmark for caesarean delivery rates. Manitoba has the lowest primary caesarean delivery rate among the provinces, at 14% of all deliveries in 2008/2009. (11)

Global Rates and Trends

Across OECD countries, caesarean delivery rates increased from 14% of all births in 1990 to nearly 26% in 2009. (10) Rates were highest in Turkey and Mexico, at over 40% of all deliveries, and lowest in the Netherlands (14%) and Nordic countries (including Finland, Iceland, Norway, and Sweden). In the Netherlands, home births are a common option for women with low-risk pregnancies; 30% of all births occurred at home in 2004. (13)

The observed increase in caesarean delivery rates temporarily slowed during the 1990s in some OECD countries such as Canada and the United States as a result of changes in obstetrical practice, including a trial of normal labour and delivery after previous caesarean delivery to reduce the number of repeat procedures. (14) However, caesarean rates soon increased, in part due to reports of complications from trial of labour and continued changes in patient preferences. (15) Other trends, such as increases in first births among older women and the rise in multiple births resulting from assisted reproductive therapy, also contributed to the global increase in caesarean deliveries.

Rate increases since 2000 have been particularly rapid in Denmark, the Czech Republic, Poland, and the Slovak Republic. (10) Finland and Iceland are the only 2 OECD countries that have slightly reversed the trend of rising caesarean delivery rates since 2000. (10) The continued rise in caesarean deliveries is only partly related to changes in medical indications. A recent study of caesarean delivery rates found that even after adjusting for maternal and medical factors, women who had a preference for a caesarean delivery were almost twice as likely to have one compared with women who preferred a vaginal delivery. (16)

Canadian Rates and Trends

Caesarean rates have increased steadily in Canada since 1995, stabilizing in the last decade, (17) but they vary substantially from region to region. In 2008/2009, primary (first delivery) caesarean rates ranged from 23% of deliveries in Newfoundland and Labrador to 5% in Nunavut. (11) As noted above, Manitoba had the lowest provincial rate, at 14%. (11)

Ontario Rates and Trends

In 2007, caesarean deliveries comprised 28% of all hospital deliveries in Ontario. (18) Among women who had full-term, singleton, vertex presentations, 23% had caesarean deliveries.

Provincial caesarean delivery rates increased with maternal age and varied by local health integration network (LHIN), but did not vary by neighbourhood income or neighbourhood educational attainment of the mother.

EVIDENCE-BASED ANALYSIS

Research Questions

This report addressed 3 research questions:

- What are the factors affecting the likelihood of having a caesarean delivery in a low-risk obstetrical population?
- What is the Ontario provincial caesarean delivery rate for a low-risk obstetrical population, and does this rate vary within the province?
- What are the likely reasons for caesarean delivery rate variation in Ontario, if it exists?

Research Methods

A mixed-methods approach was used, which included a systematic review of the literature to delineate factors associated with the likelihood of caesarean delivery. Then, an analysis of administrative and clinical data on hospital deliveries in Ontario was used to determine provincial caesarean delivery rates, variation in rates, and reasons for variation. Details of each methodology are reported in their respective sections.

Expert Panel

In January 2013, an Expert Advisory Panel on Caesarean Delivery Rate Review was struck. Members of the panel included physicians, nurses, midwives, childbirth educators, obstetrical anesthetists, hospital administrators, and personnel from the Ministry of Health and Long-Term Care.

The role of the Expert Advisory Panel on Caesarean Delivery Rate Review was to contextualize the evidence produced by Health Quality Ontario and provide advice on the relevant issues pertaining to caesarean delivery rates in Ontario. However, the statements, conclusions, and views expressed in this report do not necessarily represent the views of Expert Advisory Panel members.

Systematic Review

Research Methods

Literature Search

Search Strategy

A literature search was performed on February 4, 2013, using OVID MEDLINE, OVID MEDLINE In-Process and Other Non-Indexed Citations, OVID Embase, EBSCO Cumulative Index to Nursing & Allied Health Literature (CINAHL), and EBM Reviews for studies published from January 1, 2008, to February 4, 2013. (Appendix 1 provides details of the search strategies.) Abstracts were reviewed by a single reviewer and, for those studies meeting the eligibility criteria, full-text articles were obtained. Reference lists were also examined for any additional relevant studies not identified through the search.

Inclusion Criteria

- English-language full-text publications
- published between January 1, 2008, and February 4, 2013
- systematic reviews with meta-analysis of randomized controlled trials (RCTs) and/or observational data
- maternal, obstetrical, fetal, or service-delivery factors
- comparator was accepted routine care or no treatment
- low-risk population

When more than 1 systematic review for a particular factor met the inclusion criteria, the most current review (i.e., the one with the most up-to-date literature search) was included.

Exclusion Criteria

- individual observational studies or RCTs
- comparisons of different techniques for a given intervention (i.e., early versus late administration of epidural)
- systematic reviews whose body of evidence was included in an updated systematic review answering the same research question

Outcomes of Interest

- caesarean delivery or preference for caesarean delivery

Quality of Evidence

The Assessment of Multiple Systematic Reviews (AMSTAR) measurement tool was used to assess the
methodological quality of systematic reviews. (19)

The quality of the body of evidence for each outcome was examined according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Working Group criteria. (20) The overall quality was determined to be high, moderate, low, or very low using a step-wise, structural methodology.

Study design was the first consideration; the starting assumption was that RCTs are high quality, whereas observational studies are low quality. Five additional factors—risk of bias, inconsistency, indirectness, imprecision, and publication bias—were then taken into account. Limitations in these areas resulted in downgrading the quality of evidence. Finally, 3 main factors that may raise the quality of evidence were considered: the large magnitude of effect, the dose response gradient, and any residual confounding factors. (20) For more detailed information, please refer to the latest series of GRADE articles. (20)

As stated by the GRADE Working Group, the final quality score can be interpreted using the following definitions:

High	High confidence in the effect estimate—the true effect lies close to the estimate of the effect
Moderate	Moderate confidence in the effect estimate—the true effect is likely to be close to the estimate of the effect, but may be substantially different
Low	Low confidence in the effect estimate—the true effect may be substantially different from the estimate of the effect
Very Low	Very low confidence in the effect estimate—the true effect is likely to be substantially different from the estimate of effect

Results of Systematic Review

The database search yielded 352 citations published between January 1, 2008, and February 4, 2013 (with duplicates removed). Articles were excluded based on information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment. Figure 1 shows the breakdown of when and for what reason citations were excluded from the analysis.

Fourteen systematic reviews met the inclusion criteria. (21-34) The reference lists of the included studies were hand-searched to identify other relevant studies, but no additional citations were included.

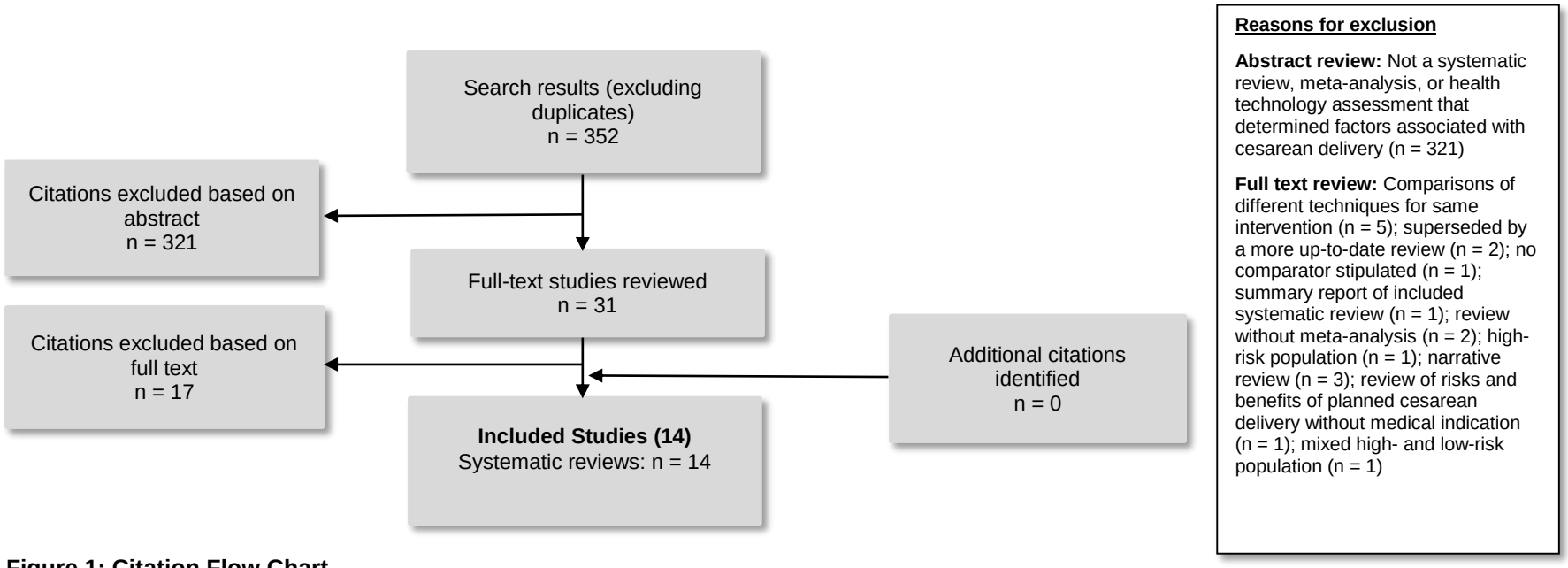

Figure 1: Citation Flow Chart

For each included study, the study design was identified and is summarized below in Table 1, a modified version of a hierarchy of study design by Goodman. (35)

Table 1: Body of Evidence Examined According to Study Design

Study Design	Number of Eligible Studies
RCTs	
Systematic review of RCTs	14
Large RCT	
Small RCT	
Observational Studies	
Systematic review of non-RCTs with contemporaneous controls	
Non-RCT with non-contemporaneous controls	
Systematic review of non-RCTs with historical controls	
Non-RCT with historical controls	
Database, registry, or cross-sectional study	
Case series	
Retrospective review, modelling	
Studies presented at an international conference	
Expert opinion	
Total	14

Abbreviation: RCT, randomized controlled trial.

The 14 systematic reviews assessed 14 factors affecting the likelihood of having a caesarean delivery in a low-risk obstetrical population: (21-34)

- labour induction policy
- epidural analgesia during labour
- instrument choice for assisted vaginal delivery
- electronic fetal monitoring
- partogram to monitor progress of labour
- package of care for active management during labour
- oxytocin for induction of labour
- gestational diabetes
- glycemic control
- maternal age
- women’s preference for caesarean delivery
- maternal body mass index
- assisted reproduction
- group prenatal care

Labour Induction Policy

One Cochrane systematic review (26) assessed the effect on the caesarean delivery rate of a policy of labour induction at or beyond term compared with expectant management (defined in the study as awaiting spontaneous labour until a later gestational age or until a maternal or fetal indication for induction of labour was determined). The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 2. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 2: Labour Induction Policy in Low-Risk Women at or Beyond Term Compared With Expectant Management

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Gulmezoglu et al, 2012 (26)	RCT	Up to April 12, 2012	Policy of labour induction at a predetermined gestational age	Expectant management until an indication for birth arises	Trial protocols differed according to gestational age, method of induction, and expectant management Population included low-risk women at or beyond term	11/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; RCT, randomized controlled trial.

In the meta-analysis by Gulmezoglu et al, (26) 21 RCTs contributed to the comparison of a labour induction policy versus a policy of expectant management. The meta-analysis included 4,515 labouring women in the induction policy group and 4,234 in the expectant management group. Compared with a policy of expectant management, mothers who were managed with an induction policy had an 11% decrease in the caesarean delivery rate (relative risk [RR], 0.89; 95% confidence interval [CI], 0.81–0.97; I^2 = 19%; fixed effect). This finding remained statistically significant in the gestational-age subgroup of 41 weeks, with a risk reduction of 26% (RR, 0.74; 95% CI, 0.58–0.96; fixed effect) in favour of induction policies. The lack of statistical significance in the other gestational-age subgroups (37–39 weeks, 39–40 weeks, < 41 weeks, and > 41 weeks) could have been due to inadequate optimal information size. Similarly, the lack of statistical difference among subgroups could have been due to the low number of studies in each subgroup, also leading to inadequate optimal information size. It was observed previously that when an induction policy postponed elective inductions to 39 weeks or after, patients spontaneously gave birth before the scheduled elective induction, resulting in lower rates of elective caesarean deliveries. (36)

Epidural Analgesia During Labour

One Cochrane systematic review (21) assessed the effect on the caesarean delivery rate of using epidural pain management compared with non-epidural analgesia or no analgesia in labour. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 3. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 3: Epidural Analgesia Compared With Non-Epidural Analgesia or No Analgesia

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Anim-Somuah et al, 2011 (21)	RCT	Up to September 30, 2011	All forms of epidural administration, including combined spinal epidural	No pain relief intervention or any form of pain relief not involving regional block	Pregnant women requesting pain relief, regardless of parity and whether labour was spontaneous or induced	10/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; RCT, randomized controlled trial.

In the meta-analysis by Anim-Somuah et al, (21) 27 RCTs contributed to the comparison of epidural analgesia in labour compared with non-epidural analgesia or no analgesia. Among the 27 RCTs, 3 used combined spinal epidural, and the remainder used epidural analgesia. The meta-analysis included 4,223 labouring women in the epidural analgesia group and 4,194 in the non-epidural group. The caesarean delivery rate did not differ between groups (RR, 1.10; 95% CI, 0.97–1.25; I^2 = 7%; fixed effect). However, compared to the non-epidural analgesia group, mothers who were managed with epidural analgesia during labour had a 43% increase in caesarean delivery rate due to fetal distress (RR, 1.43; 95% CI, 1.03–1.97; I^2 = 0%; fixed effect; 11 studies; 4,816 women). Fetal distress was not defined in the systematic review. Of the 11 studies that contributed to this meta-analysis, 1 used combined spinal epidural analgesia, and the remainder used epidural analgesia; all participants were in spontaneous labour. A separate analysis from the same review found a 19% increase in oxytocin augmentation in the epidural group compared with the non-epidural analgesia group (RR, 1.19; 95% CI, 1.03–1.39; I^2 = 90%; random effect; 13 studies; 5,815 women).

Instrument Choice for Assisted Vaginal Delivery

One Cochrane systematic review (30) assessed the effect on the caesarean delivery rate of using any type of forceps compared with any type of ventouse in assisted vaginal delivery. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 4. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 4: Any Type of Forceps Compared With Any Type of Ventouse for Assisted Vaginal Delivery

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
O'Mahony et al, 2010 (30)	RCT	Up to October 4, 2010	Any type of forceps	Any type of ventouse	Women in the second stage of labour due for instrumental vaginal delivery; singleton cephalic pregnancies	10/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; RCT, randomized controlled trial.

In the meta-analysis by O'Mahony et al (30), 4 RCTs contributed to the comparison of any type of forceps with any type of ventouse for assisted vaginal delivery. All RCTs included women with singleton cephalic pregnancies. Three RCTs included women at > 37 weeks' gestation, and 1 included women at 35 weeks' gestation. The meta-analysis included 615 labouring women in the forceps group and 607 in the ventouse group. The caesarean delivery rate did not differ

between groups (RR, 1.76; 95% CI, 0.95–3.23; I^2 = 0%; fixed effect). The systematic review also compared different types of forceps and ventouse instruments, but that comparison was outside the scope of this review. The systematic review did not complete a subgroup analysis of operator experience.

Electronic Fetal Monitoring

One Cochrane systematic review (25) assessed the effect on the caesarean delivery rate of cardiotocography (CTG) compared with intermittent auscultation of the fetal heart on admission to the labour ward. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 5. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 5: CTG Compared With Intermittent Auscultation on Admission to the Labour Ward in Low-Risk Women

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Devane et al, 2012 (25)	RCT	Up to November 2011	CTG at admission to labour ward	Intermittent auscultation of the fetal heart rate on admission to labour ward	Women at 37 to 42 completed weeks of pregnancy and at low risk for intrapartum fetal hypoxia and developing complications during labour	10/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; CTG, cardiotocography; RCT, randomized controlled trial.

In the meta-analysis by Devane et al, (25) 4 RCTs contributed to the comparison of CTG with intermittent auscultation in low-risk women. The meta-analysis included 5,657 labouring women in the CTG group and 5,681 in the intermittent auscultation group. Compared with intermittent auscultation, there was a 20% increase in the caesarean delivery rate when CTG was used on admission to the labour ward in low-risk women (RR, 1.20; 95% CI, 1.00–1.44; I^2 = 0%; random effect). Given that the lower CI interval was 1.00 and the absence of statistical heterogeneity in the analysis, the authors concluded that CTG was likely to increase the caesarean delivery rate by approximately 20%. If the data from this meta-analysis were reversed to report a good outcome, there would be a 17% decrease in the caesarean delivery rate in favour of intermittent auscultation at admission (RR, 0.83; 95% CI, 0.69–1.00; I^2 = 0%; random effects model). The authors also reported that compared with intermittent auscultation, CTG on admission was associated with a statistically significant 30% increase in continuous electronic fetal monitoring during labour in low-risk women (RR, 1.30; 95% CI, 1.14–1.48; 3 studies; 10,753 women).

Partogram to Monitor Progress of Labour

One Cochrane systematic review (27) assessed the effect on the caesarean delivery rate of partogram during labour compared with no partogram. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 6. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 6: Partogram Compared With No Partogram During Labour in Women With Spontaneous Term Pregnancies

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Lavender et al, 2012 (27)	RCT	Up to June 2012	Partogram use during labour	No partogram	Population included women with spontaneous term pregnancy	10/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; RCT, randomized controlled trial.

In the meta-analysis by Lavender et al, (27) 2 RCTs contributed to the comparison of partogram during labour compared with no partogram in women with spontaneous term pregnancies. The meta-analysis included 804 labouring women in the partogram group and 786 in the no-partogram group. The caesarean delivery rate did not differ between groups (RR, 0.64; 95% CI, 0.24–1.70), but the I^2 value was 93%, indicating high heterogeneity. Subgroup analysis for high and low resource settings indicated that compared to no partogram, using a partogram during labour in low-resource settings reduced the caesarean delivery rate by 62% (RR, 0.38; 95% CI, 0.24–0.61; 1 trial; random effect; 434 women); the rate did not differ between groups in high-resource settings (RR, 1.03; 95% CI, 0.82–1.28; random effect; 1 trial; 1,156 women).

Package of Care for Active Management During Labour

One Cochrane systematic review (23) assessed the effect on the caesarean delivery rate of following a predefined package of interventions during labour compared to routine care in low-risk women. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 7. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 7: Package of Care for Active Management in Labour Compared With Routine Care in Low-Risk Women

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Brown et al, 2008 (23)	RCT	Up to February 28, 2008	A predefined interventionist package of active management during childbirth	Routine care as per care setting, local labour-ward management protocols, and the variable practice of clinicians	Predefined package of care had to include more than 2 of the key elements traditionally described as active management of labour including routine amniotomy and early augmentation with oxytocin; strict criteria for the diagnosis of labour, abnormal progress in labour, and fetal compromise; continual presence of a midwife/nurse during labour; peer review of assisted deliveries; and progress of labour plotted using a graph) Low-risk population	10/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; RCT, randomized controlled trial.

In the meta-analysis by Brown et al, (23) 7 RCTs contributed to the comparison of a package of care for active management in labour compared with routine care (no package of care) in low-risk women. The meta-analysis included 2,573 labouring women in the package of care group and 2,817 in the routine care group. The caesarean delivery rate did not differ between groups (RR, 0.88; 95% CI, 0.77–1.01; I^2 = 21%; fixed effect). The authors of the meta-analysis noted that 1 RCT (37) had a 35% drop-out rate in both treatment groups combined post-randomization but before the onset of labour. This study (37) was given the most weight in the meta-analysis. When a sensitivity analysis was completed removing this study, the results indicated a statistically significant decrease in caesarean delivery rate in the package of care group compared with the routine care group (RR, 0.77; 95% CI, 0.63–0.94; I^2 = 0%; fixed effect; 6 trials; 3,475 women). Nevertheless, the authors (37) noted that while a large number of post-randomization exclusions occurred in the trial, outcome data were provided for these exclusions, and there was a < 1% attrition rate for this outcome. Because of this, the nonsignificant findings of the meta-analysis, including all the 7 studies, were accepted for this review.

Oxytocin for Induction of Labour

One Cochrane systematic review (24) assessed the effect on the caesarean delivery rate of oxytocin for the treatment of slow progress in the first stage of spontaneous labour. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 8. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 8: Oxytocin to Augment Labour in Low-Risk Women

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Bugg et al, 2011 (24)	RCT	Up to June 5, 2011	Intravenous oxytocin to augment labour (women who commenced oxytocin for poor progress in the active stage of labour)	Placebo or no treatment with oxytocin or in whom the treatment with oxytocin was delayed	Low-risk pregnant women who were slow to progress in the first stage of spontaneous labour at 37–42 weeks and a singleton fetus presenting vertex Women with a previous caesarean delivery or who were induced with oxytocin from the outset were excluded	10/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; RCT, randomized controlled trial.

In the meta-analysis by Bugg et al, (24) 3 RCTs contributed to the comparison of intravenous oxytocin compared with no treatment in low-risk women. The meta-analysis included 65 labouring women in the intravenous oxytocin group and 73 in the no-treatment group. The caesarean delivery rate did not differ between groups (RR, 0.84; 95% CI, 0.36–1.96; I^2 = 0%; fixed effect).

Gestational Diabetes

One systematic review (34) assessed the effect on the caesarean delivery rate of gestational diabetes mellitus (GDM) diagnosed by either the WHO or the International Association of the Diabetes in Pregnancy Study Group (IADPSG) criteria. The characteristics of this systematic

review and its AMSTAR score (19) are reported in Table 9. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 9: Gestational Diabetes Mellitus and Caesarean Delivery

Author, Year	Study Design Included	Search Dates	Cohort 1	Cohort 2	Other	AMSTAR Score
Wendland et al, 2012 (34)	Cohort studies (retrospective and prospective)	Up to March 15, 2011	GDM diagnosed by WHO and/or IADPSG criteria	Women without GDM	—	9/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; GDM, gestational diabetes mellitus, IADPSG, International Association of the Diabetes in Pregnancy Study Group; NA, not applicable; WHO, World Health Organization.

In the meta-analysis by Wendland et al, (34) 5 cohort studies (4 prospective and 1 retrospective) contributed to the evaluation of GDM and caesarean delivery. Compared to women without GDM, women diagnosed with GDM using the WHO criteria had a 37% higher risk of having a caesarean delivery (RR, 1.37; 95% CI, 1.24–1.51; random effects model; 4 trials; 30,045 women). The I^2 value was 29%, indicating low heterogeneity across the 4 trials using the WHO criteria. Women diagnosed with GDM using the IADSG criteria had a 23% higher risk of having a caesarean delivery compared to a non-GDM cohort (RR, 1.23; 95% CI, 1.01–1.51; random effects model; 3 trials; 33,788 women). The I^2 value was 93%, indicating high heterogeneity across the 3 studies using the IADPSG criteria. In both analyses, women with GDM had a statistically significant higher risk of having a caesarean delivery compared to women without GDM.

Glycemic Control

One Cochrane systematic review (29) assessed the effect on the caesarean delivery rate of different intensities of glycemic control (tight versus very tight) in low-risk pregnant women with pre-existing type 1 or 2 diabetes. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 10. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 10: Tight-Moderate Glycemic Control Compared With Loose Glycemic Control in Low-Risk Women With Pre-existing Type 1 or 2 Diabetes

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Middleton et al, 2012 (29)	RCT, nRCT	Up to May 24, 2012	Tight-moderate glycemic control (fasting blood glucose ≤ 6.7 mmol/L)	Loose glycemic control (fasting blood glucose 6.7–8.9 mmol/L)	Population included pregnant women with pre-existing type 1 or 2 diabetes	10/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; nRCT, nonrandomized controlled trial; RCT, randomized controlled trial.

In the meta-analysis by Middleton et al, (29) 1 RCT contributed to the comparison of tight-moderate glycemic control with loose glycemic control in women with pre-existing type 1 or 2 diabetes. This study was completed in Saudi Arabia. (38) Tight glycemic control in this study was defined as a target of 5.6 mmol/L or below (n = 16 women), moderate glycemic control was defined as a target of 5.6 to 6.7 mmol/L (n = 29 women) and loose glycemic control was defined

as a target of 6.7 to 8.9 mmol/L (n = 15 women). (38) The study did not specify whether blood glucose was fasting, but the authors assumed that it was. (29) For the purposes of meta-analysis, the tight and moderate glycemic control groups were combined and compared to the loose glycemic control group (45 labouring women in the tight-moderate glycemic control group and 15 in the loose glycemic control group). Compared to women with loose glycemic control, women with tight-moderate glycemic control had a 72% decrease in caesarean delivery rate (RR, 0.28; 95% CI, 0.10–0.78; fixed effect). (29)

Maternal Age

One systematic (22) review assessed the effect on the caesarean delivery rate of advanced maternal age among nulliparous and multiparous women. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 11. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 11: Maternal Age and Caesarean Delivery

Author, Year	Study Design Included	Search Dates	Cohort 1	Cohort 2	Other	AMSTAR Score
Bayrampour and Heaman, 2010 (22)	Cohort, case control	January 1, 1995, to March 1, 2008	35 years or older	34 years or younger	Nulliparous and multiparous women with singleton pregnancies Compared total caesarean deliveries, including emergency or elective Studies done in developed countries only	6/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews.

In the meta-analysis by Bayrampour and Heaman, (22) 21 RCTs contributed to the comparison of maternal age 35 years or older with maternal age 34 years and younger. The relative risk for caesarean delivery in nulliparous women 35 years of age and older compared with those 34 years of age and younger was 1.44 to 2.27 (I^2= 91%), estimated from 12 studies (random effects model) and a total sample size of 561,352 women. In 25,598 older multiparas women, the relative risk for caesarean delivery was 1.63 to 2.78 (I^2 = 94%). Due to high heterogeneity in both estimates, a pooled effect estimate was not reported. Most studies in the analysis reported the total caesarean delivery rate, which included both emergency and elective deliveries. Fifteen of the 21 studies adjusted for potential confounders, including sociodemographic factors (race/ethnicity, education, parity, and marital status), smoking, maternal height, assisted conception, duration of labour, induced labour, fetal distress, epidural anesthesia, and physician and hospital factors. Each study controlled for different confounder variables; prepregnancy body mass, gestational age, birth weight, history of chronic disease, and pregnancy complications were the most frequently controlled.

Women's Preference for Caesarean Delivery

One systematic review (28) assessed the effect of women's preference for a caesarean delivery compared with vaginal delivery. This study also reported the proportion of women who preferred a caesarean delivery by subgroup according to study characteristics and women's

characteristics. A random-effect metaregression analysis was used to determine which variables were significantly associated with a caesarean delivery preference. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 12. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 12: Women's Preference for a Caesarean Delivery Compared With a Vaginal Delivery

Author, Year	Study Design Included	Search Dates	Cohort	AMSTAR Score
Mazzoni et al, 2011 (28)	Cross-sectional, cohort	Up to March 2009	Study determined the preference for caesarean delivery in subgroups according to study characteristics (study region, country income level, and year of study) and women's characteristics (history of previous caesarean delivery, parity, and period of reproductive life when preference was evaluated)	8/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews.

In the meta-analysis by Mazzoni et al, (28) 32 cross-sectional and 6 cohort studies contributed to the analysis of women's preference for a caesarean delivery. Of 19,403 women, 15.6% (95% CI, 12.5%–18.9%) preferred a caesarean delivery; the I^2 was 97.3% for this overall estimate. Of 616 nulliparous women, 10.2% (95% CI, 6.8%–14.1%) preferred a caesarean delivery. Of 12,677 multiparous women, 17.5% (95% CI, 13.4%–21.8%) preferred a caesarean delivery. Of women who had had a previous caesarean delivery (n = 4,010) 29.4% preferred a caesarean delivery (95% CI, 24.4%–34.8%), compared with 10.1% (95% CI, 7.5%–13.1%) of women who had not had a previous caesarean delivery (n = 13,922). The rate for the United States and Canada combined, regardless of parity or previous caesarean delivery experience, was 16.8% (95% CI, 7.9%–28.1%; 6 nonrandomized controlled trials; I^2 ranged from 82.2% to 98.5%). In the multivariate metaregression analysis, after adjusting for other characteristics, women with a previous caesarean delivery and women from middle-income countries were significantly more likely to prefer a caesarean delivery compared to women without a history of caesarean delivery and women from high-income countries.

Maternal Body Mass Index

One systematic review (32) assessed the effect on the caesarean delivery rate of maternal body mass index (BMI). The characteristics of this systematic review and its AMSTAR (19) rating are reported in Table 13. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 13: Maternal BMI as a Risk Factor for Caesarean Delivery in Low-Risk Women

Author, Year	Study Design Included	Search Dates	Cohort 1	Cohort 2	Other	AMSTAR Score
Poobalan et al, 2009 (32)	Retrospective and prospective cohort	1966 to 2007	Overweight (BMI 25–30 kg/m^2) Obese (BMI 30–35 kg/m^2) Morbidly obese (BMI > 35 kg/m^2)	Normal weight (BMI 20–25 kg/m^2)	Nulliparous singleton pregnancy All elective caesarean deliveries	7/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; BMI, body mass index.

In the meta-analysis by Poobalan et al, (32) 11 cohort studies (7 retrospective, 4 prospective) contributed to the analysis of the association between maternal BMI ≥ 25 kg/m^2 and caesarean delivery. Five studies were completed in the United States, 3 in the United Kingdom, 1 in Denmark, 1 in Sweden, and 1 in France. Compared to mothers with a normal BMI, overweight women were at 1.5 times higher risk of caesarean delivery (odds ratio, 1.5; 95% CI, 1.48–1.58; 10 studies; random effect; 43,025 women), obese women were at 2.3 times higher risk (odds ratio, 2.26; 95% CI, 2.04–2.51; random effect; 11 studies; 20,419 women) and morbidly obese women were at 3.4 times higher risk (odds ratio, 3.38; 95% CI, 2.49–4.57; random effect; 4 studies; 1,874 women).

Assisted Reproduction

One systematic review (31) assessed the effect on the caesarean delivery rate of in vitro fertilization (IVF)/intracytoplasmic sperm injection (ICSI) assisted pregnancy. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 14. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 14: Women Who Had an IVF/ICSI-Assisted Pregnancy Compared With Women Who Had Spontaneous Conception Pregnancies

Author, Year	Study Design Included	Search Dates	Cohort 1	Cohort 2	Other	AMSTAR Score
Pandey et al, 2012 (31)	Matched and unmatched cohort studies	1978–2011	IVF/ICSI assisted conception	Spontaneous conception	Singleton pregnancies Many women delivered at less than 37 weeks	9/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; IVF, in vitro fertilization; ICSI, intracytoplasmic sperm injection.

In the meta-analysis by Pandey et al, (31) 17 cohort studies (14 matched and 3 unmatched) contributed to the comparison of assisted reproduction (IVF/ICSI) pregnancies with spontaneous pregnancies. The meta-analysis included 18,186 IVF/ICSI conceptions and 584,938 spontaneous conceptions. Compared with pregnancies via spontaneous conception, women who conceived using IVF/ICSI were 56% more likely to have a caesarean delivery (RR, 1.56; 95% CI 1.51–1.60; I^2 = 80%; fixed effect; 17 trials; 603,124 women). On subgroup analysis, this finding remained statistically significant, with a 47% increase in matched cohort studies (RR, 1.47; 95% CI, 1.38–1.56; fixed effect; 14 trials; 13,959 women) and a 59% increase in unmatched cohort studies (RR, 1.59; 95% CI, 1.54–1.64; fixed effect; 3 trials; 96,606 women). However, the I^2 values for the matched and unmatched cohort subgroup analyses were 78% and 86%, respectively. Sixteen of the 17 studies included preterm deliveries (< 37 weeks). It was not possible to isolate the caesarean delivery rate in the IVF/ICSI population with term pregnancies.

Group Prenatal Care

One systematic review (33) assessed the effect on the caesarean delivery rate of group prenatal care in low-risk women compared with individual prenatal care. The characteristics of this systematic review and its AMSTAR score (19) are reported in Table 15. Limitations in the AMSTAR rating are reported in Appendix 2.

Table 15: Group Prenatal Care Compared With Individual Prenatal Care in Low-Risk Women

Author, Year	Study Design Included	Search Dates	Intervention	Control	Other	AMSTAR Score
Ruiz-Mirazo et al, 2012 (33)	RCT, nRCT	Up to June 5, 2011	Group prenatal care	Individual prenatal care	Low-risk pregnant women Nulliparous and multiparous	7/11

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; nRCT, nonrandomized controlled trial; RCT, randomized controlled trial.

In the systematic review by Ruiz-Mirazo et al, (33) 1 RCT reported on the outcome of caesarean delivery. The RCT by Jafari et al (39) was a cluster RCT; 320 women received group prenatal care and 308 received individual prenatal care. The study was completed in Iran. Compared with individual prenatal care, women who received group prenatal care had a 20% reduction in caesarean delivery (RR, 0.80; 95% CI 0.65–0.99; fixed effect; 1 trial; 628 women).

Summary

A summary of the factors affecting the likelihood of caesarean delivery is reported in Table 16. Elective induction policies and group prenatal care decreased the likelihood of caesarean delivery in low-risk women.

Table 16: Summary of Factors Affecting the Likelihood of Caesarean Delivery in Low-Risk Women

Increases Likelihood	Decreases Likelihood	No Influence[a]
Electronic fetal monitoring (cardiotocography)	Labour induction policy[f]	Epidural analgesia during labour
Loose glycemic control[b]	Group prenatal care[g]	Oxytocin for induction of labour
Gestational diabetes		Instrument choice for assisted vaginal delivery
Assisted reproduction[c]		Partogram to monitor progress of labour[h]
Maternal body mass index[d]		Package of care for active management during labour
Women's preference for caesarean delivery		
Maternal age[e]		

[a]No statistical difference between treatment (factor) and comparator.
[b]In mothers with type 1 and 2 diabetes.
[c]In vitro fertilization/intracytoplasmic sperm injection.
[d]Women with body mass index ≥ 25 kg/m^2.
[e]In women ≥ 35 years of age.
[f]In women at 41 weeks' gestation or beyond.
[g]One randomized controlled trial.
[h]In high resource settings.

A forest plot for the outcome of caesarean delivery for group prenatal care is provided in Appendix 3. The GRADE quality of evidence is reported in Appendix 2: the quality of evidence for an elective induction policy at 41 weeks compared with expectant management was high, and the quality of evidence for group prenatal care compared with individual care was low.

Provincial Rate Review

Research Methods

We used clinical and administrative data on caesarean deliveries in Ontario to evaluate potential rate variation across the province and whether such variation could be attributed to practice differences or maternal factors. At each stage of analysis, the expert panel provided input on the findings and guidance on subsequent analyses.

Provincial Caesarean Delivery Rates

The Canadian Institute for Health Information Discharge Abstracts Database provides data on all hospitalizations in Ontario, including information on deliveries that occur in hospitals. Clinical records for mothers and infants have been linked at the Institute for Clinical Evaluative Sciences (ICES) to create a unified hospital record in the Mother-Baby Linked Database (MOMBABY) (40) of delivering mothers and their newborns. The dataset includes information on maternal gestational age at admission and at delivery, newborn gestational age (in weeks) at delivery and flags that identify multiple births and stillbirths. These data were used to conduct a preliminary review of caesarean delivery rates in Ontario in calendar years 2007–2011 for all women in Ontario; women with full-term, singleton, vertex presentations and no evidence of previous caesarean delivery; women with a breech presentation; and women with a history of caesarean delivery.

Data were stratified by age group (< 21 years, 21–34 years, 35+ years), and rates were prepared by LHIN, rural versus urban location of the mother, and hospital maternal level of care as defined by the Provincial Centre for Maternal and Child Health (PCMCH). Level of care is intended to categorize hospitals according to the intensity of maternal and infant care and is based on staffing levels, staff availability, and onsite intensive care provision. Levels are ordered from low to high: 1, 2, 2+, 3 modified, and 3. Level 3 hospitals can provide care for deliveries with the most risk and infants with the most complex illnesses. (41)

Provincial Caesarean Delivery Rates Among Low-Risk Women

The preliminary analyses were presented to the expert panel, and based on their feedback, the cohort was limited to low-risk women and the data source changed from the ICES MOMBABY dataset (40) to the clinical database from the Better Outcomes and Registry Network (BORN) Ontario. (42) BORN integrates data on prenatal care, delivery, and postpartum care in a mother-child registry. Data are collected from a number of sources and include information on maternal characteristics, labour, birth, and early newborn care. Deliveries can be classified by Robson group (see below), and delivering hospitals can be classified by delivery volume (for any given year), PCMCH level of care, and hospital peer group (small community, large community, academic).

For the BORN analyses, the cohort was limited, based on information from hospital records,[1] to women who were classified as part of Robson groups 1, 2a, and 2b. (43) Robson groups represent a standard classification system of 10 mutually exclusive and totally inclusive classification categories for deliveries:

1. Nulliparous, singleton, cephalic, term, ***spontaneous labour***

2a. Nulliparous, singleton, cephalic, term, ***induced labour***

2b. Nulliparous, singleton, cephalic, term, ***caesarean delivery before labour***

[1]Care received in an office setting—possibly including induction methods—cannot be captured reliably in hospital records. Some women may have been misclassified as being in spontaneous labour when presenting to hospital after having received some type of induction in a physician's office.

Caesarean delivery rates for 5 fiscal years were prepared by Robson group and reported by fiscal year (2007/2008 to 2011/2012) at the provincial and LHIN levels. Rates were also compared across a set of maternal characteristics (maternal age, neighbourhood income quintile, neighbourhood educational attainment, rural/urban status, and primary language).

Provincial Caesarean Delivery Rates Among a Very-Low-Risk Subgroup of Women

Based on the findings of the second set of analyses, the expert panel recommended a follow-up analysis. Caesarean delivery rates in a further refined subgroup of women were compared at the provincial, LHIN, and hospital levels. Five years of cumulative data (fiscal years 2007/2008 to 2011/2012) on caesarean delivery rates among women who delivered in hospital were prepared for a more homogeneous group of women:

- Robson 1, 2a, and 2b
- aged 20 to 34 years
- no maternal medical problems
- no obstetrical complications

Women with the following indications for caesarean delivery were excluded: cord prolapse, diabetes, fetal anomaly, placental abruption, placenta previa, pre-eclampsia, other fetal health problem, other maternal health problem.

The objective of creating a very low-risk cohort was to eliminate a number of indications for caesarean delivery, thereby reducing or limiting potential clinical reasons for variation in rates. The following 5 indications for caesarean delivery were not incorporated as cohort exclusions: failure of descent/progress (dystocia); intrauterine growth restriction or small for gestational age; large for gestational age; non-reassuring fetal status; and premature rupture of membranes.

Rates were prepared by LHIN; hospital PCMCH level of care (1, 2, 2+, modified 3, 3); hospital birth volume in 2011/2012 (≤ 100, 101–250, 251–500, 501–1,000, 1,001–2,499, 2,500–4,000, >4,000); and by hospital, with rates grouped by PCMCH level of care and birth volume.

Results of Provincial Rate Review

Provincial Caesarean Delivery Rates

Caesarean delivery rates in Ontario for all women who deliver in hospital were stable over time for the overall population and within age strata. Rates were lowest in women under age 20; women aged 35 and older had approximately twice the caesarean delivery rate as the youngest age group. The overall provincial caesarean delivery rate for 2007 to 2011 hovered around 28% (Table 17). The expert panel felt there was little evidence of clinically important variation in caesarean delivery rates by LHIN or over time.

Table 17: Caesarean Delivery Rates Among Ontario Women Who Delivered in Hospital, by Age and Calendar Year

Age Group	2007		2008		2009		2010		2011	
	%	N	%	N	%	N	%	N	%	N
≤ 20	18.1	7,769	18.3	7,766	17.6	7,510	17.3	7,167	18.4	6,631
21–34	26.3	99,092	26.8	99,080	26.6	98,489	26.7	96,550	26.6	96,807
35+	35.9	28,039	37.7	28,473	37.3	28,590	37.6	29,066	37.6	29,152
Total	**27.8**	**134,900**	**28.6**	**135,319**	**28.4**	**134,589**	**28.6**	**132,783**	**28.6**	**132,590**

Abbreviations: ICES, Institute for Clinical Evaluative Sciences; MOMBABY, Mother-Baby Linked Database.
Source: ICES-MOMBABY dataset. (40)

Provincial Caesarean Delivery Rates Among Low-Risk Women

Based on expert panel consensus, the cohort was restricted to a low-risk group consisting of women classified as Robson group 1, 2a, and 2b when presenting to hospital. Provincial rates were reported for 5 fiscal years to assess the stability of the rates over time. Similar to what was seen in the preliminary analysis, rates and relative proportions across Robson groups were consistent over time (Table 18). As expected, rates for women in Robson group 2b were close to 100%, but this group of women accounted for only about 3% of total deliveries. Women in Robson group 2a had twice the rate of caesarean deliveries that women in Robson group 1 did. However, this finding should be interpreted with caution, because Robson class is established at hospital presentation. Women who undergo induction in an office setting may be classified as being in spontaneous labour (Robson 1) when the present to hospital, but should actually be classified as having been induced (Robson 2a).

Table 18: Caesarean Delivery Rates Among Ontario Women Who Delivered in Hospital, by Robson Group (1, 2a, 2b, and Combined) and Fiscal Year

Robson Group	2007/2008		2008/2009		2009/2010		2010/2011		2011/2012	
	%	N	%	N	%	N	%	N	%	N
1	15.1	31,180	15.5	32,116	14.6	32,212	14.6	31,285	15.4	31,918
2a	30.3	15,153	31.1	15,970	30.6	16,429	30.4	15,419	30.7	15,348
2b	100.0	1,519	99.9	1,650	100.0	1,549	100.0	1,567	100.0	1,628
Combined	**22.6**	**47,852**	**23.3**	**49,736**	**22.5**	**50,190**	**22.4**	**48,271**	**23.0**	**48,894**

Abbreviations: BORN, Better Outcomes and Registry Network.
Source: BORN Ontario. (42)

BORN data were also used to evaluate variations in caesarean delivery rates across a number of maternal demographic factors, including maternal age, neighbourhood income quintile, neighbourhood educational attainment, rural/urban status, and primary language. As expected, higher maternal age was significantly associated with an increase in caesarean delivery rates ($P < 0.001$), but the remaining demographic factors showed no consistent significant association with caesarean delivery rates (Table 19).

Table 19: Caesarean Delivery Rates for Robson Groups 1 and 2a by Maternal Characteristics (2011/2012)

Characteristic	Groups	Robson 1		Robson 2a	
		%	N	%	N
Maternal age	<21 years	9.7	3,136	20.2	1,314
	21–34 years	14.9	25,062	29.7	11,805
	35–39 years	22.6	3,098	40.5	1,779
	40+ years	28.4	592	48.2	446
	***P* value**	<0.001	—	<0.001	—
Neighbourhood income quintile	1	15.6	6,182	31.7	2,981
	2	15.4	6,176	31.2	2,980
	3	15.5	6,178	30.1	2,979
	4	14.9	6,194	30.7	2,989
	5	15.5	6,163	29.8	2,971
	***P* value**	0.83	—	0.48	—
Neighbourhood educational attainment	Less than high school	15.5	5,640	30.3	2,840
	High school[a]	15.3	15,014	31.0	7,253
	Postsecondary	15.3	10,505	30.4	4,945
	***P* value**	0.55	—	0.73	—
Rural/urban status	Rural	15.0	3,507	27.5	1,831
	Urban	15.4	28,276	31.1	13,473
	***P* value**	0.53	—	0.001	—
Primary language	English	15.6	26,031	30.7	12,892
	French	17.6	477	30.7	192
	Other	14.0	2,785	29.3	1,057
	***P* value**	**0.04**	**—**	**0.64**	**—**

Abbreviations: BORN, Better Outcomes and Registry Network.
[a]Did not complete postsecondary.
Source: BORN Ontario, mothers who delivered in hospital. (42)

The analysis also included an evaluation of regional variation in caesarean delivery rates for women in Robson groups 1 and 2a to assess whether there was any clinically important variation in rates across LHINs. Table 20 presents the rates for women in Robson groups 1 and 2a for 5 fiscal years by LHIN. The rates for women in Robson group 2b were close to 100% in all LHINs and over time, and so are not included in the table.

Table 20: Caesarean Delivery Rates for Robson Groups 1 and 2a by LHIN (2007/2008–2011/2012)

LHIN	2007/2008		2008/2009		2009/2010		2010/2011		2011/2012	
	1	2a	1	2a	1	2a	1	2a	1	2a
1	12.2	27.2	11.9	27.0	13.1	29.0	12.3	29.6	14.5	28.3
2	11.7	24.7	12.0	25.9	10.1	24.0	10.4	24.0	10.3	25.2
3	14.1	29.8	12.8	30.7	12.9	27.1	14.9	29.9	14.1	29.6
4	17.8	32.8	16.2	33.7	15.0	30.7	12.4	28.8	14.1	26.8
5	14.3	32.5	18.7	39.9	18.8	36.5	18.6	37.6	20.7	37.9
6	12.9	28.3	13.4	26.2	12.5	28.5	12.5	30.4	11.9	29.8
7	16.5	32.4	15.3	32.3	16.4	32.5	15.8	31.0	16.3	32.8
8	16.6	31.0	17.1	31.3	15.1	28.7	14.3	30.4	16.3	29.9
9	15.1	34.1	17.8	33.0	15.7	37.2	16.1	32.2	16.9	33.1
10	13.9	29.5	14.8	32.4	16.4	310	16.3	30.3	16.4	33.3
11	15.0	25.7	16.3	33.4	12.8	28.5	15.1	31.2	160	29.3
12	18.4	32.2	16.5	30.9	17.1	36.6	16.2	30.0	18.8	35.3
13	12.8	31.5	14.7	30.5	14.0	32.2	14.5	30.5	14.5	32.6
14	18.7	33.7	12.2	27.8	14.3	33.9	16.7	34.4	14.5	34.5
Ontario	**15.1**	**30.3**	**15.5**	**31.1**	**14.6**	**30.6**	**14.6**	**30.4**	**15.4**	**30.7**

Abbreviation: BORN, Better Outcomes and Registry Network; LHIN, Local Health Integration Network.
Source: BORN Ontario, mothers who delivered in hospital. (42)

Rates across LHINs varied by approximately 10% (from lowest to highest rates) for women in both Robson groups, but the expert panel did not feel that this variation was clinically important, or that it represented practice variation. The large geographic units and potentially unaccounted differences (by region) in clinically important maternal factors were believed to explain the observed variation, as well as hospital-level differences related to catchment, delivery volumes, and practice patterns. For this reason, the expert panel felt that data at the hospital level were needed to answer the research question.

Provincial Caesarean Delivery Rates Among a Very-Low-Risk Subgroup of Women

The final set of analyses was constructed for a more homogeneous, lower-risk group of women and reported at the LHIN and hospital levels. The rationale was that observed variation in this cohort at the regional or hospital level could more easily be interpreted. Data for 5 fiscal years were combined to ensure sufficient cell size.

LHIN

LHIN variation in caesarean delivery rates in this very-low-risk cohort of women mirrored what was observed in previous analyses (Table 21). While the difference between the highest and lowest LHIN rates was striking, the difference across the remaining LHINs did not raise concerns among the expert panel.

Table 21: Caesarean Delivery Rates for Robson Groups 1 and 2a in a Very-Low-Risk Cohort[a] by LHIN (2007/2008–2011/2012)

LHIN	Robson 1		Robson 2a		Combined (1, 2a, 2b)	
	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N
1	10.9 (9.7–12.1)	2,740	27.1 (24.7–29.6)	1,335	16.8 (15.6–17.9)	4,103
2	6.6 (5.8–7.5)	3,267	16.5 (14.4–18.8)	1,114	9.7 (8.8–10.6)	4,409
3	12.4 (11.4–13.3)	4,705	26.8 (24.8–28.9)	1,772	17.0 (16.1–17.9)	6,528
4	12.4 (11.7–13.2)	7,610	26.6 (25.0–28.2)	3,027	17.1 (16.4–17.9)	10,727
5	16.2 (15.4–17.1)	6,726	33.7 (31.6–35.9)	1,864	20.8 (19.9–21.6)	8,669
6	10.0 (9.4–10.6)	9,633	26.3 (24.7–27.9)	2,954	14.3 (13.6–14.9)	12,650
7	13.2 (12.5–13.9)	9,640	28.1 (26.4–29.7)	2,820	17.4 (16.7–18.0)	12,585
8	13.5 (12.9–14.1)	13,958	27.6 (26.2–29.0)	4,022	17.9 (17.3–18.4)	18,249
9	14.1 (13.5–14.9)	9,659	30.1 (28.4–31.9)	2,753	18.8 (18.1–19.4)	12,575
10	14.1 (12.9–15.5)	2,878	29.1 (26.3–32.2)	947	18.4 (17.2–19.7)	3,851
11	9.7 (9.0–10.5)	5,975	23.5 (21.4–25.7)	1,512	13.3 (12.5–14.1)	7,554
12	14.4 (12.9–16.0)	2,040	28.1 (24.7–31.7)	661	18.4 (16.0–19.9)	2,721
13	12.1 (10.9–13.2)	3,151	26.5 (24.1–29.1)	1,245	17.3 (16.2–18.4)	4,456
14	14.5 (12.3–16.9)	938	35.9 (30.2–41.8)	276	19.6 (17.4–22.0)	1218
Provincial rate	**12.6 (12.3–12.8)**	**82,920**	**27.4 (26.9–27.9)**	**26,302**	**17.0 (16.7–17.2)**	**110,295**

Abbreviations: BORN, Better Outcomes and Registry Network; CI, confidence interval; LHIN, Local Health Integration Network.
[a]The cohort included women aged 20–34 years with no maternal medical or obstetrical problems and without the following indications for caesarean delivery: cord prolapse, diabetes, fetal anomaly, placental abruption, placenta previa, pre-eclampsia, or other fetal or maternal health problems.
Source: BORN Ontario, mothers who delivered in hospital. (42)

PCMCH Level of Care

Caesarean delivery rates by PCMCH level of care for hospitals showed very little variation. Level 1 hospital rates were slightly higher than the provincial rate and level 2 hospital rates were slightly lower than the provincial rate. The variation was consistent for rates within Robson groups and for the entire cohort. Even though variations were statistically significant, the expert panel did not consider them to be clinically important (Table 22).

Table 22: Caesarean Delivery Rates for Robson Groups 1 and 2a in a Very-Low-Risk Cohort[a] by PCMCH Level of Care (2007/2008–2011/2012)

PCMCH Level of Care	Robson 1		Robson 2a		Combined (1, 2a, 2b)	
	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N
1	14.8 (14.1–15.4)	12,001	31.9 (30.5–33.3)	4,297	20.0 (19.4–20.7)	16,450
2	11.6 (11.2–11.9)	34,887	25.3 (24.5–26.2)	10,443	15.5 (15.2–15.8)	45,742
2+	12.9 (12.5–13.4)	23,477	27.8 (26.8–28.9)	7,144	17.3 (16.9–17.8)	30,964
Modified 3	12.1 (11.2–13.0)	4982	27.7 (25.7–29.7)	1,964	17.3 (16.5–18.2)	7,019
3	12.8 (12.1–13.6)	7572	26.9 (25.2–28.7)	2,454	17.1 (16.3–17.8)	10,119
Provincial rate	**12.6 (12.3–12.8)**	**82,919**	**27.4 (26.9–27.9)**	**26,302**	**17.0 (16.7–17.2)**	**110,294**

Abbreviations: BORN, Better Outcomes and Registry Network; CI, confidence interval; PCMCH, Provincial Centre for Maternal-Child Health.
[a]The cohort included women aged 20–34 years with no maternal medical or obstetrical problems and without the following indications for caesarean delivery: cord prolapse, diabetes, fetal anomaly, placental abruption, placenta previa, pre-eclampsia, or other fetal or maternal health problems.
Source: BORN Ontario, mothers who delivered in hospital. (42)

Hospital Birth Volume

Caesarean delivery rates by hospital birth volume were also compared, and findings suggested that there was variation by birth volume, but only in lower-volume hospitals. When reviewing caesarean delivery rates for hospitals with volumes of less than 500 (≤ 100, 101–250, 251–500), there was a stepwise increase in rates as hospital birth volumes rose, and a comparison of confidence intervals suggested that rates differed. However, for hospitals with birth volumes of > 500 deliveries a year, there was no difference in caesarean delivery rates (Table 23).

Table 23: Caesarean Delivery Rates for Robson Groups 1 and 2a in a Very-Low-Risk Cohort[a] by Birth Volume (2007/2008–2011/2012)

Group	Robson 1		Robson 2a		Combined (1, 2a, 2b)	
	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N
≤ 100	7.6 (5.1–10.8)	367	30.8 (22.1–40.6)	104	14.0 (11.0–17.5)	478
101–250	13.6 (11.0–16.5)	627	32.9 (25.9–40.6)	167	18.3 (15.6–21.1)	800
251–500	18.2 (16.9–19.5)	3,300	37.8 (34.8–40.8)	1,017	23.4 (22.1–24.7)	4,350
501–1000	12.8 (12.1–13.5)	8,286	26.3 (24.8–27.8)	3,284	17.4 (16.7–18.1)	11,678
1001–2,499	11.9 (11.4–12.3)	21,119	26.7 (25.7–27.7)	7,455	16.5 (16.1–16.9)	28,832
2,500–4,000	12.9 (12.5–13.3)	27,414	26.9 (25.9–27.9)	7,955	16.9 (16.5–17.3)	35,715
4,000+	11.9 (11.5–12.3)	21,804	27.6 (26.5–28.7)	6,320	16.4 (15.9–16.8)	28,439
Provincial rate	**12.6 (12.3–12.8)**	**82,917**	**27.4 (26.9–27.9)**	**26,302**	**17.0 (16.7–17.2)**	**110,292**

Abbreviations: BORN, Better Outcomes and Registry Network; CI, confidence interval.
[a]The cohort included women aged 20–34 years with no maternal medical or obstetrical problems and without the following indications for caesarean delivery: cord prolapse, diabetes, fetal anomaly, placental abruption, placenta previa, pre-eclampsia, or other fetal or maternal health problems.
Source: BORN Ontario, mothers who delivered in hospital. (42)

Hospital

Hospital-specific data within PCMCH level-of-care classifications and birth volumes were compared to see if differences in hospital-specific rates could be attributed to either of these factors. The intention was to determine whether there was significant variation in caesarean delivery rates across the province and not necessarily to identify hospitals with high and low rates; a number was assigned to each hospital to avoid naming them.

Hospital-specific rates ranged from 4.5% to 35.5%, and there were no obvious clusters by PCMCH level of care or birth volume (Figures 2 and 3).

Within PCMCH levels of care, there was wide variation between hospitals, suggesting that the hospital-specific variation across Ontario was not associated with level of care. This was true for all levels of care, but the differences were most pronounced at the lowest levels of care. The range from highest to lowest were as follows: level 1 hospitals, 5.2% to 35.5%; level 2 hospitals, 4.5% to 25.9%; level 2+ hospitals, 13.6% to 21.5%; modified level 3 hospitals, 14.9% to 18.7%; and level 3 hospitals, 6.3% to 21.7%.

Within birth volumes, there was a similarly striking variation in caesarean delivery rates between hospitals, again suggesting that hospital-specific variation was not due to factors related to birth volumes, such as experience or processes. This was true for all groupings of birth volumes. The range from the highest to lowest rates were as follows: hospitals with < 500 deliveries, 5.2% to 35.5%; hospitals with 501 to 2,499 deliveries, 4.8% to 28.8%; hospitals with 2,500 to 4,000 deliveries, 6.3% to 21.7%; hospitals with > 4,000 deliveries, 4.5% to 21.5%.

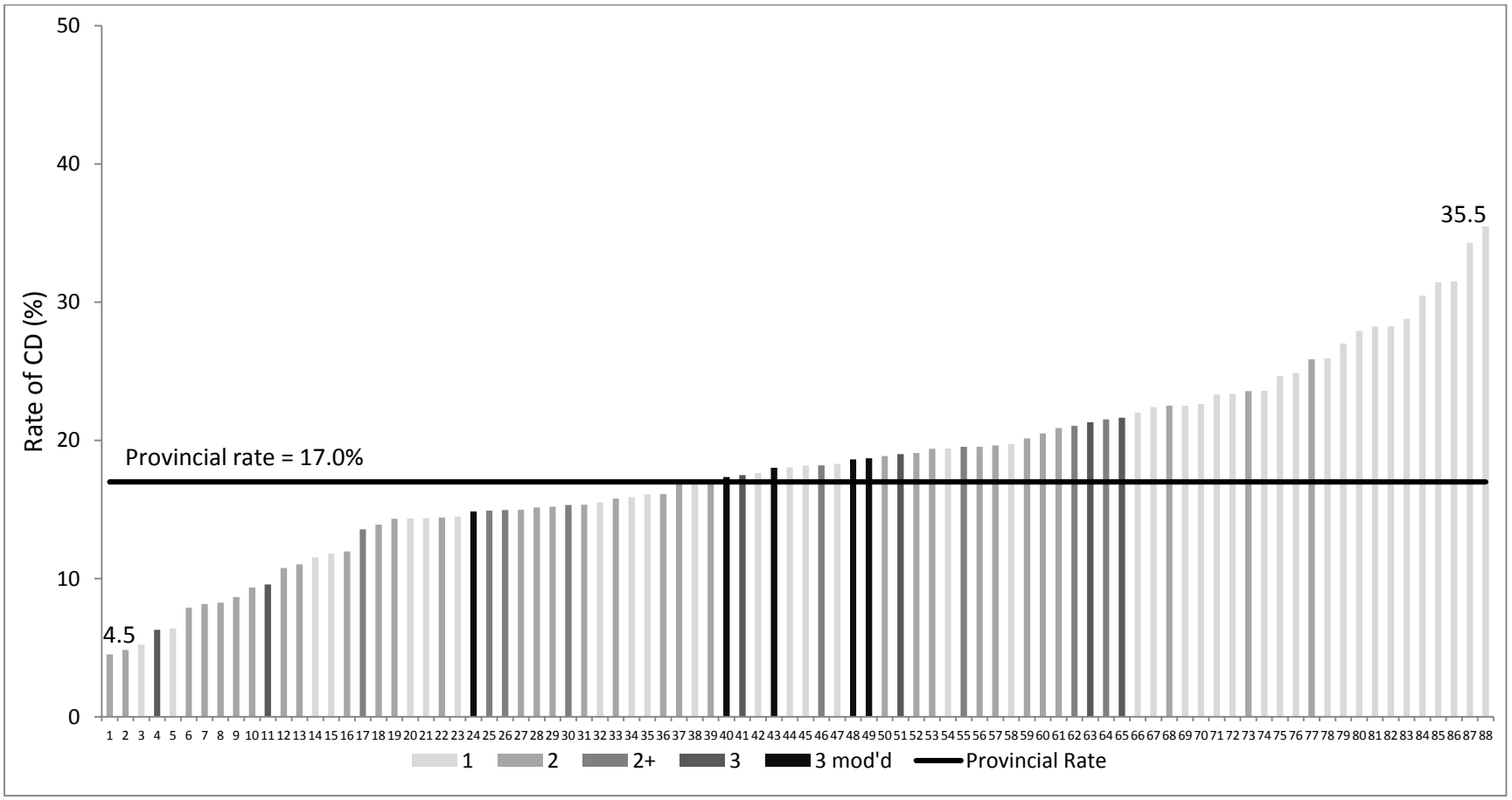

Figure 2: Caesarean Delivery Rate for a Very-Low-Risk Cohort of Ontario Women Who Delivered in Hospital, by Hospital and PCMCH Level of Care (2007/2008–2011/2012)[a]

Abbreviations: BORN, Better Outcomes and Registry Network; CD, caesarean delivery; PCMCH, Provincial Centre for Maternal-Child Health.
[a]The cohort included women aged 20–34 years with no maternal medical or obstetrical problems and without the following indications for caesarean delivery: cord prolapse, diabetes, fetal anomaly, placental abruption, placenta previa, pre-eclampsia, or other fetal or maternal health problems.
Source: BORN Ontario, mothers who delivered in hospital. (42)

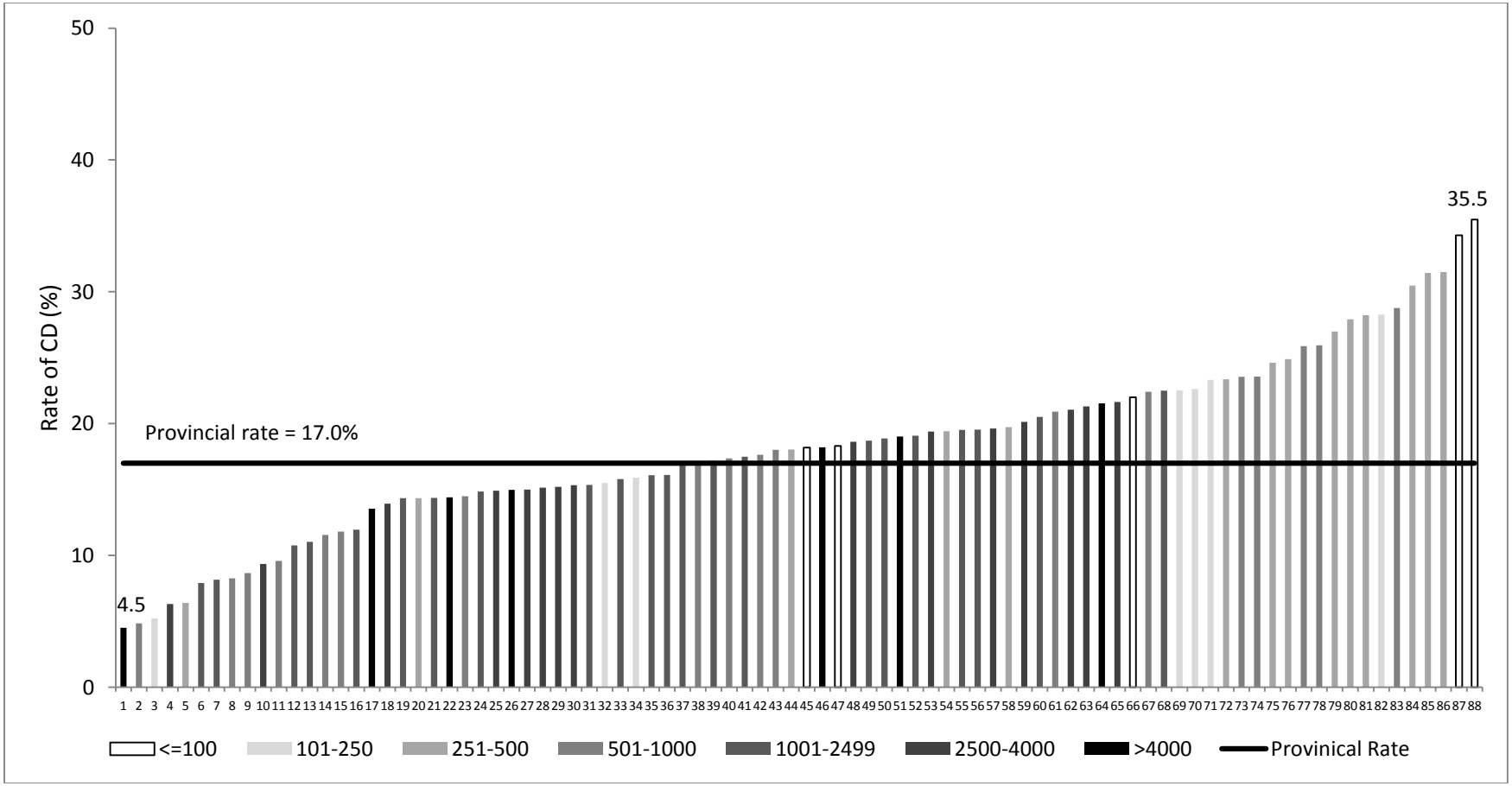

Figure 3: Caesarean Delivery Rate for a Very-Low-Risk Cohort of Ontario Women Who Delivered in Hospital, by Hospital and Birth Volume (2007/2008–2011/2012)[a]

Abbreviations: BORN, Better Outcomes and Registry Network.
[a]The cohort included women aged 20–34 years with no maternal medical or obstetrical problems and without the following indications for caesarean delivery: cord prolapse, diabetes, fetal anomaly, placental abruption, placenta previa, pre-eclampsia, or other fetal or maternal health problems.
Source: BORN Ontario, mothers who delivered in hospital. (42)

Panel Recommendations

After considering the evidence, the Expert Advisory Panel on Rate Variation in Caesarean Sections Across Ontario proposed the following recommendations for the consideration of the Ontario Health Technology Advisory Committee (OHTAC):

1. Health Quality Ontario, along with key partners, ought to develop and standardize a provincial elective induction policy for low-risk women.
2. The province should adopt a provincial standard in the caesarean delivery rate for low-risk women equal to a 20% relative decrease in the current provincial rate of 17.0%.
3. Data from the BORN registry ought to be available to hospitals for audit and quality-improvement initiatives to achieve the planned provincial standard rate for caesarean delivery in low-risk populations.
4. BORN, along with PCMCH, ought to provide audit and feedback to hospitals regarding their low-risk obstetrical population to support quality improvement in maternal-infant care.
5. LHINs ought to establish perinatal networks to support the management of labour and delivery in low-risk populations.
6. As part of its public reporting function, Health Quality Ontario ought to report annually on key performance indicators, including caesarean delivery and induction rates in low-risk women.

CONCLUSIONS

- Nine factors were significantly associated with either an increased or decreased likelihood of having a caesarean delivery, and 5 factors had no influence. Moderate-quality evidence supported the finding that in a low-risk population, an elective induction policy would significantly reduce the rate of caesarean deliveries compared with a policy of expectant management.
- The provincial caesarean delivery rate for a very-low-risk population was 17.0%. However, rates varied among Ontario hospitals (4.5% to 35.5%) and were independent of PCMCH level-of-care classifications or birth volumes (based on data for 2011/2012).
- An evaluation of an Ontario administrative database suggested that variation in caesarean delivery rates may be due to maternal age and/or obstetrical practice variation. There was no clinically or statistically significant variation in rates associated with neighbourhood income quintile, neighbourhood educational attainment, rural or urban status, or primary language.

EXISTING GUIDELINES FOR TECHNOLOGY

We searched the National Guideline Clearinghouse Registry (www.guidelines.ca) for grey literature that reported on factors affecting the likelihood of having a caesarean delivery. Search terms were "caesarean and cesarean," "caesarean section," and "cesarean section." The search returned 49 possible reports, of which 1 was relevant. A systematic review without meta-analysis, completed by the National Institute for Health and Clinical Excellence (NICE), focused on the factors affecting the likelihood of caesarean delivery during intrapartum care. (12)

Table 24 provides a summary of the findings from the NICE systematic review. (12)

Table 24: Factors Affecting the Likelihood of Having a Caesarean Delivery in Low-Risk Women—NICE Literature Review

Increases Likelihood	Decreases Likelihood	No Influence[a]	Further Research Needed
Electronic fetal monitoring	Induction beyond 41 weeks in low-risk pregnancy Continuous support during labour Planned home birth Involvement of a consultant obstetrician in decision-making Partogram with a 4-hour action line	Epidural analgesia Active management Immersion in water during labour Walking in labour Raspberry leaves Midwifery-led clinic Non-supine position during second stage of labour Early amniotomy	Delayed admission in labour Oxytocin augmentation Parenteral analgesia Complimentary therapies

Abbreviation: NICE, National Institute for Health and Clinical Excellence.
[a]No statistical difference between treatment (factor) and comparator.

ACKNOWLEDGEMENTS

Editorial Staff
Jeanne McKane, CPE, ELS(D)

Medical Information Services
Corinne Holubowich, Bed, MLIS
Kellee Kaulback, BA(H), MISt

Expert Advisory Panel on Rate Variation in Caesarean Sections Across Ontario

Panel Members	Affiliation(s)	Appointment(s)
Co-Chairs		
Pat Campbell	Ontario Hospital Association	President and CEO
Dr. Lorraine Ferris	Dalla Lana School of Public Health, University of Toronto	Professor
Obstetrician		
Dr. George Arnold	Markham Stouffville Hospital	Chief of Obstetrics and Gynaecology
Dr. Nicholas Braithwaite	—	—
Dr. Henry Fairley	Thunder Bay Regional Health Sciences Centre	Chief of Obstetrics and Gynaecology
Dr. Matt Gysler	Trillium Health Partners	—
Dr. Glasine Lawson	Stevenson Memorial Hospital	Chief of Obstetrics and Gynaecology
Dr. Nick Leyland	Hamilton Health Sciences McMaster University Medical Centre	Chief/Chair of Department of Obstetrics and Gynaecology
Dr. Maxine Lingurar	Sault Area Hospital	Chief of Obstetrics and Gynaecology
Dr. Matt Sermer	University of Toronto Mount Sinai Hospital	Professor of Obstetrics and Gynaecology Chief of Obstetrics and Gynaecology
Dr. Mark Walker	University of Ottawa Better Outcomes Registry & Network (BORN)	—
Dr. Kim Warwick	—	—
Researcher		
Dr. Ivy-Lynn Bourgeault	University of Ottawa	Professor and CIHR/Health Canada Research Chair in Health Human Resource Policy
Dr. Christine Kurtz Landy	York University	Assistant Professor, Faculty of Health
Registered Midwife		
Vicki Van Wagner	Ryerson University	Associate Professor
Obstetrical Anesthesiologist		
Dr. Pam Angle	Sunnybrook Health Sciences Centre	Director, Obstetrical Anesthesia Research Unit

Panel Members	Affiliation(s)	Appointment(s)
Dr. Sandra Katsiris	London Health Sciences Centre St. Joseph's Health Care London, Western University	Director of Obstetrical Anesthesia Associate Professor
Obstetrical Nurse		
Kate Godwin	Markham Stouffville Hospital	—
Marie-Josée Trépanier	Champlain Maternal Newborn Regional Program (CMNRP)	Regional Director
Nancy Watts	Canadian Association of Perinatal and Women's Health Nurses (CAPWHN) London Health Sciences Centre	President, CAPWHN Clinical Nurse Specialist, Women's Care Program, LHSC
Obstetrician/CEO		
Dr. Jennifer Blake	Society of Obstetricians and Gynaecologists of Canada (SOGC)	CEO
CEO		
Michael Barrett	South West Local Health Integration Network	CEO
Janet Beed	Markham Stouffville Hospital	President and CEO
Executive Director		
Marilyn Booth	Provincial Council for Maternal and Child Health	Executive Director
Prenatal Educator		
Virginia Collins	The Childbirth Experience	Childbirth Educator
Lisa Keenan-Lindsay	Seneca College of Applied Arts and Technology OPHA Supporting Normal Birth Workgroup	Professor of Nursing
Ministry of Health and Long-Term Care Representative		
Wendy Katherine	MOHLTC, Health System Strategy and Policy Division	Manager, Women's and Family Health

APPENDICES

Appendix 1: Literature Search Strategies

Search date: February 4, 2013
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE; CINAHL; Cochrane Library; CRD

Q: What are the factors associated with Caesarean section procedures?
Limits: 2008-current; English
Filters: Case reports, editorials, letters, comments, conference abstracts

Database: Ovid MEDLINE(R) <1946 to January Week 4 2013>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <February 1, 2013>, Embase <1980 to 2013 Week 05>
Search Strategy:

#	Searches	Results
1	exp Cesarean Section/	87437
2	(c?esarean section* or c?section* or c section* or abdominal deliver*).ti,ab.	68893
3	or/1-2	109225
4	exp Patient Satisfaction/	131833
5	exp Consumer Satisfaction/ use mesz	71057
6	exp patient attitude/ use emez	224440
7	exp consumer attitude/ use emez	1040
8	exp Attitude to Health/	340481
9	exp Decision Making/	234421
10	exp "Health Services Needs and Demand"/ use mesz	43429
11	exp Motivation/	180799
12	exp "Patient Acceptance of Health Care"/ use mesz	148557
13	((prefer* or satisf* or request*) adj4 (Wom?n or patient* or matern* or mother*)).ti,ab.	147336
14	((birth* or deliver* or c?esarean or c-section* or maternal) adj3 prefer*).ti,ab.	2875
15	exp risk factors/ use mesz or exp risk factor/ use emez	1059539
16	exp Unnecessary Procedures/ use mesz or exp unnecessary procedure/ use emez	4474
17	(risk* adj4 (factor* or relativ* or assess* or ratio*)).ti,ab.	963104
18	or/4-17	2555623
19	3 and 18	17683
20	Meta Analysis.pt.	36886
21	Meta Analysis/ use emez	68767
22	Systematic Review/ use emez	57104
23	exp Technology Assessment, Biomedical/ use mesz	8789
24	Biomedical Technology Assessment/ use emez	11437
25	(meta analy* or metaanaly* or pooled analysis or (systematic* adj2 review*) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab.	301403
26	((health technolog* or biomedical technolog*) adj2 assess*).ti,ab.	3938
27	or/20-26	361998

28	19 and 27	975
29	limit 28 to english language	932
30	limit 29 to yr="2008 -Current"	476
31	exp Case Reports/ use mesz or exp case report/ use emez	3476367
32	exp editorial/ or exp comment/ or exp congresses/ or exp letter/	2778464
33	or/31-32	5917490
34	30 not 33	465
35	remove duplicates from 34	310

CINAHL

#	Query	Limiters/Expanders	Results
S1	(MH "Cesarean Section+")	Search modes - Boolean/Phrase	8,916
S2	(cesarean section* caesarean section or c-section* or c section* or abdominal deliver*)	Search modes - Boolean/Phrase	507
S3	S1 OR S2	Search modes - Boolean/Phrase	9,179
S4	(MH "Consumer Satisfaction+")	Search modes - Boolean/Phrase	36,727
S5	(MH "Patient Attitudes")	Search modes - Boolean/Phrase	21,200
S6	(MH "Consumer Attitudes")	Search modes - Boolean/Phrase	3,466
S7	(MH "Attitude to Health+")	Search modes - Boolean/Phrase	81,778
S8	(MH "Decision Making+")	Search modes - Boolean/Phrase	57,927
S9	(MH "Health Services Needs and Demand+")	Search modes - Boolean/Phrase	14,399
S10	(MH "Motivation+")	Search modes - Boolean/Phrase	45,696
S11	(prefer* or satisf* or request*) N4 (Women* or woman* or patient* or matern* or mother*)	Search modes - Boolean/Phrase	39,793
S12	((birth* or deliver* or cesarean* or caesarean* or c-section* or c section* or maternal) N3 prefer*)	Search modes - Boolean/Phrase	370
S13	(MH "Risk Factors+")	Search modes - Boolean/Phrase	94,761
S14	(risk* N4 (factor* or relativ* or assess* or ratio*))	Search modes - Boolean/Phrase	247,170
S15	(MH "Unnecessary Procedures")	Search modes - Boolean/Phrase	1,204
S16	S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15	Search modes - Boolean/Phrase	455,562

#	Query	Limiters/Expanders	Results
S17	S3 AND S16	Search modes - Boolean/Phrase	2,323
S18	(MH "Meta Analysis") or (MH "Systematic Review")	Search modes - Boolean/Phrase	28,113
S19	((health technology N2 assess*) or meta analy* or metaanaly* or pooled analysis or (systematic* N2 review*) or published studies or medline or embase or data synthesis or data extraction or cochrane)	Search modes - Boolean/Phrase	64,316
S20	S18 OR S19	Search modes - Boolean/Phrase	64,316
S21	S17 AND S20	Search modes - Boolean/Phrase	137
S22	S17 AND S20	Limiters - Published Date from: 20080101-20131231; English Language Search modes - Boolean/Phrase	79

Cochrane

ID	Search	Hits
#1	MeSH descriptor: [Cesarean Section] explode all trees	2144
#2	c?esarean section* or c?section* or c section* or abdominal deliver*:ti (Word variations have been searched)	1069
#3	#1 or #2	2704
#4	MeSH descriptor: [Patient Satisfaction] explode all trees	7582
#5	MeSH descriptor: [Consumer Satisfaction] explode all trees	8155
#6	MeSH descriptor: [Attitude to Health] explode all trees	20987
#7	MeSH descriptor: [Decision Making] explode all trees	2134
#8	MeSH descriptor: [Health Services Needs and Demand] explode all trees	352
#9	MeSH descriptor: [Motivation] explode all trees	4229
#10	MeSH descriptor: [Patient Acceptance of Health Care] explode all trees	16765
#11	((prefer* or satisf* or request*) near/4 (Wom?n or patient* or matern* or mother*)):ti (Word variations have been searched)	1233
#12	((birth* or deliver* or c?esarean or c-section* or maternal) near/3 prefer*):ti (Word variations have been searched)	10
#13	MeSH descriptor: [Risk Factors] explode all trees	16429
#14	MeSH descriptor: [Unnecessary Procedures] explode all trees	81
#15	(risk* near/4 (factor* or relativ* or assess* or ratio*)):ti (Word variations have	2986

ID	Search	Hits
	been searched)	
#16	#4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15	43506
#17	#3 and #16 from 2008 to 2013	64

CRD

Line	Search	Hits
1	MeSH DESCRIPTOR Cesarean Section EXPLODE ALL TREES	145
2	(c?esarean section* or c?section* or c section* or abdominal deliver*):TI	94
3	#1 OR #2	205
4	MeSH DESCRIPTOR Patient Satisfaction EXPLODE ALL TREES	623
5	MeSH DESCRIPTOR Consumer Satisfaction EXPLODE ALL TREES	645
6	MeSH DESCRIPTOR Attitude to Health EXPLODE ALL TREES	1524
7	MeSH DESCRIPTOR Decision Making EXPLODE ALL TREES	254
8	MeSH DESCRIPTOR Health Services Needs and Demand EXPLODE ALL TREES	92
9	MeSH DESCRIPTOR Motivation EXPLODE ALL TREES	110
10	MeSH DESCRIPTOR Patient Acceptance of Health Care EXPLODE ALL TREES	1217
11	((prefer* or satisf* or request*) adj4 (Wom?n or patient* or matern* or mother*)):TI	6
12	((birth* or deliver* or c?esarean or c-section* or maternal) adj3 prefer*):TI	0
13	MeSH DESCRIPTOR risk factors EXPLODE ALL TREES	2020
14	MeSH DESCRIPTOR unnecessary procedures EXPLODE ALL TREES	16
15	(risk* adj4 (factor* or relativ* or assess* or ratio*)):TI	159
16	#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15	3890
17	#3 AND #16	37
18	(#17):TI FROM 2008 TO 2013	13

Appendix 2: Evidence Quality Assessment

Table A1: AMSTAR, Scores of Included Systematic Reviews

Author, Year	AMSTAR Score	(1) Provided Study Design	(2) Duplicate Study Selection	(3) Broad Literature Search	(4) Considered Status of Publication	(5) Listed Excluded Studies	(6) Provided Characteristics of Studies	(7) Assessed Scientific Quality	(8) Considered Quality in Report	(9) Methods to Combine Appropriate	(10) Assessed Publication Bias	(11) Stated Conflict of Interest
Gulmezoglu et al, 2012 (26)	11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Anim-Somuah et al, 2011 (21)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓
O'Mahony et al, 2010 (30)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓
Devane et al, 2012 (25)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓
Lavender et al, 2012 (27)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓
Brown et al, 2008 (23)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓
Bugg et al, 2011 (24)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓
Wendland et al, 2012 (34)	9	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓
Middleton et al, 2012 (29)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓
Bayrampour and Heaman, 2010 (22)	6	✓	✗	✓	✗	✓	✗	✓	✓	✓	✗	✗
Mazzoni et al, 2011 (28)	8	✓	✓	✓	✓	✗	✓	✓	✗	✓	✗	✓
Poobalan et al, 2009 (32)	7	✓	✓	✓	✗	✗	✗	✓	✓	✓	✗	✓
Pandey et al, 2012 (31)	9	✓	✓	✓	✗	✓	✓	✓	✓	✗	✓	✓
Ruiz-Mirazo et al, 2012 (33)	7	✓	✓	✓	✗	✗	✓	✓	✓	✓	NA	✗

Abbreviations: AMSTAR, Assessment of Multiple Systematic Reviews; NA, not applicable.
[a]Maximum possible score is 11. Details of AMSTAR score are described in Shea et al. (19)

Table A2: GRADE Evidence Profile for Labour Induction Policy

No. of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
Caesarean Delivery							
21 RCTs (44-64)	Serious[a] limitations	No serious limitations	No serious limitations	No serious limitations	Undetected[b]	None	⊕⊕⊕ Moderate
Subgroup 37–39 Weeks							
1 RCT (46)	No serious limitations	Not applicable	No serious limitations	Serious limitations[c]	Likely[d]	None	⊕⊕ Low
Subgroup 39–40 Weeks							
3 RCTs (49;51;60)	Serious lImitations[e]	No serious limitations	No serious limitations	Serious limitations[c]	Undetected	None	⊕⊕ Low
Subgroup < 41 Weeks							
1 RCT (47)	Serious limitations[f]	Not applicable	No serious limitations	Serious limitations[c]	Likely[d]	None	⊕ Very Low
Subgroup 41 Weeks							
4 RCTs (50;52;57;58)	No serious limitations	No serious limitations	No serious limitations	Serious limitations[g]	Undetected	None	⊕⊕⊕ Moderate
Subgroup > 41 Weeks							
12 RCTs (44;45;48;53;54;55;56;59;61-64)	Serious limitations[h]	No serious limitations	No serious limitations	No serious limitations	Undetected	None	⊕⊕⊕ Moderate

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; RCT, randomized controlled trial.
[a]Twelve of 21 studies had unclear allocation concealment; the rest had low risk of bias. Outcome assessor was not blinded in all RCTs; caesarean delivery is an objective outcome.
[b]Funnel plot for caesarean delivery had a flattened appearance, and its interpretation was unclear.
[c]Confidence interval included appreciable harms and benefits.
[d]One study retrieved from the literature search.
[e]Two of 3 RCTs had unclear allocation concealment.
[f]Unclear allocation concealment methods.
[g]Optimal information size not met.
[h]Eight of 12 RCTs had unclear allocation concealment methods.

Table A3: GRADE Evidence Profile for Group Prenatal Care

No. of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
Caesarean Delivery							
1 RCT (39)	Serious limitations[a]	Not applicable	Serious limitations[b]	No limitations	Undetected[c]	None	⊕⊕ Low

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; RCT, randomized controlled trial.
[a]Cluster randomization study; allocation concealment was not reported.
[b]Study completed in Iran.
[C]One study; difficult to assess publication bias.

Table A4: Risk of Bias Among Randomized Controlled Trials for Induction Policy

Author, Year	Allocation Concealment	Blinding	Complete Accounting of Patients and Outcome Events	Selective Reporting Bias	Other Limitations
Breart et al, 1982 (46)	No limitations[a]	Limitations[b]	No limitations[a]	No limitations[a,c]	No limitations
Cole et al, 1975 (49)	Limitations[d]	Limitations[b]	No limitations[a]	No limitations	No limitations
Egarter et al, 1989 (51)	Limitations[d]	Limitations[b]	No limitations[a]	No limitations	No limitations
Nielson et al, 2005 (60)	No limitations	Limitations[b]	No limitations	Limitations[e]	No limitations
Chakravarti et al, 2000 (47)	Limitations[d]	Limitations[b]	No limitations	No limitations[a,f]	No limitations
Dyson et al, 1987 (50)	No limitations[a]	Limitations[b]	No limitations	No limitations	No limitations
Gelisen et al, 2005 (52)	No limitations	Limitations[b]	No limitations	No limitations	No limitations
James et al, 2001 (57)	No limitations[a]	Limitations[b]	No limitations	No limitations	No limitations
Martin et al, 1989 (58)	Limitations[g]	Limitations[b]	No limitations	No limitations	No limitations
Augensen et al, 1987 (44)	Limitations[h]	Limitations[b]	No limitations	No limitations	No limitations
Bergsjo et al, 1989 (45)	Limitations[b]	Limitations[b]	No limitations	Limitations[i]	No limitations
Chanrachkul et al, 2003 (48)	Limitations[d]	Limitations[b]	No limitations	No limitations	No limitations
Hannah et al, 1992 (53)	No limitations	Limitations[b]	No limitations	No limitations	No limitations
Heimstad et al, 2007 (54)	No limitations	Limitations[b]	No limitations	No limitations	No limitations
Henry et al, 1969 (55)	Limitations[d]	Limitations[b]	No limitations	No limitations	No limitations
Herabutya et al, 1992 (56)	Limitations[d]	Limitations[b]	No limitations	No limitations	No limitations
NICHHD, 1994 (59)	No limitations	Limitations[b]	No limitations	No limitations	No limitations
Ocon et al, 1997 (61)	Limitations[d]	Limitations[b]	No limitations	No limitations [a]	No limitations
Roach et al, 1997 (62)	Limitations[j]	Limitations[b]	No limitations	Limitations[k]	No limitations
Sahraoui et al, 2005 (63)	Limitations[d]	Limitations[b]	No limitations	No limitations	No limitations
Witter et al, 1987 (64)	No limitations[a]	Limitations[b]	No limitations	Limitations[l]	No limitations

Abbreviation: NICHHD, National Institute of Child Health and Human Development.
[a]Evaluation differed from that of Cochrane review.
[b]Not reported.
[c]Perinatal mortality was not reported.
[d]Method of allocation concealment was not reported.
[e]Perinatal mortality was not reported, and only 3 neonatal outcomes were reported.
[f]No prespecified outcomes.
[g]Allocation was in sealed envelopes, but there was no mention of opaqueness, numbering, or sequential opening of envelope.
[h]Allocation concealment was unclear, given that it was not undertaken by a staff member or team clearly uninvolved in the trial.
[i]Limited information was provided for some outcomes, such as combined maternal complications.
[j]Allocation was in a series of identical envelopes, but there was no mention of sealed envelopes, opaqueness, or sequential numbered envelopes.
[k]Perinatal mortality was not reported.
[l]Perinatal death was not reported.

Table A5: Risk of Bias Among Randomized Controlled Trials for Group Prenatal Care

Author, Year	Allocation Concealment	Blinding	Complete Accounting of Patients and Outcome Events	Selective Reporting Bias	Other Limitations
Jafari et al, 2010 (39)	Limitations[a]	No limitations	No limitations	No limitations	No limitations

[a]Not reported.

Appendix 3: Forest Plot

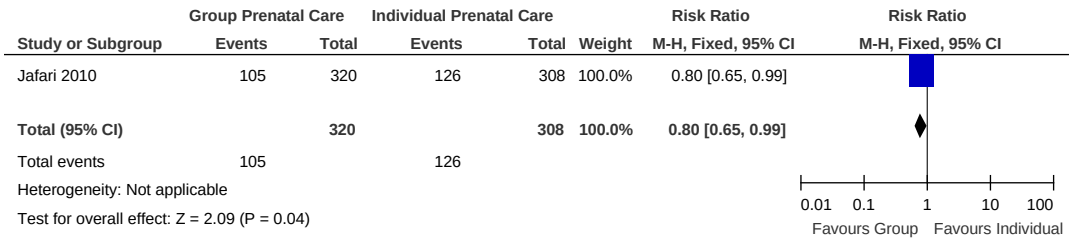

Figure A1: Group Prenatal Care Compared With Individual Prenatal Care

Abbreviations: CI, confidence interval; M-H, Mantel-Haenszel.

REFERENCES

(1) American College of Obstetricians and Gynecologists. Vaginal birth after previous cesarean delivery. Practice bulletin No 115. Obstet Gynecol. 2010 Aug;116:450-63.

(2) Hanley GE, Janssen PA, Greyson D. Regional variation in the cesarean delivery and assisted vaginal delivery rates. Obstet Gynecol. 2010 Jun;115(6):1201-8.

(3) Liu S, Liston RM, Joseph KS, Heaman M, Sauve R, Kramer MS et al. Maternal mortality and severe morbidity associated with low-risk planned cesarean delivery versus planned vaginal delivery at term. Can Med Assoc J. 2007 Feb 13;176(4):455-60.

(4) Society of Obstetricians and Gynaecologists of Canada. Joint policy statement on normal childbirth [Internet]. Ottawa (ON): SOGC; [updated 2008 Dec 3; cited 2014 May 1]. 3 p. Available from: http://sogc.org/guidelines/joint-policy-statement-on-normal-childbirth-policy-statement/

(5) National Collaborating Centre for Women's and Children's Health. Caesarean section [Internet]. London, (UK): Royal College of Obstetricians and Gynecologists Press; [updated 2011 Nov; cited 2014 May 1]. Available from: http://www.nice.org.uk/nicemedia/live/13620/57162/57162.pdf

(6) Barber EL, Lundsberg LS, Belanger K, Pettker CM, Funai EF, Illuzzi JL. Indications contributing to the increasing cesarean delivery rate. Obstet Gynecol. 2011 Jul;118(1):29-38.

(7) Declercq E, Young R, Cabral H, Ecker J. Is a rising cesarean delivery rate inevitable? Trends in industrialized countries, 1987 to 2007. Birth. 2011 Jun;38(2):99-104.

(8) MacDorman MF, Menacker F, Declercq E. Cesarean birth in the United States: epidemiology, trends, and outcomes. Clin Perinatol. 2008 Jun;35(2):293-307, v.

(9) Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A et al. Caesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. Lancet. 2006 Jun 3;367(9525):1819-29.

(10) Organisation for Economic Co-operation and Development (OECD). Caesarean sections in health at a glance 2011: OECD indicators. Paris: OECD Publishing; 2011 Jan 1. 97 p.

(11) Canadian Institute for Health Information. Health care in Canada 2010. Ottawa (ON): CIHI; 2010. 115 p.

(12) Centers for Disease Control and Prevention. Reduce cesarean births among low-risk women with no prior cesarean births [Internet]. [updated 2014; cited 2014 May 1]. Available from: http://www.healthypeople.gov/2020/topicsobjectives2020/TechSpecs.aspx?hp2020id=MICH-7.1

(13) Euro-Peristat Project. European perinatal health report. Brussels: Euro-Peristat; 2008. 280 p.

(14) Lagrew DC, Jr., Adashek JA. Lowering the cesarean section rate in a private hospital: comparison of individual physicians' rates, risk factors, and outcomes. Am J Obstet Gynecol. 1998 Jun;178(6):1207-14.

(15) Sachs BP, Kobelin C, CAstro MA, Frigoletto F. The risks of lowering the cesarean-delivery rate. N Engl J Med. 1999;340:54-7.

(16) Fuglenes D, Aas E, Botten G, Oian P, Kristiansen IS. Maternal preference for cesarean delivery: do women get what they want? Obstet Gynecol. 2012 Aug;120(2 Pt 1):252-60.

(17) Public Health Agency of Canada. Canadian perinatal health report: 2008 edition. Ottawa (ON): PHAC; 2008. 335 p.

(18) Dunn S, Wise MR, Johnson LM, Anderson G, Ferris LE, Yeritsyan N, et al. Reproductive and gynecological health. In: Bierman AS, editor. Project for an Ontario women's health evidence-based report: volume 2. Toronto: POWER study; 2011. 164 p.

(19) Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol. 2007;7:10.

(20) Guyatt GH, Oxman AD, Schunemann HJ, Tugwell P, Knottnerus A. GRADE guidelines: a new series of articles in the Journal of Clinical Epidemiology. J Clin Epidemiol. 2011 Apr;64(4):380-2.

(21) Anim-Somuah M, Smyth RM, Jones L. Epidural versus non-epidural or no analgesia in labour. Cochrane Database Sys Rev. 2011;(12):CD000331.

(22) Bayrampour H, Heaman M. Advanced maternal age and the risk of cesarean birth: a systematic review. Birth. 2010;37(3):219-26.

(23) Brown HC, Paranjothy S, Dowswell T, Thomas J. Package of care for active management in labour for reducing caesarean section rates in low-risk women. Cochrane Database Sys Rev. 2008;(4):CD004907.

(24) Bugg GJ, Siddiqui F, Thornton JG. Oxytocin versus no treatment or delayed treatment for slow progress in the first stage of spontaneous labour. Cochrane Database Sys Rev. 2011;(7):CD007123.

(25) Devane D, Lalor JG, Daly S, McGuire W, Smith V. Cardiotocography versus intermittent auscultation of fetal heart on admission to labour ward for assessment of fetal wellbeing. Cochrane Database Sys Rev. 2012;2:CD005122.

(26) Gulmezoglu AM, Crowther CA, Middleton P, Heatley E. Induction of labour for improving birth outcomes for women at or beyond term. Cochrane Database Sys Rev. 2012;6:CD004945.

(27) Lavender T, Hart A, Smyth RM. Effect of partogram use on outcomes for women in spontaneous labour at term. Cochrane Database Sys Rev. 2012;8:CD005461.

(28) Mazzoni A, Althabe F, Liu NH, Bonotti AM, Gibbons L, Sanchez AJ et al. Women's preference for caesarean section: a systematic review and meta-analysis of observational studies. BJOG. 2011;(4):391-9.

(29) Middleton P, Crowther CA, Simmonds L. Different intensities of glycaemic control for pregnant women with pre-existing diabetes. Cochrane Database Sys Rev. 2012;(8):CD008540.

(30) O'Mahony F, Hofmeyr GJ, Menon V. Choice of instruments for assisted vaginal delivery. Cochrane Database Sys Rev. 2010;11:CD005455.

(31) Pandey S, Shetty A, Hamilton M, Bhattacharya S, Maheshwari A. Obstetric and perinatal outcomes in singleton pregnancies resulting from ivf/icsi: a systematic review and meta-analysis. Hum Reprod Update. 2012;18(5):485-503.

(32) Poobalan AS, Aucott LS, Gurung T, Smith WCS, Bhattacharya S. Obesity as an independent risk factor for elective and emergency caesarean delivery in nulliparous women - systematic review and meta-analysis of cohort studies. Obes Rev. 2009;10(1):28-35.

(33) Ruiz-Mirazo E, Lopez-Yarto M, McDonald SD. Group prenatal care versus individual prenatal care: a systematic review and meta-analyses. J Obstet Gyn Can. 2012;34(3):223-9.

(34) Wendland EM, Torloni MR, Falavigna M, Trujillo J, Dode MA, Campos MA et al. Gestational diabetes and pregnancy outcomes - a systematic review of the World Health Organization (WHO) and the International Association of Diabetes in Pregnancy Study Groups (IADPSG) diagnostic criteria. BMC Preg Child. 2012;12(23):1-13.

(35) Goodman, C. Literature searching and evidence interpretation for assessing health care practices. Stockholm, Sweden: Swedish Council on Technology Assessment in Health Care; 1996. [cited 2012 May 22]. 81 p. SBU Report No. 119E.

(36) Akinsipe DC, Villalobos LE, Ridley RT. A systematic review of implementing an elective labor induction policy. J Obst Gyn Neonat Nurs. 2012;41(1):5-16.

(37) Frigoletto FD, Jr., Lieberman E, Lang JM, Cohen A, Barss V, Ringer S et al. A clinical trial of active management of labor. N Engl J Med. 1995 Sep 21;333(12):745-50.

(38) Farrag OA. Prospective study of 3 metabolic regimens in pregnant diabetics. Aust N Z J Obstet Gynaecol. 1987 Feb;27(1):6-9.

(39) Jafari F, Eftekhar H, Fotouhi A, Mohammad K, Hantoushzadeh S. Comparison of maternal and neonatal outcomes of group versus individual prenatal care: a new experience in Iran. Health Care Women Int. 2010 Jul;31(7):571-84.

(40) Institute for Clinical Evaluative Sciences. MOMBABY derived cohorts 1988-March 2013 [Internet]. Toronto: Institute for Clinical Evaluative Sciences; [updated 2014; cited 20013 Mar]. Available from: https://datadictionary.ices.on.ca/Applications/DataDictionary/Default.aspx?viewmode=DataServices

(41) Provincial Council for Maternal and Child Health. Standardized maternal and newborn levels of care definitions [Internet]. Toronto: PCMCH; [updated 2013 Jan 8; cited 2014 May 1]. 13 p. Available from: http://pcmch.on.ca/sites/default/files/Level%20of%20Care%20Guidelines%202011%20Updated%20August1%202013.pdf

(42) Better Outcomes Registry and Network. BORN Information System [Internet]. Ottawa (ON): BORN Ontario; [updated 2014; cited 2013 Mar]. Available from: https://www.bornontario.ca/en/born-information-system/?q=3

(43) Robson MS. Can we reduce the caesarean section rate? Best Pract Res Clin Obstet Gynaecol. 2001 Jan 1;15(1):179-94.

(44) Augensen K, Bergsjo P, Eikeland T, Askvik K, Carlsen J. Randomised comparison of early versus late induction of labour in post-term pregnancy. Br Med J (Clin Res Ed). 1987 May 9;294(6581):1192-5.

(45) Bergsjo P, Huang GD, Yu SQ, Gao Z, Bakkereig LS. Comparison of induced vs non-induced labor in post-term pregnancy. Acta Obstet Gynecol Scand. 1989;68:683-7.

(46) Breart G, Goujard J, Maillard F, Chavigny C, Rumeau-Rouquette C, Sureau C. Comparison of 2 obstetrical attitudes vis-a-vis inducing labor at term. Randomized study. J Gynecol Obstet Biol Reprod. 1982;11(1):107-12.

(47) Chakravarti S, Goenka B. Conservative policy of induction of labour in uncomplicated postdated pregnancies. Int J Gynecol Obstet. 2000;70(Suppl 3): C62.

(48) Chanrachkul B, Herabutya Y. Postterm with favorable cervix: is induction necessary? Obst Gynecol Reprod Biol. 2003;106:154-7.

(49) Cole RA, Howie PW, Macnaughton MC. Elective induction of labour. A randomised prospective trial. Lancet. 1975 Apr 5;1(7910):767-70.

(50) Dyson DC, Miller PD, Armstrong MA. Management of prolonged pregnancy: induction of labor versus antepartum fetal testing. Am J Obstet Gynecol. 1987 Apr;156(4):928-34.

(51) Egarter CH, Kofler E, Fitz R, Husslein P. Is induction of labour indicated in prolonged pregnancy? Results of a prospective randomised trial. Gynecol and Obstet. 1989;27:6-9.

(52) Gelisen O, Caliskan E, Dilbaz S, Ozdas E, Dilbaz B, Ozdas E et al. Induction of labor with three different techniques at 41 weeks of gestation or spontaneous follow-up until 42 weeks in women with definitely unfavorable cervical scores. Eur J Obstet Gynecol Reprod Biol. 2005 Jun 1;120(2):164-9.

(53) Hannah ME, Hannah WJ, Hellman J, Hewson S, Milner R, Willan A. Induction of labour as compared with serial antenatal monitoring in post-term pregnancy. N Engl J Med. 1992;326:1587-92.

(54) Heimstad R, Skogvoll E, Mattsson LA, Johansen OJ, Eik-Nes SH, Salvesen KA. Induction of labor or serial antenatal fetal monitoring in postterm pregnancy: a randomized controlled trial. Obstet Gynecol. 2007 Mar;109(3):609-17.

(55) Henry GR. A controlled trial of surgical induction of labour and amnioscopy in the management of prolonged pregnancy. J Obstet Gynaecol Br Commonw. 1969 Sep;76(9):795-8.

(56) Herabutya Y, Prasertsawat PO, Tongyai T, Isarangura Na AN. Prolonged pregnancy: the management dilemma. Int J Gynaecol Obstet. 1992 Apr;37(4):253-8.

(57) James C, George SS, Gaunekar N, Seshadri L. Management of prolonged pregnancy: a randomized trial of induction of labour and antepartum foetal monitoring. Natl Med J India. 2001 Sep;14(5):270-3.

(58) Martin JN, Jr., Sessums JK, Howard P, Martin RW, Morrison JC. Alternative approaches to the management of gravidas with prolonged-postterm-postdate pregnancies. J Miss State Med Assoc. 1989 Apr;30(4):105-11.

(59) National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units. A clinical trial of induction of labour versus expectant management in postterm pregnancy. Obstet Gynecol. 1994;170:716-23.

(60) Nielsen PE, Howard BC, Hill CC, Larson PL, Holland RH, Smith PN. Comparison of elective induction of labor with favorable Bishop scores versus expectant management: a randomized clinical trial. J Matern Fetal Neonatal Med. 2005 Jul;18(1):59-64.

(61) Ocon L, Hurtado R, Coteron JJ, Zubiria A, Ramiriz O, Garcia JA. Prolonged pregnancy:procedure guidelines. Progresos de Obstetricia y Ginecologia. 1997;40:101-6.

(62) Roach VJ, Rogers MS. Pregnancy outcome beyond 41 weeks gestation. Int J Gynaecol Obstet. 1997 Oct;59(1):19-24.

(63) Sahraoui W, Hajji S, Bibi M, Nouira M, Essaidi H, Khairi H. Management of pregnancies beyond forty-one week's gestation with an unfavorable cervix. J Gynecol Obstet Biol Reprod. 2005 Sep;34(5):454-62.

(64) Witter FR, Weitz CM. A randomized trial of induction at 42 weeks gestation versus expectant management for postdates pregnancies. Am J Perinatol. 1987 Jul;4(3):206-11.

(65) Neilson JP. Fetal electrocardiogram (ECG) for fetal monitoring during labour. Cochrane Database Sys Rev. 2012;4:CD000116.

Health Quality Ontario
130 Bloor Street West, 10th Floor
Toronto, Ontario
M5S 1N5
Tel: 416-323-6868
Toll Free: 1-866-623-6868
Fax: 416-323-9261
Email: EvidenceInfo@hqontario.ca
www.hqontario.ca

ISSN 1915-7398 (online)
ISBN 978-1-4606-3517-9 (PDF)