



British Columbia Perinatal Health Program
Optimizing neonatal, maternal and fetal health

Caesarean Birth Task Force Report 2008

British Columbia Perinatal Health Program Caesarean Birth Task Force Report

February 2008 - Revised February 2009



Publication and Contact Information

Published by the British Columbia Perinatal Health Program (BCPHP)

Suggested citation: British Columbia Perinatal Health Program. Caesarean Birth Task Force Report 2008. Vancouver, BC. February 2008

For further information contact:

British Columbia Perinatal Health Program
F502-4500 Oak Street
Vancouver, BC V6H 3N1
Telephone : 604-875-3737
Fax : 604-875-3747
<http://www.bcphp.ca>

ACKNOWLEDGEMENT

This report is the result of the combined effort of the Caesarean Birth Task Force. All of the members of the Caesarean Birth Task Force have read the report in its entirety and are in support of the findings, recommendations and conclusions therein contained.

Members of the Task Force are:

Lily Lee, Perinatal Nurse Consultant, BC Perinatal Health Program (Chair)

Kim Campbell, Instructor, UBC Midwifery

Jan Christilaw, Head, BCWH Specialized Women's Health

Duncan Farquharson, Medical Director, BC Perinatal Health Program

Sue Harris, Head, BCWH Department of Family Practice

Patti Janssen, Associate Professor, Department of Health Care & Epidemiology, UBC

Michael C. Klein, Professor Emeritus, Family Practice & Paediatrics, UBC

Romy McMaster, Perinatal Analyst, BC Perinatal Health Program

Diane Sawchuck, Perinatal Nurse Consultant, BC Perinatal Health Program

Andrew Sear, Family Practitioner

Paul Thiessen, Paediatrician

Henry Woo, Obstetrician and Gynaecologist

We would like to acknowledge the contribution of Carla Hilario and Flora Teng, UBC Nursing and Medical students respectively, for their assistance in preparing this report. As well, we would like to give special thanks to Serena Howlett for her editorial expertise.

EXECUTIVE SUMMARY

The caesarean birth rate in Canada has risen steadily for the last three decades in all jurisdictions. By 2005 in BC the rate had risen to 30.4%, the highest of all provinces and territories in Canada. The reasons for this are not completely clear, though many factors appear to be involved. These trends have raised concerns and questions within the maternity care community as well as all levels of government and the public. In an attempt to understand and address these issues, the Ministry of Health requested assistance from the BC Perinatal Health Program. This led to the formation of the Caesarean Birth Task Force (CBTF) of the BC Perinatal Health Program (BCPHP) in 2006. The mandate of the Task Force, as commissioned by the Ministry of Health, was to determine whether the caesarean birth rate was appropriate for the province and if not, to suggest steps that could be taken to address the inherent issues.

The specific objectives of the Task Force were to:

- i. Review trends in caesarean birth rates in BC.
- ii. Review evidence on maternal and infant risks, benefits and outcomes.
- iii. Describe maternal, pregnancy and obstetric factors associated with rate increases and variations between provincial Health Authorities and Health Service Delivery Areas.
- iv. Determine if current caesarean birth rates are medically justifiable, and if not, to propose quality improvement strategies that consider population characteristics and practice context, and other variables.
- v. Recommend practice strategies to optimize the use of caesarean birth in BC.
- vi. Suggest a comprehensive continuous quality improvement (CQI) framework to support improvement initiatives.
- vii. Propose an action plan to the BCPHP Executive Committee that will inform the development of guidelines, education initiatives, and future research and performance improvement.

The BC Perinatal Database Registry has collected and reported on all births in BC since 2000. Over this time there has been an average of 40,000 births per year. During this time the rate of spontaneous vaginal delivery decreased from 64.2 to 60.1%; the rate of assisted vaginal delivery, including vacuum and forceps intervention, decreased from 12.2 to 10.4%. The provincial caesarean delivery rate rose from 23.6 to 29.5%.

This task force builds on the work of a previous Provincial Task Force that reported in 1993. Some of the trends relating to caesarean section have persisted since then, but a number of factors have changed. The availability of the BC Perinatal Database Registry for ongoing monitoring, analysis and feedback has greatly strengthened our ability to track trends and changes, both for practice patterns and demographics. In addition, there is widespread support within all levels of government and within the maternity care community to look closely at the issue of caesarean delivery as it relates to current practice. A number of studies comparing caesarean and vaginal birth outcomes among low-risk mothers suggest that vaginal birth is preferable for maternal health. These studies have shown increased maternal morbidity in both the current pregnancy and future pregnancies. In addition, large studies have shown a 2 to 3-fold increase in various neonatal respiratory morbidities following elective caesarean delivery compared to vaginal delivery, with resultant increase in need for admission to a Newborn Intensive Care Unit (NICU).

Some factors that help explain the rising caesarean rates are: increasing maternal age, rates of hypertension, diabetes, obesity and multiple gestations. However, the increase in proportion of caesarean births exceeds actual increases (individually and collectively) in the prevalence of these conditions among pregnant women. In other words, the caesarean birth rate is rising faster than medical or demographic conditions would justify.

While the frequency of induced labour has remained fairly stable, the caesarean delivery rate for induced mothers increased from 22.6% in 2000 to 25.7% in 2005. For nulliparous women with postdate pregnancies, induction, as opposed to spontaneous labour, was associated with almost twice the rate of caesarean delivery.

Our statistical analysis also suggests that caesarean delivery frequency varies with the care provider, geographic location, health delivery area and mix of care providers. This may reflect the reality that obstetricians care for women who have an increased risk of requiring intervention, while women with less risk seek out the care of midwives and family doctors. The perception of risk may also vary between groups of care providers, and may be a contributing factor to the trends seen in the past six years. In general, it appears that both consumers and providers of care have become comfortable with technology, and more risk averse. However, all interventions bring some risk of complication, and need to be evaluated on their merit.

In addition to concerns for maternal and neonatal health, economic issues are important to consider in the provincial picture. The Canadian Institute for Health Information (CIHI) estimates the average cost of caesarean section to be significantly higher, and length of stay longer, than vaginal birth. Thus, a rising caesarean delivery rate puts increasing economic and human resource demands on our already challenged system.

Research evidence suggests that significant reductions in caesarean birth rates can be achieved through customized quality improvement strategies rather than arbitrary benchmarks. Multi-faceted strategies include peer review, audit and feedback and identification of barriers to change. Sustainable change requires clear, accessible and timely data, management infrastructure, ongoing monitoring, and, perhaps most importantly, the support of hospital administration and commitment of team members. Surveillance and monitoring of important indicators, with a continuous cycle of accurate and timely data collection, synthesis and dissemination, are crucial to the success of any improvement strategy. The BCPHP is committed to the ongoing monitoring of birth outcomes in BC.

All available research suggests that the public needs better information about pregnancy, labour and birth. A strategy to engage consumer-oriented media should be central to this work, and will contribute to better understanding and decision-making by the public. Childbearing women and their families should be provided with evidence-based information about pre-existing or demographic factors and modifiable factors that contribute to obstetric interventions in childbirth. High quality information will allow women to be active participants in their own care.

To build on the findings of the Caesarean Birth Task Force, a Consensus Conference was convened in January 2008 to engage in further dialogue provincially and to produce a consensus statement that addressed the trends, risks and benefits, perspectives and future strategies regarding caesarean birth in BC.

It is hoped that by surfacing these important issues, we can as a provincial community, work together to assure that the women of BC and their families have access to the best maternity care. The BCPHP is confident that with the commitment of our excellent maternity care providers, and our partners in government and health administration, these objectives can be achieved.

The overall recommendations from the Caesarean Birth Task Force follow. These summarize the detailed recommendations and summary statements that are to be found at the end of each section of the report.

OVERALL RECOMMENDATIONS

MINISTRY OF HEALTH

1. The Ministry of Health develops a ten-year health human resources plan that aims to:
 - a. Train, recruit and retain more care providers in maternity care, including perinatal nurses, midwives, primary care physicians and obstetric specialists. Doula support is not yet funded provincially, but research evidence suggests that this should be considered.

- b. Support the continuing development of collaborative multidisciplinary models of maternity care with the “right mix” of maternity providers appropriate to the needs of the community or jurisdiction.
 - c. Design a system to support obstetric specialists in their consultant role.
2. The Ministry of Health addresses existing barriers, incentives and funding for the development of collaborative models of practice among maternity care providers including midwives, nurses, family physicians and obstetricians through the development and evaluation of demonstration projects and dissemination of rigorous program evaluations.
3. The Ministry of Health partners with provincial agencies (Michael Smith Foundation for Health Research, BC Medical Services Association) to fund requests for research proposals to develop and disseminate knowledge of practice change that will reduce rates of caesarean section.
4. The Ministry of Health develops a process for ongoing evaluation of progress towards implementing the recommendations of this report, including semi-annual review.

BC PERINATAL HEALTH PROGRAM (BCPHP)

1. BCPHP performs ongoing data monitoring with respect to caesarean section rates and factors associated with caesarean section and disseminates this information on an annual basis to health authorities and all levels of maternity care facilities.
2. BCPHP assists health authorities to define local evidence-based benchmarks for caesarean section rates.
3. BCPHP partners with health authorities to develop quality improvement strategies aimed at reduction of caesarean rates while maintaining optimal birth outcomes. These strategies include:
 - a. Creation of multi-disciplinary teams mandated to implement quality improvement programs (See Appendix E: Implementing EPIC) within designated hospitals
 - b. Analysis of local determinants of variation in caesarean birth rates (e.g. Robson classification)
 - c. Establishment of hospital or region-based reduction targets for caesarean birth
 - d. Selection of strategies and interventions to reach targets based on published evidence and local determinants of variation
 - e. Implementation of strategies with rapid cycles of evaluation and modification
 - f. Dissemination of experience with practice change and evaluation among partnering health authorities and hospitals
 - g. Assisting Health Authorities or institutions in the use of comparability techniques to help them assess their performance against comparable institutions or regions
4. BCPHP supports the dissemination of knowledge gained from these quality improvement initiatives through publication in peer-reviewed literature.
5. BCPHP incorporates findings of published evaluations into BCPHP guidelines.
6. BCPHP modifies the structure of the perinatal database to promote ongoing surveillance of relevant variables arising from quality improvement strategies.
7. BCPHP disseminates evidence-based information appropriate for childbearing women, their families and the general public about pregnancy and childbirth, including:
 - a. Risks and benefits associated with caesarean vs. vaginal birth

- b. Modifiable factors associated with risk of caesarean birth such as obesity, smoking and advancing maternal age
8. BCPHP uses lay media outlets to disseminate this information--including public service announcements, web-based resources, and print material.

REGIONAL HEALTH AUTHORITIES

1. Regional Health Authorities designate internal responsibility for dissemination of caesarean birth surveillance products developed by BCPHP within health authorities.
2. Regional Health Authorities partner with BCPHP to develop quality improvement strategies aimed at reduction of caesarean rates while maintaining optimal birth outcomes as outlined in recommendation (2) under BC Perinatal Health Program. This will include allocation of resources for coordination and support of quality improvement strategies.
3. Regional Health Authorities commit to encouragement and resourcing of practice change initiatives arising through quality improvement activities.

MATERNITY CARE PROVIDERS

1. Providers access dissemination materials made available through Health Authorities and BCPHP.
2. Providers invest time in adopting recommended best practices within hospitals.
3. Providers consider participation in quality improvement teams within hospitals.
4. Providers assist in the dissemination of consumer-oriented educational materials distributed through the BCPHP as well as in the interpretation of these materials in the appropriate context for consumers.
5. Providers participate in quality improvement processes of practice guideline development and evaluation at the BCPHP.

TABLE OF CONTENTS

ACKNOWLEDGEMENT	III
EXECUTIVE SUMMARY	V
OVERALL RECOMMENDATIONS	VI
MINISTRY OF HEALTH	VI
BC PERINATAL HEALTH PROGRAM (BCPHP).....	VII
REGIONAL HEALTH AUTHORITIES	VIII
MATERNITY CARE PROVIDERS	VIII
1. INTRODUCTION	1
2. BIRTH TRENDS.....	3
2.1 CANADA	3
2.2 BRITISH COLUMBIA.....	4
2.3 SUMMARY OF BIRTH TRENDS	9
3. MATERNAL AND INFANT HEALTH OUTCOMES AND PUBLIC HEALTH COSTS	11
3.1 MATERNAL HEALTH OUTCOMES	11
3.2 INFANT HEALTH OUTCOMES	14
3.3 PUBLIC HEALTH COSTS	15
3.4 SUMMARY OF MATERNAL AND INFANT HEALTH OUTCOMES AND PUBLIC HEALTH COSTS.....	15
4. FACTORS CONTRIBUTING TO THE RISE IN CAESAREAN RATES IN BC.....	17
4.1 MATERNAL CHARACTERISTICS	17
4.2 PREGNANCY CHARACTERISTICS	21
4.3 MATERNAL HEALTH STATUS	23
4.4 OBSTETRIC FACTORS	23
4.5 MATERNITY CARE PROVIDERS	25
4.6 ANALYTICAL METHODS	26
4.7 SUMMARY OF FACTORS CONTRIBUTING TO THE INCREASED RATE OF CAESAREAN BIRTHS	27
5. STRATEGIES TO REDUCE CAESAREAN RATES IN BC	29
5.1 QUALITY IMPROVEMENT STRATEGIES	29
5.2 DATA COLLECTION AND FEEDBACK	32
5.3 EDUCATING THE PUBLIC	36
5.4 COLLABORATIVE MODELS OF PRACTICE	37
5.5 EVIDENCED-BASED PROVIDER PRACTICES	38
5.6 SUMMARY OF STRATEGIES	40
6. EVIDENCE FOR BEST PRACTICE	41
6.1 INDUCTION OF LABOUR.....	41
6.2 SUPPORTING A TRIAL OF LABOUR	42
6.3 PAIN MANAGEMENT IN LABOUR.....	43
6.4 INTRAPARTUM FETAL SURVEILLANCE	46
6.5 MANAGEMENT OF BREECH PRESENTATION.....	48
6.6 PREVENTION AND MANAGEMENT OF DYSTOCIA.....	50
6.7 INSTRUMENTAL DELIVERY: USE OF FORCEPS AND VACUUM	51
6.8 RURAL MATERNITY CARE	53
6.9 MATERNAL REQUEST CAESAREAN	54
7. CONCLUSION	56

8. CONSENSUS CONFERENCE AND PANEL STATEMENT	57
IS IT POSSIBLE TO OPTIMIZE THE CESAREAN BIRTH RATE IN BC?	59
WHAT ARE THE ROLES OF CAREGIVERS IN OPTIMIZING CESAREAN BIRTH IN BC?	59
WHAT SUPPORT IS REQUIRED FROM GOVERNMENT, HEALTH AUTHORITIES, HOSPITALS AND THE BCPHP TO OPTIMIZE THE CESAREAN BIRTH RATE ACROSS BC?	61
WHAT IS AN APPROPRIATE PUBLIC EDUCATION STRATEGY REGARDING CHILDBIRTH?	63
CESAREAN CONSENSUS CONFERENCE – PANEL MEMBERS	63
APPENDICES.....	67
APPENDIX A: GLOSSARY OF TERMS	68
APPENDIX B: LITERATURE SEARCH STRATEGY FOR MATERNAL AND INFANT HEALTH.....	72
APPENDIX C: CIHI PROVIDER CODES	73
APPENDIX D: MULTIPLE REGRESSION ANALYSIS TABLES.....	74
APPENDIX E: PLANNED CHANGE USING THE EPIC PROCESS.....	77
APPENDIX F: CURRENT BCPHP REPORTS AND REPORTING TOOLS.....	79
APPENDIX G: LEVELS OF EVIDENCE	80
APPENDIX H: BC HEALTH AUTHORITIES AND BC HEALTH SERVICE DELIVERY AREAS.....	81
REFERENCES	82

1. INTRODUCTION

Historically, British Columbia has had the highest or second highest rate of caesarean birth in Canada¹. In 1993 the Caesarean Birth Task Force of the BC Perinatal Health Program (BCPHP) recommended educational measures, legalization of midwifery, improved data collection, development of practice guidelines and introduction of perinatal review procedures. While a number of these measures have been implemented, the caesarean birth rate has continued to climb.

In 2005 the provincial rate reached an all time high of 30.4%, causing renewed concerns about the consequences of this trend [1]. Delivery by caesarean section poses specific risks to maternal and newborn health, uses considerable resources and strains the public health system [2]. Caesarean delivery is associated with higher costs than that of vaginal delivery [3].

Technological and socio-economic changes play a significant role in maternal health care and attitudes about pregnancy and childbirth [4]. As a society, we have become increasingly comfortable with technology, and are more risk averse, more reluctant to experience pain, and more assertive as consumers. Physicians, midwives, nurses and women have become accustomed to technology in labour and birth, many believing it offers choice, safety and control.

While appropriate pharmacological and surgical interventions have historically been associated with a decrease in perinatal mortality, the overuse of technology carries negative implications [5-9]. Mass media dissemination of health information and resulting misperceptions about the relative risks and benefits of vaginal and caesarean birth have influenced inappropriate decision-making about modes of delivery on the part of providers and consumers.

Concurrent with these changes, there have been substantial changes in the demographics of childbearing. Delayed childbearing, increasing prevalence of overweight and obesity, and pre-existing medical conditions, such as diabetes and hypertension, have all had an impact on the way women and providers manage pregnancy, labour and delivery.

In recent years the supply of family doctors in BC has decreased, shifting the burden for normal, low-risk deliveries to obstetricians. At the same time, the number of obstetricians is declining as a consequence of both normal attrition and growing medical malpractice concerns that function as a barrier to entry. Hospital nurses comfortable in managing birth are also in short supply and caesarean births exacerbate this problem by requiring an increased length of stay (72 vs. 12-48 hours) and, in some cases, re-hospitalization [10, 11]. The number of licensed midwives in BC is inadequate to meet consumer demand and to participate in new models of maternity care. And it is increasingly difficult for smaller communities to offer maternity care in the face of significant health human resource deficits.

The British Columbia Perinatal Health Program (BCPHP) created the Caesarean Birth Task Force to explore caesarean-related health risks to childbearing women and newborns, to determine whether the high rate is appropriate, whether an “ideal rate” could be established and, if so, what strategies would help the province attain that benchmark. The Task Force was mandated by the Ministry of Health to convene a panel of experts to assist in the development of appropriate strategies to reduce caesarean rates while maintaining or improving maternal and newborn health outcomes.

The BCPHP plays an influential role in providing leadership in the improvement of maternity care practices and supports a philosophy of interdisciplinary education. Since 1990 the BCPHP and its predecessor BCRCP have developed and distributed interdisciplinary obstetric and newborn care practice guidelines to all acute perinatal

¹ Throughout this report the terms caesarean section, caesarean birth, and caesarean delivery are used. The CBTF recognizes the complexity of the terminology. While a caesarean section is a surgical procedure, it is also the birth of an infant, and is performed within a larger context of birth and delivery. Therefore all three terms are included to respect the individual philosophies of women who experience a caesarean section and to recognize the complexities of its meaning.

care facilities in the province with recommendations based on current research [12]. Workshops are provided throughout the province in response to requests from health authorities, hospitals or an identified need.

BCPHP collects and analyzes data about perinatal practices, outcomes, and resources through the BC Perinatal Database Registry (BCPDR), a province-wide computerized database with full provincial data collection beginning in April 2000. The data in this report, unless otherwise specified, was extracted from the BCPDR using maternal discharge dates of January 1, 2000 to December 31, 2005 as the inclusion criteria. The data represent all maternal discharges from any BC facility as well as any home births from the specified time period. Women delivering twins or multiples will only be counted once in the data. Deliveries resulting in both live and stillbirths are included. Women who reside in BC but deliver outside of the province were not included in the analysis; conversely, any woman delivering in BC but who generally reside outside of province were included in the data. Definitions for terms used throughout the report can be found in Appendix A.

The Task Force was mandated by the Ministry of Health to review trends, risk factors, and indications for caesarean births, make recommendations to the BCPHP Executive Committee and develop an action plan to optimize caesarean birth rates. The Task Force met monthly from September 2006 to December 2007. It reviewed data and literature about maternal and pregnancy characteristics, obstetric factors, maternity care providers, delivery modalities and health outcomes.

A Nova Scotia study using the Nova Scotia Atlee Perinatal database [13] served as a model for the Task Force. In that setting substantial increases in the primary caesarean section delivery rate were attributed to concurrent changes in maternal age, parity, pre-pregnancy weight gain, and weight gain during pregnancy as well as changes in obstetric practices.

Building on the groundwork of the Task Force, a Consensus Conference "*Cesarean Birth in BC: Trends, Perspectives and Strategies*" was convened January 24 – 26, 2008, to engage in further dialogue provincially. Participants attended by invitation and had the opportunity to listen to presentations from invited experts, to provide feedback, including the *Caesarean Birth Task Force* recommendations, as well as the logistics of implementing these recommendations throughout the province. A separate 16-member panel with representation from rural, regional and tertiary centers developed the consensus statement based on pre-determined questions. The consensus statement reflects the panels' assessment of scientific knowledge available at the time the statement was written. For further information about the Consensus Conference Statement and Panel Members, please refer to Section 8 of this report.

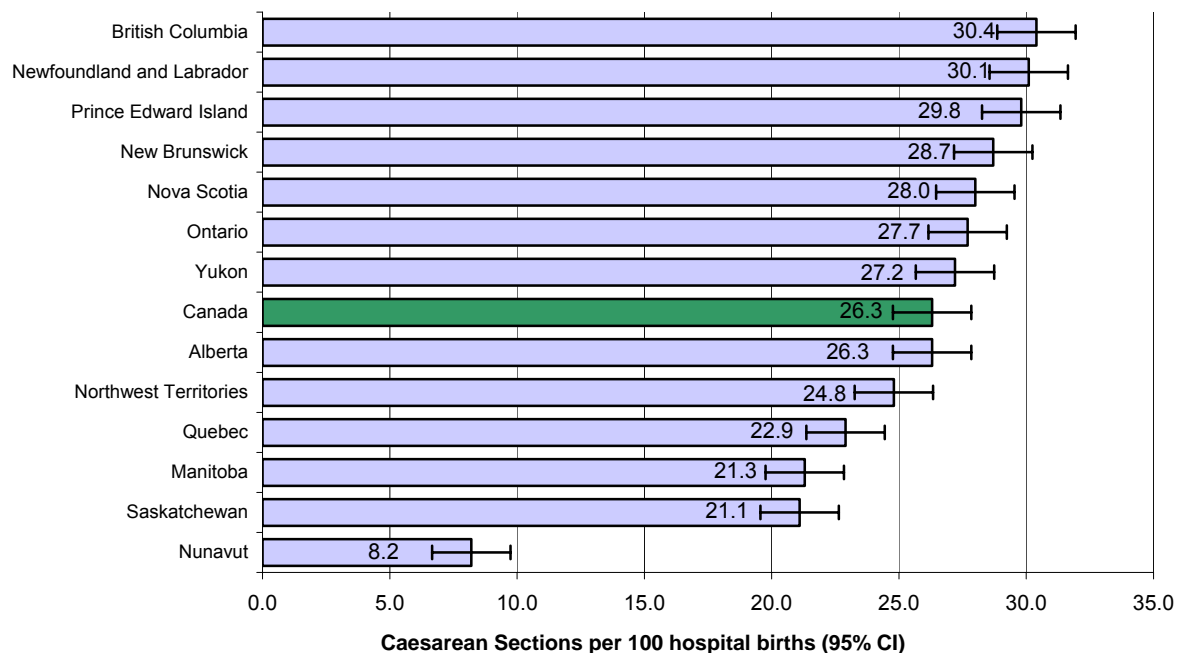
2. BIRTH TRENDS

CAESAREAN BIRTH RATES

2.1 CANADA

Caesarean birth rates in Canada have increased by 45% in the last decade, from 18.2% in 1995-1996 to 26.3% in 2005-2006 [1]. There is wide variation across the country, ranging from 8.2% in Nunavut to 30.4% in British Columbia [14]. Rates are higher in the coastal provinces and lower in Saskatchewan (21.1%) and Manitoba (21.3%) (Figure 1).

FIGURE 1. CAESAREAN SECTION RATES BY PROVINCE/TERRITORY IN CANADA, 2005/2006



SOURCE: CANADIAN INSTITUTE FOR HEALTH INFORMATION HEALTH INDICATORS REPORT 2007²

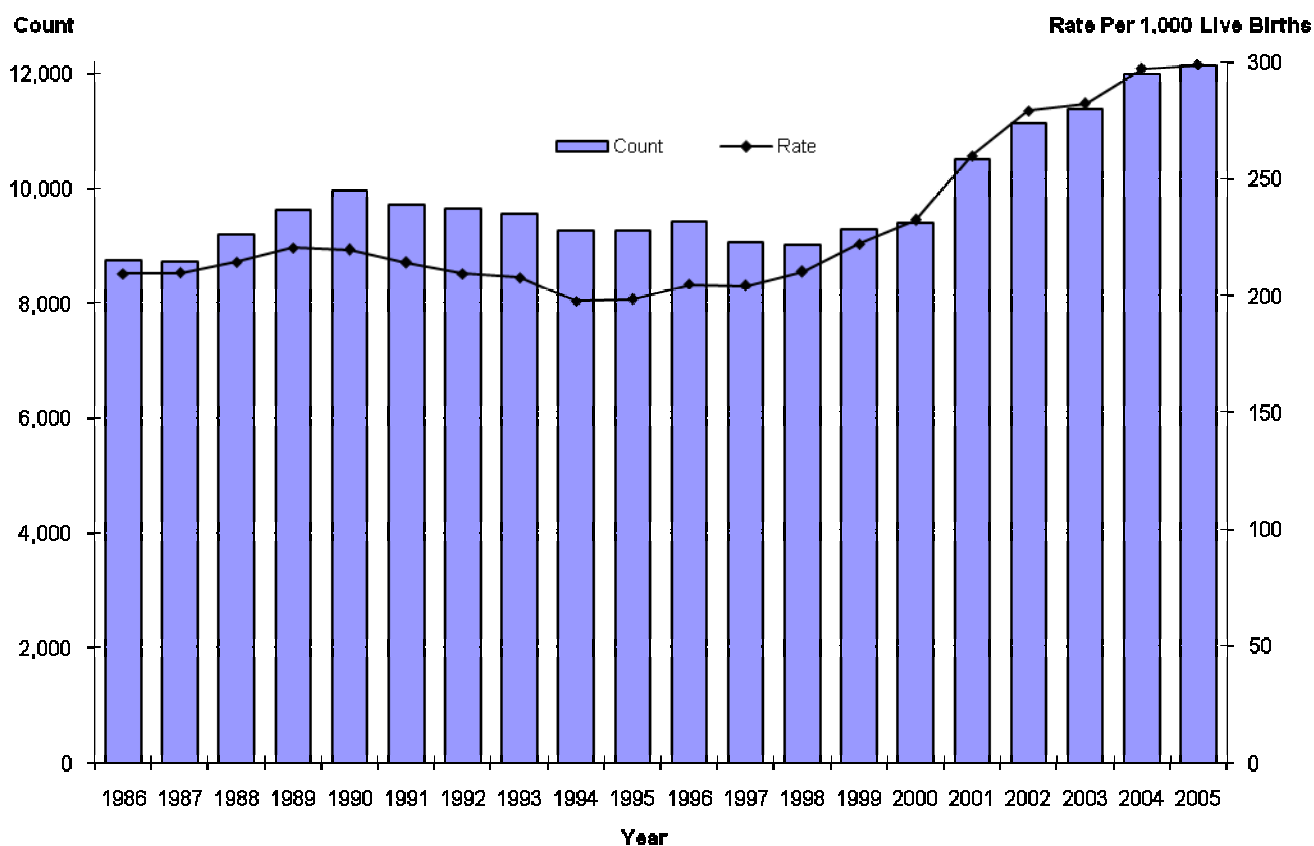
² The Canadian Institute for Health Information (CIHI) Health Indicators Report 2007 reports data by fiscal year and from hospital-based deliveries only. Therefore, caesarean section rates reported in the CIHI report and the CBTF Report may vary slightly.

2.2 BRITISH COLUMBIA

From 1986 to 1997 caesarean section rates were relatively stable, at 21% in 1986 and 20.4% in 1997 (Figure 2) with a high of 22% in 1989. Since then rates have risen steadily to 29.9% in 2005. The rate in each Health Authority in BC has increased over the last six years, becoming both higher and more varied across the province (see map, Appendix H). The Northern Health Authority had the lowest rates in both 2000 (22.6%) and 2005, (26.4%). The Vancouver Coastal Health Authority had the highest rate in 2000 (24.7%), but in 2005 the Vancouver Island Health Authority had the highest rate at 31.5% (Figure 3).

Health Service Delivery Area (HSDA) data shows that in 2005 residents of the South Vancouver Island and Thompson Cariboo Shuswap HSDA had the highest caesarean section rates in the province (35.3% and 32.2% respectively), up from 2000, when the rate was 24.6% and 27.8% respectively (Figure 4). Residents of East Kootenay have also had a substantial increase in caesarean rates from 2000 (20.5%) to 2005 (31.0%). The Northeast (24.4% in 2005) and Kootenay Boundary HSDA (21.0% in 2005) had the lowest rates.

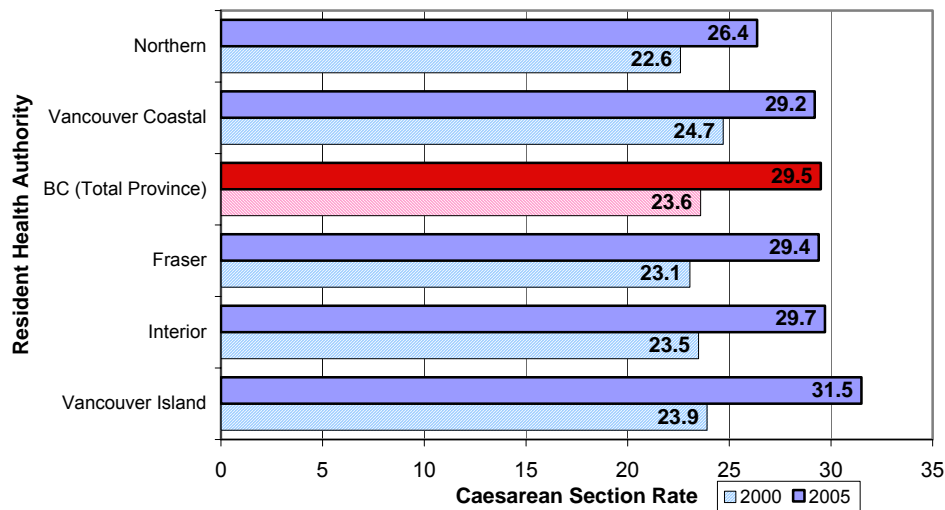
FIGURE 2. CAESAREAN SECTIONS IN BRITISH COLUMBIA, 1986 TO 2005



SOURCE: BC VITAL STATISTICS³

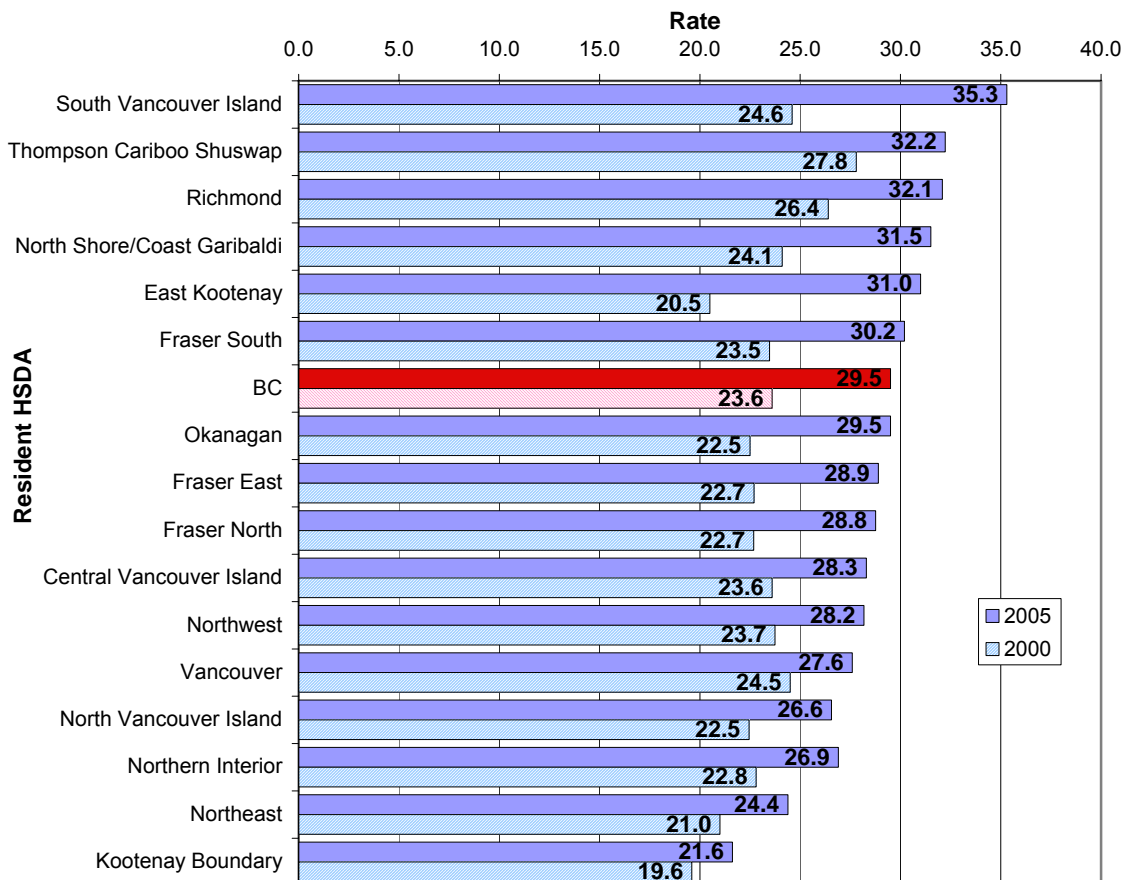
³ This figure reports on live births only. Therefore, caesarean section rates reported elsewhere in the report (that include stillbirths) may vary slightly.

FIGURE 3. CAESAREAN SECTION RATES BY BC HEALTH AUTHORITY, 2000 AND 2005



SOURCE: BC PERINATAL DATABASE REGISTRY

FIGURE 4. CAESAREAN SECTION RATES BY BC HEALTH SERVICE DELIVERY AREA, 2000 AND 2005



SOURCE: BC PERINATAL DATABASE REGISTRY

PRIMARY INDICATIONS FOR CAESAREAN BIRTH

Repeat caesarean section, dystocia, fetal distress, breech presentation and “other” are the most important primary indications for caesarean births (Table 1). Another category, “VBAC declined/maternal request”, was added to the list of primary indications for caesarean birth commencing with April 1, 2004 discharges. This indication was introduced to identify the women who either request a caesarean section (maternal request) without medical indication or who have had a previous caesarean birth or are eligible for a VBAC, but who decline the VBAC (VBAC declined). This indication differs from the ‘Repeat CS’ indication in that the ‘Repeat CS’ indication identifies those women whose caesarean section is medically indicated or is otherwise initiated by the care provider (e.g. she is not eligible for a VBAC). Maternal request/VBAC declined constituted 3.8% of all deliveries (Table 1) and 13% of all caesarean sections performed in BC in 2005.

TABLE 1. RATES OF PRIMARY INDICATIONS FOR CAESAREAN BIRTHS IN BC, 2000 TO 2005

	2000	2001	2002	2003	2004	2005
INDICATION						
Dystocia/CPD	6.1	6.4	6.2	6.2	6.1	6.0
Repeat CS	6.2	6.9	8.0	8.5	6.5	6.0
VBAC Declined/Maternal Request*	-	-	-	-	2.9	3.8
Fetal Distress	3.3	3.6	3.9	3.7	3.9	3.5
Breech	2.8	3.4	3.5	3.3	3.4	3.3
Other	2.4	2.7	2.9	3.1	3.2	3.2
Malposition/Malpresentation	1.6	1.9	2.1	2.1	2.3	2.4
Placenta Previa	0.4	0.5	0.4	0.5	0.5	0.5
Abruptio Placentae	0.4	0.3	0.4	0.4	0.3	0.4
Active Herpes	0.3	0.3	0.3	0.2	0.2	0.2
Total CS Rate	23.6	26.0	27.7	27.9	29.4	29.5

*THIS INDICATION WAS NOT COLLECTED PRIOR TO APRIL 1, 2004

SOURCE: BC PERINATAL DATABASE REGISTRY

The primary indications among expectant mothers having their first caesarean birth and those having second or subsequent procedures were then compared (Table 2). Among women who had never had a caesarean birth, the rate increased from 17.2% in 2000 to 21.0% in 2005. The most common indication for primary caesarean section among these women was dystocia, and the rate for this indicator was fairly stable between 2000 and 2005 (6.2% of all deliveries in 2000 and 6.5% in 2005).

TABLE 2. RATES OF PRIMARY INDICATIONS FOR FIRST CAESAREAN BIRTHS IN BC, 2000 TO 2005

	2000	2001	2002	2003	2004	2005
INDICATION						
Dystocia/CPD	6.2	6.5	6.4	6.5	6.4	6.5
Fetal Distress	3.3	3.6	4.1	3.8	4.1	3.8
Breech	3.0	3.5	3.6	3.6	3.6	3.5
Other	2.1	2.5	2.8	3.1	3.2	3.1
Malposition/Malpresentation	1.6	2.0	2.3	2.2	2.5	2.6
Placenta Previa	0.4	0.4	0.4	0.5	0.5	0.5
Abruptio Placentae	0.3	0.3	0.4	0.3	0.3	0.3
Maternal Request*	-	-	-	-	0.3	0.3
Active Herpes	0.3	0.3	0.3	0.2	0.2	0.2
Total CS	17.2	19.1	20.2	20.2	21.2	21.0

*WOMEN HAVING THEIR FIRST CAESAREAN SECTION CANNOT HAVE A VBAC AND THEREFORE CAN ONLY REQUEST A CAESAREAN SECTION;

THIS INDICATION WAS NOT COLLECTED PRIOR TO APRIL 1, 2004

SOURCE: BC PERINATAL DATABASE REGISTRY

Next, the primary indication for caesarean section among women who had a previous caesarean section was examined (Table 3). “Repeat caesarean section” was the most common primary indication, accounting for 52.1% of all deliveries to mothers with a previous caesarean in 2000 and 43.4% in 2005. The decrease in the

rate of this indication over time is offset by the introduction of a new indication, “VBAC Declined/Maternal Request”, that, in 2005, was the primary indicator for 25.8% of all repeat caesareans (Table 3).

TABLE 3. RATES OF PRIMARY INDICATIONS FOR REPEAT CAESAREAN BIRTHS IN BC, 2000 TO 2005

	2000	2001	2002	2003	2004	2005
INDICATION						
Repeat CS	52.1	57.1	63.2	65.6	48.3	43.4
VBAC Declined/Maternal Request*	-	-	-	-	20.0	25.8
Other	4.3	4.3	3.4	3.2	3.3	3.9
Dystocia/CPD	5.5	5.6	4.4	4.0	3.7	3.0
Fetal Distress	3.7	3.3	2.7	2.7	2.5	3.0
Breech	2.0	2.3	2.7	1.7	2.1	2.3
Malposition/Malpresentation	1.5	1.7	1.2	1.2	0.8	1.1
Placenta Previa	0.6	0.8	0.5	0.6	0.7	0.6
Active Herpes	0.4	0.1	0.2	0.2	0.2	0.1
Abruptio Placentae	0.7	0.7	0.7	0.7	0.4	0.5
Total CS Rate	70.8	75.9	79.0	80.0	82.0	82.5

*THIS INDICATION WAS NOT COLLECTED PRIOR TO APRIL 1, 2004
SOURCE: BC PERINATAL DATABASE REGISTRY

EMERGENT VS. ELECTIVE CAESAREAN BIRTHS

Emergent caesareans have increased from 15.7% in 2000 to 18.1% in 2005 (RR = 1.15, 95% CI: 1.12 – 1.19), while elective caesareans have increased from 7.8% in 2000 to 11.4% in 2005 (RR = 1.45, 95% CI: 1.39 – 1.51) (Table 4). Although emergent caesarean sections are still more common than elective, the rate of increase for elective caesarean sections is greater than for emergent procedures (a 45% relative increase in the rate of elective compared to 15% for emergent).

TABLE 4. NUMBER AND RATE OF EMERGENT AND ELECTIVE CAESAREAN BIRTHS IN BC, 2000 TO 2005

Calendar Year	Number of Deliveries	Caesarean Delivery Rate		Relative Risk (95%CI)
		Number	Rate	
EMERGENT				
2000 (reference)	39,387	6,201	15.7	1.00
2001	40,109	6,812	17.0	1.08 (1.05, 1.11)
2002	39,550	7,016	17.7	1.12 (1.09, 1.16)
2003	39,971	6,910	17.3	1.10 (1.07, 1.13)
2004	39,951	7,354	18.4	1.17 (1.13, 1.20)
2005	40,298	7,281	18.1	1.15 (1.12, 1.19)
ELECTIVE				
2000 (reference)	38,397	3,091	7.8	1.00
2001	40,109	3,586	8.9	1.14 (1.09, 1.20)
2002	39,550	3,936	10.0	1.27 (1.21, 1.33)
2003	39,971	4,219	10.6	1.35 (1.29, 1.41)
2004	39,951	4,369	10.9	1.39 (1.33, 1.45)
2005	40,298	4,584	11.4	1.45 (1.39, 1.51)

CI = CONFIDENCE INTERVAL
SOURCE: BC PERINATAL DATABASE REGISTRY

PRIMARY VS. REPEAT CAESAREAN SECTIONS

Rates of both primary and repeat caesarean sections have increased. Among mothers without a previous caesarean, the rate has increased significantly from 17.2% in 2000 to 21.0% in 2005 (Table 5). The proportion of pregnant women who have had a previous caesarean increased from 11.9% in 2000 to 13.9% in 2005 while the repeat caesarean section rate among these women increased significantly from 70.8% in 2000 to 82.5% in 2005 (Table 5).

TABLE 5. NUMBER AND RATE OF PRIMARY AND REPEAT CAESAREAN BIRTHS IN BC, 2000 - 2005

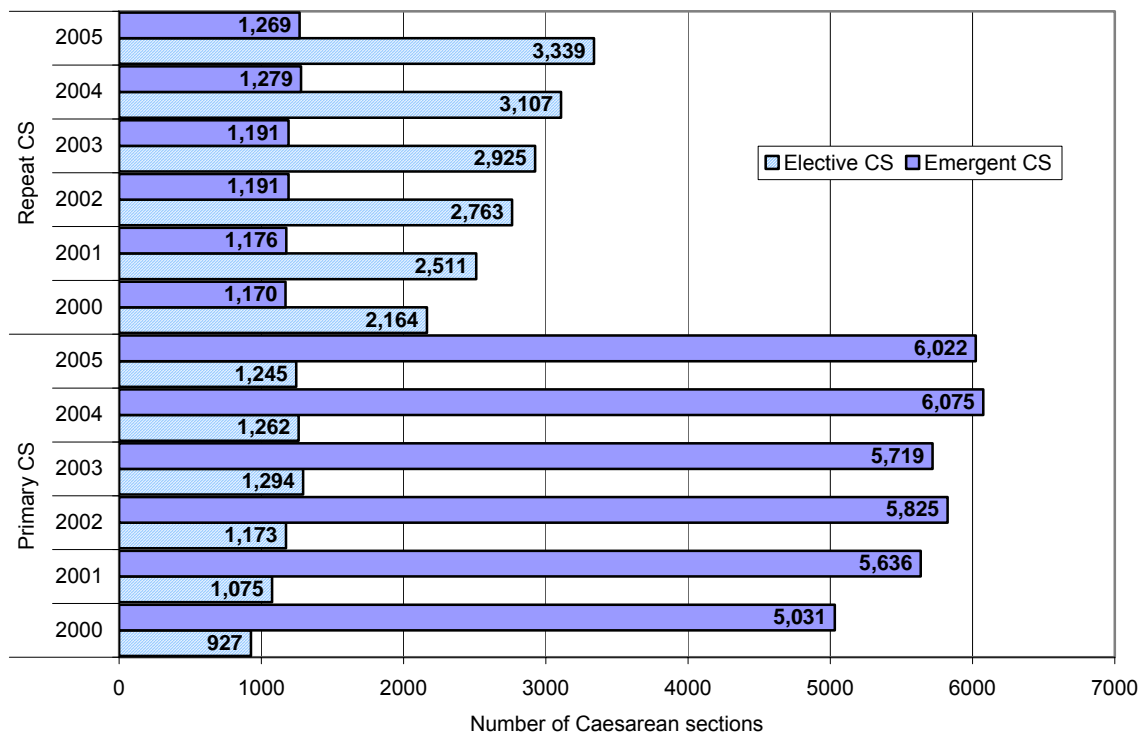
Calendar Year	Number of Deliveries	Caesarean Delivery Rate		Relative Risk (95%CI)
		Number	Rate	
PRIMARY				
2000 (reference)	34,667	5,958	17.2	1.00
2001	35,237	6,711	19.1	1.11 (1.07, 1.14)
2002	34,536	6,998	20.2	1.18 (1.14, 1.22)
2003	34,812	7,013	20.2	1.17 (1.14, 1.21)
2004	34,589	7,337	21.2	1.23 (1.20, 1.27)
2005	34,696	7,267	21.0	1.22 (1.18, 1.26)
REPEAT				
2000 (reference)	4,706	3,334	70.8	1.00
2001	4,860	3,687	75.9	1.07 (1.05, 1.10)
2002	5,006	3,954	79.0	1.11 (1.09, 1.14)
2003	5,145	4,116	80.0	1.13 (1.10, 1.16)
2004	5,352	4,386	82.0	1.16 (1.13, 1.18)
2005	5,586	4,608	82.5	1.16 (1.14, 1.19)

CI = CONFIDENCE INTERVAL

SOURCE: BC PERINATAL DATABASE REGISTRY

A comparison of emergent and elective caesareans shows that a first caesarean is more likely to be emergent, while a subsequent one is likely to be elective (Figure 5).

FIGURE 5. COMPARISON OF PRIMARY ELECTIVE VS. EMERGENT AND REPEAT ELECTIVE VS. EMERGENT CAESAREAN SECTIONS IN BC, 2000 AND 2005



SOURCE: BC PERINATAL DATABASE REGISTRY

VAGINAL BIRTHS

Rates of spontaneous vaginal birth have decreased over the last five years, from 64.2% in 2000 to 60.1% in 2005 (RR 0.94, 95% C.I. 0.93-0.95). The rate of assisted vaginal delivery, including vacuum and forceps interventions, has decreased significantly from 12.2% in 2000 to 10.4% in 2005 (RR 0.86, 95% C.I. 0.83-0.89) (Table 6).

TABLE 6. NUMBER AND RATE OF ASSISTED VAGINAL BIRTH IN BC, 2000 - 2005

Calendar Year	Number of Deliveries	Spontaneous Vaginal Delivery			Assisted Vaginal Delivery		
		Number	Rate	Relative Risk (95%CI)	Number	Rate	Relative Risk (95%CI)
2000 (reference)	39,387	25,291	64.2	1.00	4,804	12.2	1.00
2001	40,109	24,946	62.2	0.97 (0.96, 0.98)	4,795	11.9	0.97 (0.94, 1.01)
2002	39,550	24,178	61.1	0.95 (0.94, 0.96)	4,420	11.2	0.92 (0.88, 0.95)
2003	39,971	24,421	61.1	0.95 (0.94, 0.96)	4,421	11.1	0.91 (0.88, 0.95)
2004	39,951	23,914	59.9	0.93 (0.92, 0.94)	4,314	10.8	0.89 (0.85, 0.92)
2005	40,298	24,210	60.1	0.94 (0.93, 0.95)	4,213	10.4	0.86 (0.83, 0.89)

CI = CONFIDENCE INTERVAL

SOURCE: BC PERINATAL DATABASE REGISTRY

VAGINAL BIRTH AFTER CAESAREAN

The rate of attempted vaginal birth after caesarean (VBAC) decreased from 41.4% in 2000 to 24.3% in 2005, but the VBAC success rate remained stable (70.4% in 2000 and 70.9% in 2005). (Table 7)

TABLE 7. PROPORTION OF VBAC ATTEMPTED AND VBAC SUCCESSFUL IN BC, 2000-2005

Calendar Year	Number of mothers with a previous Caesarean (Proportion of all deliveries)	VBAC Attempted Rate		VBAC Successful Rate	
		N	%	N	% (of VBAC attempted)
2000	4,706 (11.9%)	1,949	41.4	1,372	70.4
2001	4,860 (12.1%)	1,758	36.2	1,173	66.7
2002	5,006 (12.7%)	1,529	30.5	1,052	68.8
2003	5,145 (12.9%)	1,474	28.6	1,030	69.9
2004	5,352 (13.4%)	1,403	26.2	956	68.1
2005	5,586 (13.9%)	1,359	24.3	963	70.9

SOURCE: BC PERINATAL DATABASE REGISTRY

2.3 SUMMARY OF BIRTH TRENDS

A review of birth trends in Canada and using BC data from 2000 to 2005 showed that:

- British Columbia currently has the highest caesarean section rate in Canada
- Vancouver Island Health Authority has the highest caesarean section rate in BC
- Dystocia was the most common primary indication for caesarean section in BC
- Primary caesarean section is more likely to be emergent, while subsequent caesarean sections are more likely to be elective
- Both primary (first) and repeat caesarean sections are on the rise, with rates of 21.0% and 82.5%, respectively, in 2005
- Fewer women are attempting VBAC but the success rate has not changed

3. MATERNAL AND INFANT HEALTH OUTCOMES AND PUBLIC HEALTH COSTS

There are two ways to consider complications of caesarean birth: (1) the absolute risk of complications, usually based on observational studies giving a rate of reported injury per a given number of cases, and (2) comparative risk/benefit analysis between elective caesareans and planned vaginal birth. For this report we use the comparative method with some reference to observational data.

Studies of relative risk are limited by dissimilarities in health status and other variables. Often the complications of caesarean section are linked with underlying pathology. Complications attributable to the operative procedure itself include hemorrhage secondary to uterine atony, extension of the uterine incision, bladder or urethra injury, broad ligament excision, injury to the gastrointestinal tract, and wound infection [15]. Variations in terminology and discharge follow-up practices make it difficult to assess the incidence and severity of complications.

3.1 MATERNAL HEALTH OUTCOMES

In 2007 the results of a Canadian cohort study were published comparing outcomes of women with no known medical conditions who had either planned primary caesarean sections for breech presentation or planned vaginal births during 1991-2005 in all provinces except Quebec and Manitoba [2]. The low-risk planned caesarean group experienced a 3-fold greater incidence of overall serious maternal morbidity, specifically cardiac arrest, major puerperal infection, anesthetic complications, venous thromboembolism, and hemorrhage requiring hysterectomy.

An earlier 15-year study in Nova Scotia reported a statistically significant association between caesarean section (CS) and uterine rupture, eclampsia, need for blood transfusion, emergency hysterectomy, and admission to an intensive care unit [16]. Another Canadian cohort study reported a significantly increased risk of postpartum readmission (2.7%), compared with spontaneous vaginal birth (1.5%) [17].

The incidence of maternal mortality in Canada is so low it is almost impossible to show trends. Thus, severe maternal morbidities are used as an analytical surrogate for mortality. In 2005, a study published by the Canadian Perinatal Surveillance group reported on a retrospective cohort study of 2,548,824 women giving birth in Canada between 1991-2000 [18]. Thirteen severe complications were identified including venous thromboembolism, eclampsia, anesthetic complications, cerebrovascular disorders associated with delivery, uterine rupture, adult respiratory distress syndrome, pulmonary edema, myocardial infarction, acute renal failure, cardiac arrest and severe hemorrhage. Although all are more common with caesarean section than uncomplicated vaginal birth, it is difficult to ascertain from this retrospective data whether a severe complication was the result of an underlying problem or the surgical procedure itself.

Elevated risk in a subsequent pregnancy has been reported for ectopic pregnancy, spontaneous abortion, and placenta previa, placenta accreta, subsequent infertility [19, 20], adhesions leading to bowel obstruction [21], and stillbirth [22, 23]. A study by the US National Center for Health Statistics (1995-2000) reported an increased risk of 40% for placenta previa and placental abruption in a second pregnancy preceded by a CS vs. vaginal delivery after adjusting for maternal socio-demographic factors [24]. The association between placenta praevia and placental abruption with prior CS is likely caused by placental attachment problems in the lower uterine segment scar. Damage to the uterine vessels during surgery may further predispose to a low implantation of the placenta in the uterus in subsequent pregnancy.

Recent comparisons of attempted vaginal births after caesarean (VBAC) compared to elective repeat caesarean reveal a two-fold increase in rates of major maternal complications for the elective repeat, including greater risk of adverse perinatal outcomes and an increased risk of adverse long-term consequences for the mother [25-28].

A recent Canadian study of over 300,000 women undergoing elective repeat Caesareans reported an in-hospital death rate almost five times higher than that among women who attempted trial of labour [26]. A study of 25,000 births in the US reported lower composite major morbidity (uterine rupture, uterine artery laceration, bladder injury, or bowel injury) among women undergoing trial of labour compared to elective repeat CS

(adjusted odds ratio 0.32, 95% CI 0.14-0.72) [29]. In contrast, a systematic review of two prospective cohort studies found no statistically significant difference in maternal or perinatal outcomes between elective repeat caesarean and planned VBAC [30]. The net response to these conflicting findings has been a decrease in rates of trial of labour and an increase in repeat CS [26].

In 2004 the UK's National Institute for Clinical Excellence (NICE) published a comprehensive and well documented review of caesarean complications (Table 8). The NICE data includes pelvic floor complications such as urinary incontinence (UI), fecal incontinence (FI) and dyspareunia. Evidence has accumulated that vaginal birth as usually practiced has *short-term* impact on the occurrence of UI, and this risk may be reduced only to a small degree by elective caesarean section [31-33]. Both cross-sectional support continued impact on UI and cohort studies with greater than 1-year follow-up, but the importance of these symptoms in terms of their effect on quality of life is unknown. However, studies reporting severity data have not shown a significant difference in occurrence of severe UI following either vaginal or caesarean birth, even short term. The number of elective caesarean sections needed to prevent one occurrence of stress UI, of any severity, is 7.5. (The NNT for unspecified UI is 10.2 and an NNT for stress UI of 14.6) [34].

The occurrence of postpartum fecal incontinence (FI) is very slightly increased after the experience of any birth and is particularly related to instrumental delivery. The evidence suggests that caesarean delivery reduces the incidence of postpartum FI and this effect appears to be similar with respect to both elective and intrapartum caesarean section [32, 35]. A recent systematic review demonstrated that it would take 167 caesarean sections to prevent one case of FI [36]. Sexual dysfunction is common following any delivery; however, there is little evidence that caesarean section reduces this risk long term [37, 38]. There is some evidence that instrument delivery may have a greater impact on sexual dysfunction than either spontaneous vaginal birth or caesarean section [39, 40].

A prospective cohort study of 97,075 births from the 2005 World Health Organization Global Survey in Maternal and Perinatal Health examined the relation between delivery modes and perinatal outcomes in several Latin America countries. They found that women who had intrapartum caesareans had an increased risk of severe maternal morbidity and mortality compared with women undergoing vaginal delivery, (OR 2.0, 95% CI: 1.6-2.5 versus OR 2.3, 95% CI: 1.7-3.1). Compared with vaginal deliveries, caesareans (intrapartum or elective) increased the risk for maternal death, hysterectomy, intensive care admission, antibiotic treatment after delivery and hospital stay greater than seven days [41].

TABLE 8. MATERNAL HEALTH EFFECTS OF CAESAREAN SECTION COMPARED WITH VAGINAL BIRTH

	Absolute risk		Relative risk (95% confidence interval)	Evidence level ^e
	CS	Vaginal birth		
Effects around the time of birth				
Reduced after CS				
Perineal pain	2%	5%	0.3 (0.2, 0.6)	Ib
Increased after CS				
Abdominal pain	9%	5%	1.9 (1.3, 2.8)	Ib
Bladder injury ^a	0.1%	0.003%	36.6 (10.4, 128.4)	III
Ureteric injury ^a	0.03%	0.001%	25.2 (2.6, 243.5)	III
Need for further surgery such as laparotomy or dilatation and curettage ^a	0.5%	0.03%	17.5 (9.4, 32.1)	IIb
Hysterectomy ^{a,d}	0.8% 0.7%	0.01% 0.02%	95.5 (67.6, 136.9) 44.0 (22.5, 85.8)	IIb
Admission to intensive care unit ^a	0.9%	0.1%	9.0 (7.2, 11.2)	III
Thromboembolic disease ^a	Overall risk 0.04-0.16%		3.8 (2.0, 4.9)	IIb
Length of stay ^b	3-4 days	1-2 days		Ib
Readmission to hospital ^a	5.3%	2.2%	2.5 (1.1, 5.4)	IIb
Maternal death ^a	82.3 per million	16.9 per million	4.9 (3.0, 8.0)	III
Not different				
Hemorrhage ^c (blood loss in excess of 1000 ml)	0.5%	0.7%	0.8 (0.4, 4.4)	Ia
Infection ^c (wound infection or endometritis)	6.4%	4.9%	1.3 (1.0, 1.7)	Ia
Genital tract injury (extension of uterine incision, cervical laceration)	0.6%	0.8%	1.2 (0.4, 3.4)	Ia
Long-term effects				
Reduced after CS				
Urinary incontinence (at 3 months after birth)	4.5%	7.3%	0.6 (0.4, 0.9)	Ib
Utero-vaginal prolapse ^a	Overall prevalence 5%		0.6 (0.5, 0.9)	III
Not different (at 3 months after birth)				
Fecal incontinence	0.8%	1.5%	0.5 (0.2, 1.6)	Ib
Back pain	11.3%	12.2%	0.9 (0.7, 1.2)	Ib
Postnatal depression	10.1%	10.8%	0.9 (0.7, 1.2)	Ib
Dyspareunia	17.0%	18.7%	0.9 (0.7, 1.1)	Ib
Implications for future pregnancies				
Increased after CS				
Having no more children ^a	42%	29%	1.5 (1.1, 2.0)	IIb
Placenta previa in a future pregnancy ^d	0.7%	0.5%	1.4 (1.1, 1.6)	IIb
	0.8%	0.5%	1.6 (1.3, 2.0)	IIb
	0.4%	0.2%	1.3 (1.0, 1.7)	IIb
Uterine rupture in a future pregnancy ^a	0.4%	0.01%	42.2 (31.1, 57.2)	IIb
Antepartum stillbirth in a future pregnancy ^a	0.4%	0.2%	1.6 (1.2, 2.3)	IIb
Source: National Institute for Clinical Excellence (NICE 2004)				
^a Data for these outcomes are from observational studies and reflect the absolute and relative risks for women who actually had either a vaginal birth or CS. Care needs to be taken in interpretation of this data as there is usually more than one explanation for the association seen and it is not possible to disentangle the effect of CS from the reasons for CS.				
^b Data provided are averages for length of hospital stay.				
^c In these RCTs antibiotics and oxytocics were used as prophylaxis against infection and hemorrhage at CS.				
^d Numbers for these risks are based on data from more than one observational study.				
^e Evidence level –adapted from Eccles and Mason [42] – refer to Appendix G				

3.2 INFANT HEALTH OUTCOMES

We compared outcomes for newborns delivered by caesarean section with spontaneous birth or an assisted birth using vacuum extraction and forceps. Analyzing the neonatal risk/benefit is complex. Morbidity associated with instrumental delivery might be prevented by caesarean section, but there is a downside. While caesarean birth can be life saving for an infant in a state of significant fetal distress, it carries additional risks of other morbidities and, in some cases, a greater risk of mortality.

A study published in 2007, using Canadian data from 1988-2002, compared neonatal outcomes in term newborns born by spontaneous and assisted vaginal delivery with newborns born by caesarean delivery, with and without labour [43]. The authors concluded that caesarean delivery in labour was more likely to be associated with increased risk for respiratory conditions than without labour. They concluded that caesarean section, particularly without labour, appears to prevent neonatal birth trauma.

A study published in 1999 reviewed nearly 600,000 births in a large California database and examined the incidence of intracranial hemorrhage with different modes of delivery [44]. Injury rates were highest in newborns delivered with forceps (1/66), next highest, vacuum (1/860), caesarean section in labour (1/907), spontaneous delivery (1/1900), and caesarean section without labour (1/2750). Compared with infants delivered spontaneously, those delivered by vacuum extraction had a significantly higher rate of subdural or cerebral hemorrhage (OR 2.7), as did infants delivered with forceps (OR 3.4) or caesarean section during labour (OR 2.5). The common risk factor appears to be abnormal labour.

Another large study, published in 2001 [45], compared the risk of neonatal injury from sequential use of vacuum and forceps with the outcomes from vaginal birth. Researchers found that risk of intracranial hemorrhage, facial nerve injury, seizures, depressed 5 min Apgar score and assisted ventilation were all significantly more common in the infants born following sequential use of instruments than in those delivered spontaneously.

Caesarean births have a higher incidence of various forms of respiratory distress, from mild transient tachypnea to severe persistent pulmonary hypertension. A recent publication reviewed a total of 9 eligible studies examining neonatal respiratory morbidity as the primary outcome following elective caesarean section [46], including less serious conditions such as transient tachypnea, as well as more serious ones, such as persistent pulmonary hypertension and the need for mechanical ventilation. All of these studies found that elective caesarean section increased the risk of various respiratory morbidities in the term and near term newborn, with the risk for most outcomes increased 2-3 times in comparison to vaginal delivery. With more accurate dating of pregnancy, the risk of prematurity and respiratory distress syndrome has been substantially reduced, but there is still a significant increase in respiratory distress syndrome compared to newborns delivered vaginally. The risk of significant respiratory morbidity can be reduced but not eliminated if elective caesarean section is deferred to week 39+ as compared to <39 weeks [47].

Respiratory distress, even transient tachypnea of the newborn, requires that infants be separated from their mothers to be cared for in a neonatal intensive care unit (NICU) for close monitoring and management such as mechanical ventilation. This separation interferes with the establishment of breast-feeding and may be difficult for families.

Persistent pulmonary hypertension (PPHN) is a clinical syndrome that results from the failure of the normal transition from fetal to neonatal circulation, and can be associated with significant and at times severe respiratory distress. A recent study of 377 infants with PPHN matched with 836 controls showed that delivery by caesarean section vs. vaginal birth resulted in a 7 fold increase in risk of this life-threatening condition [48].

A study of 5,760,000 live births in the U.S. between 1998-2001 reviewed infant and neonatal mortality risks associated with primary caesarean section for singleton full-term (37-41 weeks gestation) women with no indicated medical risks or complications [49]. Neonatal mortality rates were higher among infants delivered by caesarean section (1.77 per 1000 live births) than for those delivered vaginally (0.62 per 1000). The magnitude of this difference was reduced only moderately after statistical adjustment for demographic and

medical factors, and when deaths due to congenital malformations and events with Apgar scores less than 4 were excluded.

The 2005 World Health Organization (WHO) global survey on maternal and perinatal health in Latin America examined data from 97,095 deliveries with a median caesarean rate of 33% [50]. Increase in caesarean birth was associated with higher fetal mortality rates and higher incidence (adjusted for preterm delivery) of babies admitted to intensive care for 7 days or longer. The same study found that caesarean delivery independently reduces overall risk in fetal death for breech presentations. With cephalic presentations, after adjustment for possible confounders and gestation age, intrapartum or elective caesarean section increased the risk for longer neonatal stay of seven or more days and the risk of neonatal mortality up to hospital discharge [41].

3.3 PUBLIC HEALTH COSTS

The Canadian Institute of Health Information (CIHI) recently reported that the average cost of caesarean delivery (\$4,600) is 60% higher than that of vaginal delivery (\$2,800) [3]. Thus, a 6% “absolute reduction” in caesarean delivery from 26% to 20% of 330,000 annual births [1] would mean that 19,800 births would take place at a cost reduction of \$1,800 per birth for a total annual cost savings of \$36,640,000. The increased length of stay (average of 72 hours vs. 12 - 48 for vaginal birth) has implications for hospital nursing staff at a time when nurses are becoming increasingly scarce [10]. An increased risk of re-hospitalization associated with caesarean section has been reported in Canada [17] and the U.S.

Neonatal respiratory distress associated with caesarean birth creates a significant increase in the use of neonatal intensive care with a substantial increase in costs. This is of particular concern in BC, where ongoing difficulty in meeting the demand for neonatal intensive care resources results in regular transfer of infants out of the province for care.

3.4 SUMMARY OF MATERNAL AND INFANT HEALTH OUTCOMES AND PUBLIC HEALTH COSTS

A review of the literature showed that:

- **Wherever possible, elective caesarean section should not be performed before 39 completed weeks gestation but even this cannot completely eliminate respiratory morbidity in the neonate.**
- Compared with spontaneous vaginal births, women who had low-risk planned caesareans experienced a 3-fold greater incidence of overall serious maternal morbidity specifically cardiac arrest, major puerperal infection, anesthetic complications, venous thromboembolism, and hemorrhage requiring hysterectomy than women who had spontaneous vaginal births.
- Enhanced risk associated with caesarean birth is not confined to first caesarean delivery alone. Elevated risk in a subsequent pregnancy (even the second birth after a caesarean) for ectopic pregnancy, spontaneous abortion, and placenta previa, placenta accreta, subsequent infertility, adhesions leading to bowel obstruction, and stillbirth is clear.
- Caesarean delivery in labour is more likely to be associated with increased risk for infant respiratory complications and caesarean delivery without labour may protect infants from birth trauma.
- Intracranial hemorrhage rates are lowest in caesarean section without labour, highest in forceps delivery compared with delivery by forceps, vacuum, CS in labour, spontaneous delivery and CS without labour.
- Infant and neonatal mortality risks associated with primary caesarean section for singleton full-term (37-41 weeks gestation) women with no indicated medical risks or complications are higher among infants delivered by caesarean section than those delivered vaginally.

- Caesarean births are associated with higher fetal mortality rates and a higher incidence (adjusted for preterm delivery) of babies admitted to intensive care for 7 days or longer.
- Compared with vaginal births, CIHI estimates that average cost of caesarean delivery (\$4,600) is 60% higher than that of vaginal delivery (\$2,800). In Canada, a 6% absolute reduction in caesarean delivery from 26% to 20% would mean that 19,800 births would take place at a cost reduction of \$1,800 per birth for a total annual cost savings of \$36,640,000.

These studies show that neonatal morbidity, largely secondary to birth trauma, can be only slightly reduced by elective caesarean section but at the cost of substantially increased maternal morbidity in the index and subsequent pregnancies and increases in societal financial cost due to extra resources required to care for women having caesarean section.

4. FACTORS CONTRIBUTING TO THE RISE IN CAESAREAN RATES IN BC

Increases in caesarean birth are associated with a wide range of factors, including maternal age and health, present and past pregnancies and births, obstetric indications, type of provider and malpractice pressure [51]. Geographic variations in caesarean section rates are only partially explained by non-medical factors, such as differences in patient population and access to and capacity of the local health care system.

The Task Force analyzed changes in maternal and pregnancy characteristics and their relation to caesarean section rates using records from the BC Perinatal Database Registry (BCPDR) for all maternal discharges from January 1, 2000 to December 31, 2005 (n=239,266). Select variables were placed in four categories: 1) Maternal characteristics (age, pre-pregnancy weight, weight gain in pregnancy, pre-pregnancy body mass index, parity, and smoking in pregnancy), 2) Maternal health status (hypertension and diabetes), 3) Obstetric characteristics (multiple gestation, preterm births, dystocia, fetal distress, malpresentation, induction of labour and epidural) and 4) Maternity care providers.

The Task Force also conducted a comparative analysis of caesarean section rates and indications in two populations, (1) all mothers and (2) mothers without a previous caesarean section. We examined demographics, maternal health status, pregnancy and perinatal characteristics in these populations to identify the most significant predictors.

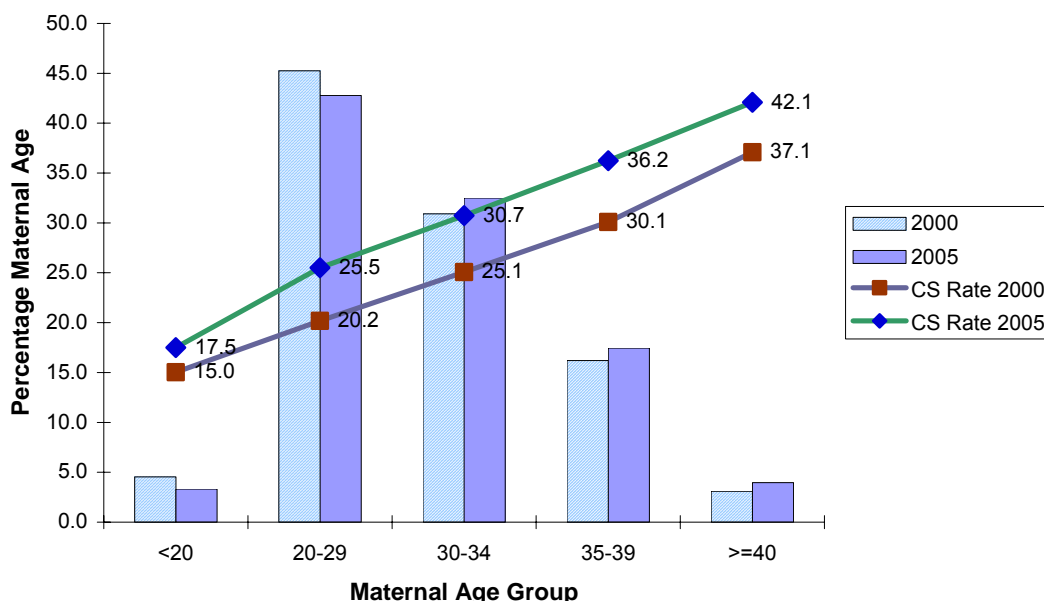
4.1 MATERNAL CHARACTERISTICS

AGE

The average age of mothers in BC increased from 29.9 years in 2000 to 30.4 years in 2005. The average age of first-time mothers increased from 28.3 years in 2000 to 28.8 years in 2005. In 2000 50.2% of all expectant mothers were 30 years of age or older; in 2005, 53.9% (Figure 6).

Caesarean section rates have increased over the last six years in every age category. In 2000 the rate for mothers aged 35 to 39 was 30.1%, while in 2005 the rates was 36.2%. The proportion of mothers aged 20 to 29 decreased from 45.2% in 2000 to 42.8% in 2005; however, the caesarean rates for this age group increased from 20.2% in 2000 to 25.5% in 2005. The rate for mothers under the age of 20 increased from 15.0% in 2000 to 17.5% in 2005 (Figure 6).

FIGURE 6. CAESAREAN BIRTH RATE BY MATERNAL AGE GROUPS 2000 AND 2005



SOURCE: BC PERINATAL DATABASE REGISTRY

BODY MASS INDEX AND WEIGHT GAIN DURING PREGNANCY

Overweight and obesity have become significant health issues with increased prevalence rates for both genders and in all categories since the 1970's [52]. Unhealthy Body Mass Index (BMI) pre-pregnancy and excessive weight gain during pregnancy is associated with numerous obstetric and perinatal health outcomes. Higher pre-pregnancy BMI increases the likelihood of caesarean birth. Pre-pregnancy overweight and obesity are associated with increased risk of gestational hypertension, diabetes, pre-eclampsia, and higher birth weight babies [53, 54].

Health Canada classifies people into four BMI groups: underweight (BMI<18.5), normal weight (18.5-24.9), overweight (25.0-29.9) and obese (>=30.0) [55]. In 2005 obese mothers had a caesarean section rate of 39.8%, while normal weight mothers had a rate of 26.7%, and underweight mothers, 22.6% (Table 9).

Rates have increased in every pre-pregnancy BMI category. Overweight mothers had rates of 25.4% in 2000 and 34.1% in 2005. Underweight mothers had a caesarean rate of 16.2% in 2000, which increased to 22.6% in 2005. The increase in rates by BMI group does not reflect the actual prevalence of these groups in the maternal population. Overweight mothers accounted for only 19.2% of mothers with known⁴ BMI in 2000 and 20.0% in 2005.

Of concern is the large proportion of mothers with unknown BMI (29.6% in 2005). Data about this group would lead to a more complete understanding of the contribution of BMI to caesarean rates.

⁴ Known BMI = mothers with complete information available to calculate BMI (e.g. pre-pregnancy weight and height).

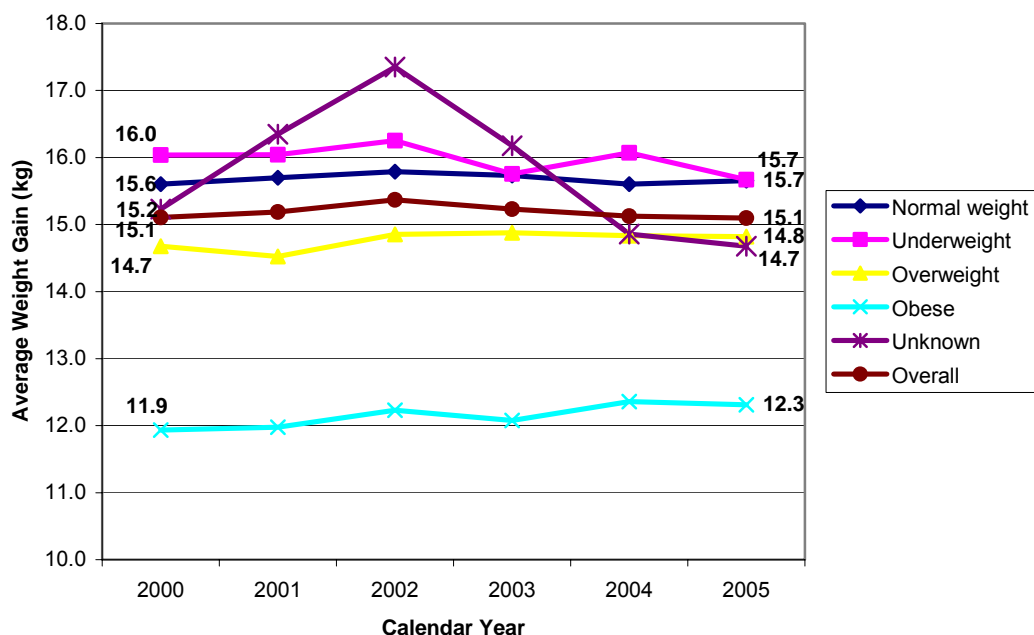
TABLE 9. PREVALENCE AND CAESAREAN SECTION RATE BY MATERNAL WEIGHT AND BODY MASS INDEX IN BC, 2000 AND 2005

Indication	Frequency		CS Rate	
	2000 (n=39,387)	2005 (n=40,298)	2000 (n=9,292)	2005 (n=11,875)
Pre-Pregnancy weight (kg)*				
<55	28.1	25.8	20.6	26.6
55-59	17.8	17.2	21.7	27.6
60-69	28.1	28.1	21.5	27.4
>=70	26.0	28.9	26.6	33.6
Missing	18.8	20.7	27.7	31.2
Pre-Pregnancy Body Mass Index Group*				
Underweight	7.4	6.5	16.2	22.6
Normal weight	63.2	62.2	20.9	26.7
Overweight	19.2	20.0	25.4	34.1
Obese	10.2	11.3	33.1	39.8
Unknown	28.2	29.9	26.0	29.6

*FREQUENCIES CALCULATED AFTER EXCLUDING MISSING/UNKNOWN VALUES
SOURCE: BC PERINATAL DATABASE REGISTRY

The average weight gain in pregnancy has remained at 15.1 kg over the past six years. Women who are obese pre-pregnancy gain less weight than the other BMI groups and this trend has not changed from 2000 to 2005 (Figure 7). Underweight women gain the most weight during pregnancy.

FIGURE 7. AVERAGE WEIGHT GAIN IN PREGNANCY IN BC, 2000 TO 2005



SOURCE: BC PERINATAL DATABASE REGISTRY

The prevalence of various weight gain categories has not changed dramatically from 2000 to 2005. The majority of pregnant women whose weight was reported gained between 10 and 20 kg. In 2000 and 2005, 29.3% and 30.0% of mothers, respectively, gained between 15 and 19 kg during pregnancy (Table 10).

Women who are heaviest pre-pregnancy have the highest probability of caesarean section, regardless of the amount of weight gained in pregnancy. Women who are normal weight pre-pregnancy and gain between 10-14 kg had a rate of 25.9% in 2005, while overweight women who gained between 5 and 9 kg in pregnancy had a caesarean section rate of 29.7% (Table 10).

TABLE 10. WEIGHT GAIN DURING PREGNANCY, OVERALL AND BY BODY MASS INDEX GROUP, FREQUENCY AND CS RATE IN BC, 2000 AND 2005

Indication	Frequency		CS Rate	
	2000 (n=39,387)	2005 (n=40,298)	2000 (n=9,292)	2005 (n=11,875)
Weight gain (kg)*				
<5	2.9	3.2	24.8	32.1
5-9	13.8	13.6	21.0	27.3
10-14	36.1	34.6	20.3	28.2
15-19	29.3	30.0	21.9	30.3
>=20	17.9	18.6	26.8	35.5
Missing	34.1	35.1	26.4	28.1
Underweight BMI				
<5	0.7	1.1	7.1	35.0
5-9	7.8	8.5	14.1	14.7
10-14	32.8	31.8	13.7	21.3
15-19	28.7	28.6	16.2	24.4
>=20	17.2	17.2	18.7	28.3
Missing	12.8	12.7	21.3	18.0
Normal weight				
<5	1	1.1	22.3	27.2
5-9	9.2	9.3	18.6	23.1
10-14	32	31.2	18.9	25.9
15-19	26.7	28.5	20.2	27.4
>=20	16.1	17	24.8	32.3
Missing	15.1	12.8	23.5	22.4
Overweight				
<5	3.5	3.7	20.4	26.6
5-9	14.3	14.6	18.7	29.7
10-14	28.8	28.4	22.6	33.1
15-19	23.1	23.1	26.7	36.6
>=20	15.4	16.8	33.1	43.3
Missing	14.9	13.5	28.3	27.5
Obese				
<5	10.6	11.1	30.8	36.5
5-9	22.6	20.8	31.9	36.4
10-14	25.5	24.1	31.8	40.9
15-19	14.1	17.4	36.4	44.8
>=20	9.1	10	39.3	48.3
Missing	18.1	16.7	32.4	34.1

*FREQUENCIES CALCULATED AFTER EXCLUDING MISSING/UNKNOWN VALUES
SOURCE: BC PERINATAL DATABASE REGISTRY

PARITY AND PREVIOUS CAESAREAN SECTION

The proportion of nulliparous women and mothers with parity ≥ 1 has remained fairly stable from 2000 to 2005 but caesarean rates have increased in both groups. Rates for nulliparous mothers increased from 26.9% in 2000 to 31.9% in 2005 and for mothers with parity ≥ 1 , rates increased from 20.9% to 27.4% (Table 11).

TABLE 11. NUMBER AND RATE OF CAESAREAN SECTIONS BY PARITY IN BC, 2000 TO 2005

TABLE 1. NUMBER AND RATE OF CAESAREAN DELIVERIES BY PARITY AND YEAR, 2000 TO 2005				
Calendar Year	Number	Caesarean Delivery Rate		Relative Risk (95%CI)
		Number	Rate	
NULLIPAROUS MOTHERS				
2000 (reference)	17,810	4,786	26.9	1.00
2001	17,868	5,308	29.7	1.11 (1.07, 1.14)
2002	17,607	5,519	31.3	1.17 (1.13, 1.21)
2003	18,120	5,563	30.7	1.14 (1.11, 1.18)
2004	18,322	5,910	32.3	1.20 (1.16, 1.24)
2005	18,607	5,928	31.9	1.19 (1.15, 1.22)
PARITY≥1 MOTHERS				
2000 (reference)	21,577	4,506	20.9	1.00
2001	22,241	5,090	22.9	1.10 (1.06, 1.14)
2002	21,943	5,433	24.8	1.19 (1.15, 1.23)
2003	21,851	5,566	25.5	1.22 (1.18, 1.26)
2004	21,629	5,813	26.9	1.29 (1.24, 1.33)
2005	21,691	5,947	27.4	1.31 (1.27, 1.36)

CI = CONFIDENCE INTERVAL
SOURCE: BC PERINATAL DATABASE REGISTRY

SMOKING IN PREGNANCY

Although the prevalence of smoking in pregnancy has decreased in BC, from 13.2% in 2000 to 10.5% in 2005, the caesarean section rate for mothers who smoke during pregnancy has increased from 22.5% to 27.5%. caesarean section rates in mothers who do not smoke in pregnancy are higher (23.8% in 2000 and 29.7% in 2005).

4.2 PREGNANCY CHARACTERISTICS

TWIN OR MULTIPLE GESTATION

A very small proportion of pregnant women carry twin or multiple fetuses, although the incidence increased slightly, from 1.3% in 2000 to 1.6% in 2005. Caesarean section rates increased for singleton births from 23.2% in 2000 to 28.9% in 2005; and for twin and multiple births from 54.8% in 2000 to 64.8% in 2005 (Table 12).

TABLE 12. PREVALENCE AND CAESAREAN SECTION RATE BY NUMBER OF BIRTHS AND GESTATIONAL AGE IN BC, 2000 AND 2005

Indication	Frequency		CS Rate	
	2000 (n=39,387)	2005 (n=40,298)	2000 (n=9,292)	2005 (n=11,875)
Number births				
Singleton	98.7	98.4	23.2	28.9
Twins/Multiples	1.3	1.6	54.8	64.8
Gestational age category (Completed weeks)*				
<28 weeks	0.6	0.5	24.4	31.9
28-31 weeks	0.6	0.7	46.0	51.5
32-33 weeks	0.8	1.0	43.8	44.5
34-36 weeks	5.7	6.8	29.5	38.7
37+ weeks	92.3	91.1	22.9	28.5
Missing	0.3	0.3	20.8	19.0

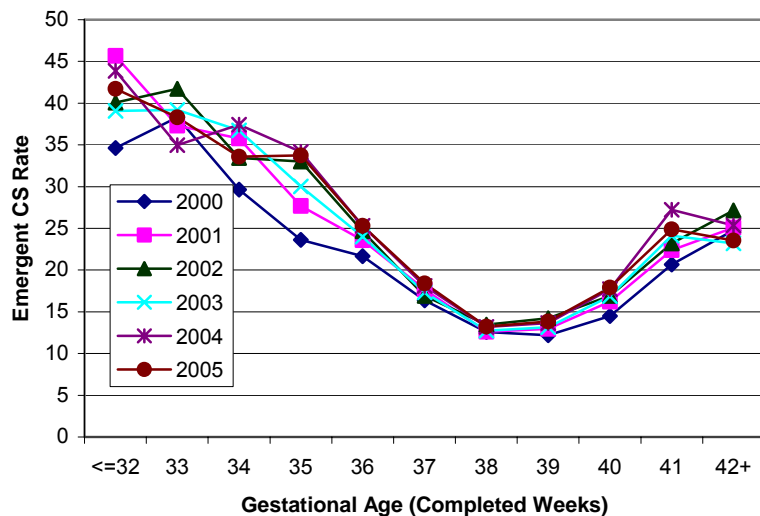
*FREQUENCIES CALCULATED AFTER EXCLUDING MISSING/UNKNOWN VALUES
SOURCE: BC PERINATAL DATABASE REGISTRY

PRETERM BIRTHS

The proportion of births between 34 and 36 completed weeks of gestation is increasing in BC, from 5.7% of deliveries in 2000 to 6.8% in 2005 (Table 12). The caesarean section rate in this gestational age group rose from 29.5% in 2000 to 38.7% in 2005. The largest gestational category, 37+ completed weeks, had the lowest caesarean rates, 22.9% and 28.5% in 2000 and 2005, respectively.

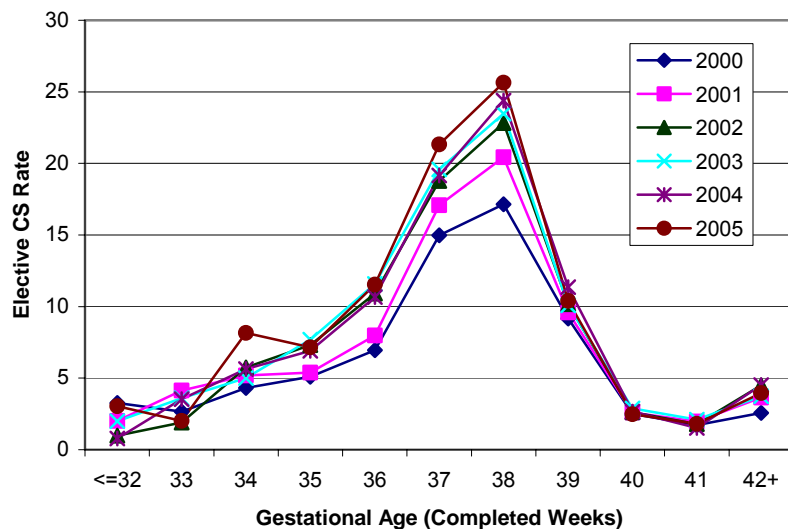
Emergent caesarean births occurred more commonly among preterm and post-term births, while elective caesarean births occurred more frequently between 38 – 39 weeks of gestation (Figures 8 and 9).

FIGURE 8. EMERGENT CAESAREAN SECTION RATE BY GESTATIONAL WEEKS IN BC, 2000 TO 2005



SOURCE: BC PERINATAL DATABASE REGISTRY

FIGURE 9. ELECTIVE CAESAREAN SECTION RATE BY FINAL GESTATIONAL AGE IN BC, 2000 TO 2005



SOURCE: BC PERINATAL DATABASE REGISTRY

4.3 MATERNAL HEALTH STATUS

HYPERTENSION

In 2005 5.2% of pregnant women had hypertension in pregnancy, of which close to half, or 45.6%, had caesarean section delivery, up from 2000 when the prevalence was 4.5% and the caesarean section rate was 39.8% (Table 13).

DIABETES

Diabetics are more likely to have a caesarean delivery than non-diabetics. In 2005 mothers with pre-existing diabetes had a caesarean section delivery rate that was double that of mothers without diabetes (56.8% vs. 28.4%). Women who developed diabetes during pregnancy (gestational diabetes) had a 40.6% caesarean delivery rate (Table 13).

TABLE 13. PREVALENCE AND CAESAREAN RATE FOR HYPERTENSION AND DIABETES IN BC, 2000 AND 2005

Indication	Frequency		CS Rate	
	2000 (n=39,387)	2005 (n=40,298)	2000 (n=9,292)	2005 (n=11,875)
Hypertension in pregnancy				
Yes	4.5	5.2	39.8	45.6
No	95.5	94.8	22.8	28.6
Diabetes				
Diabetes in Pregnancy	6.0	7.0	34.3	40.6
Pre-existing diabetes	0.3	0.4	56.3	56.8
Abnormal Glucose Tolerance	2.4	2.4	27.4	32.8
No	91.2	90.2	22.7	28.4

SOURCE: BC PERINATAL DATABASE REGISTRY

4.4 OBSTETRIC FACTORS

DYSTOCIA, FETAL DISTRESS AND MALPRESENTATION

Dystocia, fetal distress, and malpresentation were important primary indications for caesarean births. Availability of epidural analgesia to support inductions or oxytocin augmentation of labour to manage labour dystocia due to malposition favours surgical intervention by caesarean section.

INDUCTION OF LABOUR

The frequency of induction of labour has remained fairly stable at approximately 21% provincially from 2000 to 2005 (Table 14). Of the mothers with induced labour, the rate of caesarean section has increased slightly from 22.6% in 2000 to 25.7% in 2005. The proportion of women with spontaneous initiation of labour has decreased from 69.4% in 2000 to 64.9% in 2005, and the caesarean section rate for mothers with spontaneous initiation of labour was 15.4% in 2005 (Table 14). In BC in 2005, induction of labour in nulliparous women was associated with almost twice the rate of caesarean section compared with spontaneous labour (37.8% vs. 21.8%) (Table 14).

TABLE 14. PREVALENCE AND CAESAREAN SECTION RATE FOR LABOUR INDUCTION IN BC, 2000 AND 2005

Indication	Frequency		CS Rate	
	2000 (n=39,387)	2005 (n=40,298)	2000 (n=9,292)	2005 (n=11,875)
Induction by Parity (excludes no labour (elective Caesarean section))				
Overall				
Yes (labour induced)	21.4	21.0	22.6	25.7
No (spontaneous initiation of labour)	69.4	64.9	13.8	15.4
Nulliparous				
Yes (labour induced)	25.4	26.5	33.9	37.8
No (spontaneous initiation of labour)	69.5	66.0	18.9	21.8
Parity>=1				
Yes (labour induced)	18.1	16.3	9.5	8.7
No (spontaneous initiation of labour)	69.3	63.9	9.5	9.6
Induction by Gestational Age				
Preterm	1.8	2.0	20.2	20.2
Term	12.7	13.1	20.4	24.0
Post-Term	6.9	5.9	27.1	31.5
No	78.7	79.0	23.9	30.5
Primary Indication for Induction				
Post-dates	37.2	35.1	24.4	28.7
Premature rupture of membranes (PROM)	21.0	23.4	20.5	23.1
Fetal compromise	6.8	7.7	21.2	24.3
Maternal condition	25.1	25.2	24.6	27.2
Other	8.9	7.6	16.6	18.1

SOURCE: BC PERINATAL DATABASE REGISTRY

The timing of labour induction is associated with variation in caesarean section rates. In 2005, women who were induced post-term (regardless of indication for induction) had a caesarean rate of 31.5%, although representing only 5.9% of mothers.

The most common primary indication for induction in 2005 was post-date pregnancies (> 41 completed weeks or 287 days), which accounted for 35.1% of all inductions. Despite well-known practice guidelines [56] that post-date inductions should be undertaken only after 41 weeks plus 3 days gestation, 32.5% of post-date inductions are undertaken before 41 completed weeks gestation (Table 15).

TABLE 15. POST-DATES LABOUR INDUCTION AND GESTATIONAL AGE IN BC, 2000 TO 2005

Calendar Year	Total Mothers with Primary Indication for Induction of Postdates	Number with GA <41		Number with GA of 41		Number with GA of 42		Number with GA of 43+	
		N	%	n	%	n	%	n	%
2000	3,132	896	28.6	1,877	59.9	352	11.2	7	0.2
2001	3,617	1123	31	2,207	61.0	282	7.8	5	0.1
2002	3,027	977	32.3	1,808	59.7	238	7.9	4	0.1
2003	3,009	941	31.3	1,854	61.6	207	6.9	7	0.2
2004	2,744	779	28.4	1,723	62.8	221	8.1	21	0.8
2005	2,972	967	32.5	1,799	60.5	181	6.1	25	0.8

SOURCE: BC PERINATAL DATABASE REGISTRY

EPIDURAL ANALGESIA

Epidural analgesia (EA) is acknowledged as a highly effective pain relief method in labour but considerable controversy exists about the effect of epidurals on labour progress and caesarean section rates. A meta-analysis of 21 randomized trials in 6664 women comparing EA with non-epidural analgesia demonstrated that

EA is more effective in reducing pain in labour and does not contribute to increased caesarean section rate [57]. However, for a variety of reasons, use of EA continues to engender controversy.

Though unadjusted for parity or other characteristics of the woman or her labour, women who have had an epidural during labour have a higher likelihood of caesarean section in that delivery than those who have not (31.4% in mothers with epidural vs. 28.7% in mothers without epidural, 2005) (Table 16).

TABLE 16. PREVALENCE AND CAESAREAN SECTION RATES WITH EPIDURAL IN BC, 2000 AND 2005

		Frequency		CS Rate	
		2000 (n=39,387)	2005 (n=40,298)	2000 (n=9,292)	2005 (n=11,875)
Epidural	Yes	25.7	28.2	31.9	31.4
	No	74.3	71.8	20.7	28.7

SOURCE: BC PERINATAL DATABASE REGISTRY

4.5 MATERNITY CARE PROVIDERS

Provider decision-making is the product of multiple variables [58, 59]. In addition to medical judgment, training, professional demographics, access to technology, medical-legal issues and personal beliefs may all affect choice of delivery mode [60].

Historically, obstetricians functioned primarily as consultants to family doctors and midwives. Fifteen years ago there were 2400 family doctors, who attended almost 80% of the births in the province. Now there are roughly 800, attending less than 50% of the 40,000 births per year. As a result of the decrease in supply of family doctors, obstetricians are overworked and provide more primary care than in the past. Yet, the number of obstetricians is decreasing and they are aging. Many will retire in the next 10 years and the demand for replacement will be greater than the supply.

One of the reasons for the shortage of obstetricians may be the risk of litigation. The Canadian Medical Protective Association states that one in fourteen obstetrician-gynecologists will be named in a new legal action each year. While the vast majority of such cases do not result in liability, fear of a lawsuit may bias the obstetrician's decision in favour of surgery. For example, between 90 and 95% of breech presentations are delivered by caesarean section (Table 19), and reluctance to attempt a vaginal delivery after caesarean has been reported despite evidence that, in the absence of other indications, VBAC is generally low-risk [61, 62].

In the BC Perinatal Database Registry, "maternal request/VBAC declined" was added to the list of primary indications for caesarean section commencing with April 1, 2004 discharges. Maternal request/VBAC declined constituted 3.83% of all deliveries (vaginal + caesarean) and 13% (1,545) of all caesarean sections (11,875) performed in BC in 2005 (Table 1). Maternal request as an indication for caesarean section is not supported by the Society of Obstetricians of Canada [63] or the Federation International of Obstetricians and Gynecologists [64]. Elective caesarean birth upon maternal request may be "camouflaged" as resulting from other indications, such as "fibroids".

Regulated midwifery care was introduced to BC in January 1998 and midwives attend approximately 3000 births at home or in hospital each year. Since that time the number of registered midwives has grown from 44 in their first year, to 120 in 2007. There is one education program at UBC that graduates 10 students each year and the regulatory body, The College of Midwives of BC, offers foreign educated midwives a prior learning and experience assessment (PLEA) process that historically introduces approximately 10 midwives each year to the workforce. Further analysis of BCPHP data indicates that midwives are providing care to approximately 6% of the population and continue to report much lower caesarean section rates with no increase in maternal or newborn morbidity or mortality rates [65].

Midwives generally care for low risk women and believe that birth is a natural process that requires intervention only when deviations from normal are observed. This approach has been associated with lower

surgical rates without increases in neonatal morbidity or mortality [65, 66]. Typical intrapartum midwifery care includes early home support in labour that leads to later admission to hospital, continuous labour support at home or in hospital, encouraging stress management, ambulation, hydration and comfort in a familiar environment. Such personal attention enhances the physiological process. A recent study compared birth outcomes of low risk women delivered by midwives to similar low risk women delivered by physicians in the same hospitals in the first two years of regulated midwifery in BC. Women who planned a hospital birth with a midwife versus a physician were less likely to have a caesarean birth [65].

The BCPDR collects data on care provider at delivery, identifying the care provider type who provides hands-on care delivery of the baby, although this may or may not be the provider who was involved in the mother's prenatal course or 'the most responsible provider' on her delivery admission record. As well, the BCPDR obtains additional care provider information from the Ministry of Health/CIHI Discharge Abstract Data files. This additional information comprises the different types of care providers, including the 'most responsible provider', involved in the delivery admission only; therefore, it may not identify a care provider type who, for example, was involved in antenatal care but transferred care prior to admission for delivery. A delivery admission record may have up to eight CIHI care provider codes if there is more than one type of provider involved; however, as the most responsible provider is the only mandatory care provider type to record, abstraction of this variable into the database may vary or be underreported.

An algorithm was devised to examine data using CIHI provider codes (full definition in Appendix C). The caesarean section rate attributed to the Midwife group increased slightly from a rate of 13.5% in 2000 to 15.1% in 2005 (11% relative increase). The Family Physician rate increased from 18.9% in 2000 to 21.8% in 2004/2005 (15% relative increase). The Obstetrician rate increased substantially from 36.4% to 45.6% from 2000 to 2005 (Table 17).

TABLE 17. PREVALENCE AND CAESAREAN SECTION RATE FOR CARE PROVIDER GROUP IN BC, 2000 VS 2005

Indication Care Provider Group	Frequency		CS Rate	
	2000 (n=39,387)	2005 (n=40,298)	2000 (n=9,292)	2005 (n=11,875)
Midwife	3.3	7.0	13.5	15.1
Family Physician	64.7	59.1	18.9	21.8
Obstetrician	32.0	33.9	36.4	45.6

SOURCE: BC PERINATAL DATABASE REGISTRY

4.6 ANALYTICAL METHODS

Controlling for maternal age in sequential modeling only explained a very small proportion of the 35% increase in caesarean section rates over the six years. In fact, adjusting for many of the maternal factors (age, parity, pre-pregnancy BMI), health status (smoking, hypertension, diabetes), and obstetric factors (gestational age, induction and epidural), only explained a small proportion of the increase in caesarean section rate over time (see Table A, Appendix D). Only after adjustment for care provider group was a larger proportion of the caesarean section increase over time explained. The final regression model (Table B, Appendix D) shows the relationship between each of the factors and caesarean section. Mothers who are older, heavier pre-pregnancy, who have diabetes or hypertension, are induced post-term or who have had epidural are more likely to have caesarean section, although these factors only explained a very small proportion (7.9%) of the variation in caesarean section rates. Adjustment for care provider explained 13.6% of the variation in caesarean section rates.

These results suggest that maternal characteristics, such as increased age and pre-pregnancy weight, while having the effect of increasing caesarean section, are not the only factors that predict caesarean section. In fact, the small amount of variation explained by our regression model also suggests that there are other factors, not necessarily measured in the BCPDR, that are contributing to increasing risk for caesarean section.

This analysis makes clear that no one factor explains nor can one or even a few demographic interventions result in a major reduction in the rising caesarean section rate.

After conducting similar analyses in a population of only primiparous mothers, we found similar results, in that, while maternal factors such as increased age and pre-pregnancy weight have a significant effect on rates of caesarean section, other factors such as epidural use and care provider group have a more significant effect. As well, our regression model in primiparous mothers was only able to explain 10.6% of the variation in caesarean section rates (Table C, Appendix D)

Limitations

Our analysis has some data limitations that could affect the findings including the large proportion of unknown weight gain and pre-pregnancy BMI. As well, some potential factors that were not measured in the BCPDR, but could impact caesarean section rates include other obstetric practice factors, geographic influences, both in terms of population characteristics and health care access and use patterns, facility differences in terms of culture, scope of practice and use of technology. Individual provider preferences and practice style as well as patient preference and opinion were not incorporated into the analysis.

4.7 SUMMARY OF FACTORS CONTRIBUTING TO THE INCREASED RATE OF CAESAREAN BIRTHS

Data analysis reveals that between 2000 and 2005:

- The average age of mothers increased, but, more importantly, caesarean section rates increased in every age category: for mothers under the age of 20, from 15.0 to 17.5% of all births; for mothers aged 20 to 29, from 20.2 to 25.5%; and for mothers 35 to 39 years old, from 30.1 to 36.2%.
- CS rates increased in every pre-pregnancy BMI category.
- The proportion of nulliparous women and mothers with parity ≥ 1 was fairly stable but caesarean rates increased in both groups: for nulliparous mothers rates increased from 26.9 to 31.9% and for mothers with parity ≥ 1 , from 20.9 to 27.4%.
- CS rates increased for singleton births from 23.2 to 28.9%; and for multiple births from 54.8 to 64.8%.
- Hypertension in pregnancy rose from 4.5 to 5.2%, but the caesarean section rate for this group went from 39.8 to 45.6%. CS rates for women with pre-pregnancy diabetes and gestational diabetes were 56.8 and 40.6%, respectively.
- The proportion of births between 34 and 36 completed weeks of gestation increased from 5.7 to 6.8% and the CS rate in this group rose from 29.5 to 38.7%.
- While the frequency of induced labour has remained fairly stable, the caesarean section rate for induced mothers increased from 22.6 to 25.7%. For nulliparous women induction in lieu of spontaneous labour was associated with almost twice the CS rate (37.8 vs. 21.8%).

Data analysis also reveals:

- In 2005, the most common primary indication for induction was post-date pregnancy (35.1% of all inductions) with a caesarean section rate of 28.7%.
- Unadjusted for maternal characteristics or labour factors, epidural analgesia is associated with a greater likelihood of caesarean section

- Caesarean section is more frequent among women under the care of an obstetrician. It is not possible, with retrospective data, to separate the rates for obstetricians in a primary care role from their role as consultants, though as family physicians leave intrapartum maternity care, more obstetricians are taking on the primary care role.
- Regression analysis suggest that maternal characteristics, such as increased age and pre-pregnancy weight, while having an effect of increased risk of caesarean section, are not the only factors that predict the outcome of caesarean section and only explain a small amount of the variation in caesarean section rates

5. STRATEGIES TO REDUCE CAESAREAN RATES IN BC

There is no universal agreement as to the appropriate caesarean section rate, but most Canadian providers welcome efforts to reduce it and several national and international bodies have proposed a benchmark. In 1985 the World Health Organization (WHO) concluded there were no additional health benefits associated with a rate of greater than 10 – 15% [67].

The U.S. Healthy People 2010 initiative set targets for low-risk women with term, singleton and vertex presentations: 15% for first Caesareans and 63% for women with prior caesarean births. However, birth trends in the U.S. run counter to the targets — in 2004 the first caesarean section rate rose to 25%, from 18% in 1998, and the repeat CS rate was an unprecedented 90%, up from 72%.

Recognizing the contribution of the variation of patient population and care provider mix on caesarean section rates in British Columbia and after review of the literature, the Task Force is proposing a province-wide adoption of quality improvement initiatives rather than a quantitative benchmark for the entire province. We feel that a sustainable reduction or optimization of rates will come from a focus on best practice in each facility, in a context of a continuous quality improvement, with support at the health authority and provincial level, allowing each facility to realize its own benchmark. In the following sections, we describe tools for facilities, care providers, government, and provincial programs that will help to identify areas amenable to improvement, to implement reduction strategies, and to evaluate these processes, with the eventual goal of reducing Caesarean section rates.

5.1 QUALITY IMPROVEMENT STRATEGIES

Evidence suggests that significant reductions in caesarean birth rates can be achieved through quality improvement strategies [68]. Researchers in the U.S. conducted a prospective study from 1988 to 1994 focusing on provider feedback, clinical guideline implementation, and health promotion. During this period the overall caesarean section rate fell from 31.1% to 15.4% without an increase in maternal, fetal, or neonatal morbidity or mortality [69]. A randomized controlled trial of second opinion as a reduction strategy was conducted in 36 Latin American hospitals (Argentina, Brazil, Cuba, Guatemala, and Mexico) and a 25% reduction in caesarean section rates was achieved without increased maternal and perinatal mortality [70].

In the 1990's the Institute for Healthcare Improvement (IHI) determined that caesarean section rates in the US were rising without an overall improvement in perinatal outcomes and that the evidence to improve efficiency and quality existed but was not implemented in everyday practice. IHI developed a series of initiatives (IHI Breakthrough Series) to reduce rates in 28 US facilities to improve quality and reduce costs [71, 72]. This approach used on-site teams to set practice goals and select interventions and auditable standards. The first Breakthrough Series for safe reduction of caesarean section rates established the following strategic principles [71]:

1. Prevent admission for false labour
2. Avoid unnecessary inductions of labour
3. Expect a trial of labour
4. Pre-certify elective repeats
5. Increase nurses' awareness of the factors associated with increases in caesarean section rates
6. Manage pain during labour
7. Create the will for change among all maternity care providers

Of 28 participating organizations, 15% achieved caesarean delivery reductions of 30% or more during the 12-month period of active collaborative work and an additional 50% reduced rates by 10-30%. Optimal management of pain in labour, including adequate education and preparation of expectant mothers, was identified as a key factor [72]. The strength of the IHI approach was that institutional teams were involved in setting their goal rate, identification of barriers, and selecting the interventions they wanted to make changes

to. The strongest barrier to implementation was fear of litigation. This was addressed by review of actual data on the number, frequency, and interpersonal dynamics of obstetric lawsuits.

Ongoing attention to quality improvement initiatives is needed to achieve MOH and BCPHP goals. For example, in 1995 BC Women's Hospital undertook a project ("First Births") modeled on IHI principles to reduce caesarean rates for primiparous women. Key contributing factors were identified and attempts made to eliminate unnecessary induction of labour, reduce use of electronic fetal monitoring, decrease admission of women in the latent phase of labour and manage pain. A collaborative team determined guidelines and policy and conducted ongoing peer review. An initial decrease of caesarean sections from 22 to 18% was achieved and inappropriate inductions were also reduced. However, improvement in the Caesarean rate did not last for a variety of reasons, including lack of hospital buy-in, both at administrative and provider levels.

In 1999, the Ontario Women's Health Council (OWHC) developed a report on Attaining and Maintaining Best Practices in the Use of Caesarean Section [73]. OWHC studied four representative sites with lower Caesarean section rates and identified five critical factors: 1) Childbirth attitudes (pride, culture, 1-1 support); 2) Program organization (leadership, effective teams, access to professionals; 3) Knowledge (evidence – based practices, CQI, database; 4) Connections (continuity, networking with peers and other organizations; and 5) Ability to manage and monitor change. An emphasis was placed on adequate funding to promote change.

There is evidence that an effective continuous quality improvement (CQI) program for inductions can reduce the rate of Caesarean sections. At BC Women's Hospital, an interdisciplinary CQI program was initiated in the late 1990. Before the program was initiated, induction rates were 23-25% of all births. Following implementation of the CQI program, induction rates fell to approximately 20% of all births without impacting newborn outcomes, and in fiscal 2005/06 the induction rate for BC Women's was 17.9% of all births (the lowest of any Health Authority in BC) while the provincial rate was 21.0%. This multidisciplinary continuous quality improvement program encompasses the following components to ensure appropriate indications for induction and hence optimal induction rates:

- A requirement for clear indication of induction, including defined criteria for each indication
- A well-defined, transparent, unbiased and fair booking process for inductions, including a structured booking form
- Interdisciplinary accountability including peer review of each booked induction and refusal of those that do not meet the criteria
- Review, communication and feedback on inductions to all facility practitioners

In a recent meta-analysis of randomized control trials, quasi-randomized control trials, controlled before and after studies, and interrupted time series studies from 1990 to 2005, researchers looked at the effectiveness of strategies, their impact on maternal and newborn morbidity and mortality and barriers to implementation.(54) The Cochrane and Effective Practice Organization of Care criteria were used and ten papers that met these criteria were grouped into three categories: Audit and feedback, quality improvement and multifaceted strategies (Table 18).

TABLE 18. SUMMARY OF LITERATURE REVIEW OF CAESAREAN SECTION REDUCTION STRATEGIES

Strategies Used	Authors	Study Description	Relative Risk (95% Confidence Interval)
Audit and Feedback	Althabe (2004) [70]	Mandatory second opinion prior to final decision for caesarean section.	0.93 (0.86, 1.00)
	Bickell (1996) [74]	External peer reviews on quality of care done by teams and reports back to participating hospitals.	0.93 (0.87, 0.99)
	Liang (2004) [68]	Second opinion required for all caesarean sections. Weekly review of indications for all caesarean sections. VBAC encouraged. Feedback also provided.	0.83 (0.80, 0.87)
	Robson (1996) [75]	Development of standards, establishment of "current state", change implemented, medical audit. Monthly review.	0.79 (0.73, 0.86)
Quality Improvement	Frigoletto (1995) [76]	Approach to active management of labour (one to one nursing, criteria for diagnosis, active management of labour).	0.95 (0.70, 1.30)
	Lopez-Zeno (1992) [77]	Active management of labour (early amniotomy, early diagnosis of slow progress, high dose oxytocin for management of dystocia, use of EFM and IUPC).	0.75 (0.56, 0.99)
	Homer (2001) [78]	Continuity of philosophy was emphasized in a midwifery practice with opportunities for women to meet all the care providers.	0.73 (0.70, 0.77)
	Socol (1993) [79]	Three initiatives were undertaken which included encouragement of VBAC, quality management initiative and annual report to improve consistency of practice, active management of labour).	0.76 (0.71, 0.82)
Multifaceted Strategies	Poma (1998) [80]	Physician and public education on the benefits of vaginal birth, nursing education about active management of labour and electronic fetal monitoring, monthly summaries provided to medical and nursing staff and confidential reports to physicians every six months.	0.71 (0.66, 0.75)
	Lagrew (1996) [69]	Guidelines with education. Monthly staff feedback and confidential physician feedback every 6 months.	0.81 (0.75, 0.87)

The study found that caesarean section rates could be safely reduced by 20% through interventions that involve care providers and enable them to analyze and change their practice. The results of the meta-analysis also suggest that multi-faceted strategies that incorporate peer review and audit and feedback and identify the barriers to change are optimal. Barriers to change should be identified; what works in one setting may not be appropriate in another and strategies need to be tailored to the particular environment. To be successful strategies should have the support of hospital administration and commitment of team members. Sustainable change requires clear, accessible and timely data, infrastructure and monitoring.

EVIDENCE-BASED PRACTICE IDENTIFICATION AND CHANGE (EPIC)

Whereas traditional methods, such as passive dissemination of knowledge and use of opinion leaders, have had mixed results in narrowing the gap between best evidence and clinical practice [81], the Task Force recommends Evidence-based Practice Identification and Change (EPIC) to communicate knowledge to obstetric caregivers and ensure translation into practice. EPIC involves accessing and critically appraising evidence, sharing this synthesis within a community of participating agencies, analyzing practice data within individual agencies to determine specific sources of variability in outcomes, undertaking rapid cycles of

practice change, and sharing evaluations of change within the practice community. Randomized controlled trials of EPIC in the neonatal intensive care setting have been successful, but this approach has not yet been applied in an obstetric setting [82].

EPIC adds three concepts to traditional health care quality improvement methods:

1. **Evidence** - systematic reviews of evidence in published literature
2. **Objectivity** – uses benchmarked data from institutions concerned to identify key practices for targeted intervention;
3. **Collaboration** – uses network of multi-disciplinary experts in clinical care, research and administration, and links institutions to share expertise and experience.

EPIC overcomes some of the shortcomings of traditional continuous quality improvement (CQI) strategies [83], which have generally proposed change on the basis of subjective opinions rather than evidence, seldom use data from the institutions where change is desired, mostly focus on one institution at a time, and most often produce results that are not transferable or replicable [84].

During the preparation and baseline assessment phase of EPIC, key demographic, clinical practice, outcomes and process data are collected to develop benchmarks for outcome improvement. In-depth literature reviews and syntheses are then conducted to identify best practices. Practice issues at individual hospitals associated with good or poor outcomes are identified through statistical analysis to quantify their attributable risks. Multidisciplinary teams from hospitals are taught to examine the process of care and identify required changes. Practice changes are then designed to match the needs at individual hospitals for care improvement. A template for change is constructed and customized for each site.

In the intervention phase of EPIC, site coordinators and their EPIC clinical teams make changes to practices to address gaps between synthesized evidence and existing patterns of care. The Rapid Cycle Improvement Model is used to implant a new cycle every three months [85]. Feedback regarding progress and resultant outcomes in the form of visual presentations are disseminated quarterly. Repeated cycles encourage re-appraisal, reinforce procedures, identify variation among results, and generate further change cycles.

Successful implementation of the EPIC protocol to reduce caesarean section rates may have an impact on maternal and neonatal morbidity and neonatal mortality in BC. Potential reductions in hospital length of stay and readmissions could impact nursing resources. In smaller hospitals, reducing the number of caesarean deliveries could free operating theatre time for non-obstetric surgeries, and other potentially life-saving procedures. Appropriate education of pregnant women regarding risks and benefits of elective caesarean birth may relieve some of the pressure experienced by physicians to provide caesarean birth by maternal request. EPIC is designed to be sustainable in that it employs the “train the trainer” approach and should be supported by the infrastructure of the BCPHP. If the EPIC protocol is successful in reducing caesarean section rates it could serve as a model to address other provincial perinatal issues in partnership with Health Authorities and for other perinatal programs across Canada to address caesarean section rates.

5.2 DATA COLLECTION AND FEEDBACK

Data collection and feedback of important indicators are key elements to the implementation and success of any caesarean section reduction strategy. To be successful, a data collection and feedback strategy should involve a continuous cycle of data collection, information synthesis and dissemination, with interpretation in the proper context to elicit a health system response. Moreover, it should report only the most important indicators, using accurate and timely data, and should be accessible to and easily interpreted by its intended audience. It should be focused and specific, with a level of flexibility built in to allow for more in-depth analysis if required. Finally, it should be sustainable if it is expected to successfully monitor system changes. To further monitor

more timely and specific indicators as part of a reduction strategy, development of new surveillance reports are needed at both the provincial and hospital level (See Appendix F for a list of current reports and tools).

One of the issues related to institutional and regional benchmarking is the lack of valid comparison for different clinical populations. National and regional surveillance reports from organizations such as the Canadian Institute of Health Information [1] and Health Canada [86] lack the complexity of information to compare performance of institutions and maternity providers. Such data sources do not take into consideration differences in population and pregnancy factors that may account for the observed differences in overall caesarean section rates. Several published methods have been proposed to perform risk adjustment in evaluating caesarean section rates, however they are often complex statistical and regression models that are difficult to implement and lack standardization across jurisdictions [87-89]. As an example, the Robson Group Classification is one data collection tool that could be implemented at the facility, health authority, or provincial level.

The Robson classification [90] was developed as a way to categorize women into comparable mutually exclusive groups according to parity, number of births, obstetric history, period of gestation, presentation at delivery and type of labour initiation (e.g. spontaneous or induced/elective caesarean section). Robson enables researchers to compare subgroups across institutions or geographies as well as within one institution over time. Use of the Robson classification avoids the problem of one setting or region claiming that they have a particularly complex or high-risk population, as the methodology “levels the playing field.”

The Robson classification has been adopted in many European countries as one method of comparing the caesarean section rates of similar populations between institutions [91, 92] for evaluative purposes. The application of the Robson classification in the North American context has been limited [93, 94]. However, the studies which have utilized the classification supports its utility in that it obviates many of the traditional arguments that have arisen when comparing overall caesarean section rates between populations [94].

The Robson classification was applied to BC births for 2000 and 2005. The three groups that are the largest contributors to caesarean sections are groups **1** (nulliparous mothers at term with a cephalic singleton in spontaneous labour), **2** (nulliparous mothers at term with a cephalic singleton having induced or caesarean before labour), and **5** (mothers with parity \geq 1 at term with a cephalic singleton with a prior caesarean section). In BC in 2005 83.3% of mothers populated the first five Robson groups (Table 19) and among these five groups, mothers with parity \geq 1 and a singleton cephalic in spontaneous labour at term (Group 3) was the largest (27.3%); however, this group also had the lowest caesarean section rate (2.4%) (Table 19). The second largest group, nulliparous mothers in spontaneous labour with a singleton cephalic pregnancy at term (Group 1), account for approximately one-quarter of all mothers (26.7%). The caesarean section rate in this group of mothers has increased slightly over time, from 16.1% in 2000 to 19.5% in 2005 (Table 19).

Mothers with parity \geq 1 at term with a singleton cephalic pregnancy and a previous uterine scar (Group 5) were the largest contributors to overall caesarean section rates (5.8% in 2000 and 8% in 2005) (Table 19). Although caesarean section rates among mothers with breech or transverse pregnancies or with multiple pregnancies are high (Groups 6, 7, 8 or 9), their contribution to the overall caesarean section rate was relatively low.

TABLE 19. PROPORTION OF DELIVERIES, CAESAREAN SECTION RATES, AND CONTRIBUTIONS TO OVERALL CAESAREAN SECTION RATE BY ROBSON GROUP IN BC, 2000 AND 2005

		2000			2005		
	Group Description	Percent of all deliveries %	CS rate %	Contribution to overall CS rate %	Percent of all deliveries %	CS rate %	Contribution to overall CS rate %
1	Nulliparous, singleton, cephalic, >=37 weeks gestation, spontaneous labour	27.5	16.1	4.4	26.7	19.5	5.2
2	Nulliparous, singleton, cephalic, >=37 weeks gestation, induced labour or delivered by caesarean section before labour	10.4	35.1	3.7	11.5	42.5	4.9
	<i>Induced labour</i>	<i>9.9</i>	<i>31.6</i>	<i>3.1</i>	<i>10.5</i>	<i>37.0</i>	<i>3.9</i>
	<i>Caesarean section before labour</i>	<i>0.5</i>	<i>100.0</i>	<i>0.5</i>	<i>1.0</i>	<i>100.0</i>	<i>1.0</i>
3	Parity>=1, singleton, cephalic, >=37 weeks gestation, without a previous uterine scar, spontaneous labour	29.9	2.3	0.7	27.3	2.4	0.7
4	Parity>=1, singleton, cephalic, >=37 weeks gestation, without a previous uterine scar, induced labour or delivered by caesarean section before labour	7.9	8.1	0.6	7.6	12.1	0.9
	<i>Induced labour</i>	<i>7.7</i>	<i>4.6</i>	<i>0.4</i>	<i>7.1</i>	<i>6.1</i>	<i>0.4</i>
	<i>Caesarean section before labour</i>	<i>0.3</i>	<i>100.0</i>	<i>0.3</i>	<i>0.5</i>	<i>100.0</i>	<i>0.5</i>
5	Parity>=1, singleton, cephalic, >=37 weeks gestation, with a previous uterine scar	8.9	64.9	5.8	10.2	78.8	8.0
	<i>Spontaneous labour</i>	<i>4.1</i>	<i>38.3</i>	<i>1.6</i>	<i>3.2</i>	<i>42.0</i>	<i>1.4</i>
	<i>Induced labour</i>	<i>1.0</i>	<i>34.1</i>	<i>0.3</i>	<i>0.4</i>	<i>34.7</i>	<i>0.1</i>
	<i>Caesarean section before labour</i>	<i>3.9</i>	<i>100.0</i>	<i>3.9</i>	<i>6.5</i>	<i>100.0</i>	<i>6.5</i>
6	Nulliparous, singleton, breech	2.2	91.8	2.0	2.3	95.5	2.2
7	Parity>=1, singleton, breech	1.6	83.6	1.3	1.6	90.9	1.5
8	Multiple pregnancy (twins or multiples)	1.3	54.8	0.7	1.6	64.8	1.0
9	Singleton, transverse or oblique lie	0.4	93.4	0.4	0.3	93.1	0.2
10	Singleton, cephalic, <37 weeks gestation	5.6	18.5	1.0	6.5	27.3	1.8
11	Singleton, unknown presentation	4.3	68.9	3.0	4.5	68.1	3.0

SOURCE: BC PERINATAL DATABASE REGISTRY

The Robson classification was then applied at the facility level in BC to examine its utility as a data analysis tool. Two facilities within BC that have at least 2500 births per year were selected and mothers were grouped into Robson classification groups (Facility A and Facility B) (Table 20).

Table 20 shows that Facility A has had a substantial increase in the caesarean section rate among nulliparous mothers with singleton cephalic pregnancies in spontaneous labour at term (28.1% in 2005, up from 17.3% in 2000), while this group has remained at 25.9% of all deliveries in 2000 and 2005. In Facility B, the caesarean section rate for this group has only increased slightly, from 18.1% in 2000 to 19.9% in 2005.

TABLE 20. ROBSON GROUP COMPARISON OF TWO BC FACILITIES WITH ≥2500 BIRTHS PER YEAR, 2000 AND 2005

		2000						2005					
		Facility A	Facility B	Facility A	Facility B	Facility A	Facility B	Facility A	Facility B	Facility A	Facility B	Facility A	Facility B
Group Description		Percent of all deliveries		Caesarean Section Rate		Contribution to overall CS Rate		Percent of all deliveries		Caesarean Section Rate		Contribution to overall CS Rate	
1	Nulliparous, singleton, cephalic, ≥37 weeks gestation, spontaneous labour	25.9	27.5	17.3	18.1	4.5	5.0	25.9	24.8	28.1	19.9	7.3	4.9
2	Nulliparous, singleton, cephalic, ≥37 weeks gestation, induced labour or delivered by caesarean section before labour	14.5	10.4	31.7	33.9	4.6	3.5	16.6	12.1	52.3	39.3	8.7	4.7
	<i>Induced labour</i>	13.7	10.1	28.0	32.1	3.9	3.2	13.9	11.1	42.7	40.7	5.9	4.5
	<i>Caesarean section before labour</i>	0.7	0.3	100.0	100.0	0.7	0.3	2.8	0.8	100.0	100.0	2.8	0.8
3	Parity≥1, singleton, cephalic, ≥37 weeks gestation, without a previous uterine scar, spontaneous labour	23.0	29.8	2.4	2.6	0.5	0.8	21.7	25.5	2.1	2.8	0.5	0.7
4	Parity≥1, singleton, cephalic, ≥37 weeks gestation, without a previous uterine scar, induced labour or delivered by caesarean section before labour	10.3	6.9	7.9	6.8	0.8	0.5	8.2	8.5	19.6	11.3	1.6	1.0
	<i>Induced labour</i>	9.9	6.8	3.9	5.4	0.4	0.4	7.3	8.1	9.6	6.8	0.7	0.6
	<i>Caesarean section before labour</i>	0.4	0.1	100.0	100.0	0.4	0.1	0.9	0.4	100.0	100.0	0.9	0.4
5	Parity≥1, singleton, cephalic, ≥37 weeks gestation, with a previous uterine scar	10.7	7.1	64.1	61.7	6.9	4.4	11.2	10.2	83.5	70.3	9.3	7.2
	<i>Spontaneous labour</i>	5.5	4.1	44.7	45.2	2.5	1.9	3.4	4.0	50.5	35.8	1.7	1.4
	<i>Induced labour</i>	1.2	0.8	34.4	41.7	0.4	0.3	0.2	0.6	28.6	25.0	0.1	0.1
	<i>Caesarean section before labour</i>	4.0	2.2	100.0	100.0	4.0	2.2	7.6	5.6	100.0	100.0	7.6	5.6
6	Nulliparous, singleton, breech	2.6	3.2	97.0	91.8	2.5	3.0	2.5	2.5	98.6	94.1	2.4	2.4
7	Parity≥1, singleton, breech	1.6	1.7	90.2	82.0	1.4	1.4	2.0	2.1	98.3	89.7	2.0	1.9
8	Multiple pregnancy (twins or multiples)	1.8	1.9	48.9	59.6	0.9	1.1	2.0	2.4	79.3	70.3	1.6	1.7
9	Singleton, transverse or oblique lie	0.3	0.5	100.0	100.0	0.3	0.5	0.1	0.4	50.0	91.7	0.1	0.4
10	Singleton, cephalic, <37 weeks gestation	7.0	7.8	22.8	16.2	1.6	1.3	7.4	6.9	39.9	28.3	3.0	2.0
11	Singleton, unknown presentation	2.4	3.1	88.5	91.4	2.1	2.8	2.4	4.5	33.8	79.3	0.8	3.6

SOURCE: BC PERINATAL DATABASE REGISTRY

5.3 EDUCATING THE PUBLIC

MEDIA

In the absence of appropriate education, women may receive misinformation about birth on television and via the Internet. For instance, some celebrities have publicized their choice of caesarean birth.

Lay media is most helpful when it is used to increase knowledge, change attitudes, reinforce attitudes and maintain interest, provide simple cues to action, and set a social agenda [95]. Public information campaigns should be developed using public service announcements, web-based resources and print media to promote healthy childbirth, reduce fears and dispel misconceptions. Mass media has played a significant role in the reduction of tobacco consumption over the past 25 years as broadcast and print media significantly heightened public awareness [95].

In order to inform women about the risks of caesarean section, it is necessary to have accurate data and be able to present it in a way that is easily understood. A number of organizations have attempted to do so. For example, in 2004, the New York-based Maternity Center Association published “What Every Pregnant Woman Should Know about Caesarean Section” which reports 33 caesarean section complications according to their frequency and in comparison with vaginal birth outcomes.

CHILDBEARING FAMILIES

Childbearing families should be provided with evidence-based information about pre-existing or demographic factors and modifiable factors that contribute to obstetric interventions in childbirth e.g. the association between pre-pregnancy weight and weight gain during pregnancy, and the benefits and risks of both vaginal and caesarean births. Childbirth preparation classes have not been well researched and their impact on outcome is not clear. However, patient education is an integral part of the active management of labour [96].

Only about fifty percent of nulliparous women attend prenatal classes [97], creating the potential for misinformation about delivery. Some studies have utilized traditional paper-based interventions with limited success, such as a decision-aid booklet on the risks and benefits of elective repeat caesarean section [98]. This intervention yielded improved knowledge and decreased conflict in decision-making, but no increase in the number of attempted vaginal births after caesarean section, nor was there a correlation between preferences for mode of birth and delivery method. Evidence-based leaflets [99, 100] have also proved to have little impact in improving informed choice.

One-on-one counseling may be more effective in addressing psychological reasons for favouring caesarean birth. A study in Norway designed an intervention strategy for women who requested caesarean sections due to birth anxiety [101]. Women were referred to counseling by a psychosocial team at a University hospital. After the intervention 86% changed the initial request of caesarean section with 69% giving birth vaginally and 31% delivering by caesarean section due to obstetric complications.

The effectiveness of providing information in decision-making was addressed in a Cochrane Collaboration systemic review [102]. This review assesses two randomized controlled trials involving 1451 women. The studies both aimed to reduce elective repeat caesarean birth by encouraging pregnant women to attempt vaginal delivery. In one study researchers compared prenatal education and support to information based pamphlets [103], whereas the other study investigated the effectiveness of cognitive therapy [104]. Neither intervention yielded significant differences in terms of outcomes. Approximately 70% of women attempted VBAC, however the caesarean birth rate exceeded 40% and there was no significant difference between the intervention and control groups.

5.4 COLLABORATIVE MODELS OF PRACTICE

Physiological birth is the natural culmination of a pregnancy, unaided by medical intervention. Up until the introduction of antibiotics, asepsis, uterotonics, and surgical interventions, pregnancy and birth were the leading cause of mortality for childbearing women. Now there is strong support for a combination of physiological birth process and medically justified interventions.

Labour support is the close, continuous presence of a person trained in providing emotional and physical support and encouragement throughout labour and birth. Although a Cochrane systematic review analyzing 15 trials involving 12,791 women reported that continuous labour support reduced intrapartum analgesia, operative birth, and increased women's satisfaction with their birth experience, the benefit of labour support was restricted to Latin American and Southern US hospitals where women did not have access to nursing support in labour. The Society of Obstetricians and Gynecologists of Canada recommends continuous close support from an appropriately trained professional and a one-to-one nurse-patient ratio in active labour.

Supportive care during labour includes emotional support (continuous presence, reassurance, praise), information about how labour is progressing, advice about coping with pain, comfort measures (touch, massage, water therapy, hydration) and advocacy. A Cochrane review of continuous presence of a trained support person included 15 trials involving 12,791 women and concluded that such support increased satisfaction and chances for a "spontaneous" birth and has no known risks. Labour support seemed more effective when provided by women who were not hospital staff members [105, 106].

In a recent prospective cohort study low-risk healthy women who chose to give birth at home were compared to a similar group of women who gave birth in a hospital, and interventions, such as surgical birth, use of analgesia and episiotomy were lower in the "homebirth" population without an increase in adverse outcomes for the women or their infants. These outcomes are similar to data on birth centre and other homebirth outcomes [65, 66].

Several models of practice have been developed that create an environment where women are less likely to have a caesarean birth. One such model of practice is Vancouver's South Community Birth Program (SCBP), a collaborative, multi-disciplinary practice, including midwives, family physicians, community health nurses and doulas, that serves an ethnically and socio-economically diverse community [107]. The goal of SCBP is to bring birth back to a community-based, peer supported primary care experience. This project includes group prenatal care in a model called Centering Pregnancy which has been found in a Randomized Control Trial in the U.S. to lower rates of prematurity, low birth weight infants and to increase breastfeeding rates. Another feature of the program is doula support for the women from community doulas who speak their first language. The third feature of the program is collaborative care with midwives and family doctors working together along with the community health nurses to provide seamless care. All members of the team are committed to lowering intervention rates and have spent time working on practice guidelines. In addition, an Electronic Medical Record (OSCAR) that uses the BCPHP forms and can provide up to date reporting allows regular feedback to the team and permits discussion about ways that care can be further improves.

The SCBP model of care has shown promising outcomes, with a 18.3% rate of caesareans as compared to the 27.5% rate at BC Women's Hospital [107]. Features of this model may be helpful to other providers interested in reducing caesarean section rates.

The principles of collaborative, women-centered care, highlighted in SCBP, are the core recommendations of two extensive consultation and research reports. The Maternity Care Enhancement Project consulted with stakeholders throughout BC to develop a practice and business model that would address the quality and sustainability of maternity care services within the province [108]. The final recommendations from this report called for the promotion of a team-based model, which draws from many disciplines, and places the mother at the center of care. It was recommended that this strategy be supported throughout all levels of the health care system with a focus on a long-term sustainability strategy.

The Multidisciplinary Collaborative Primary Maternity Care Project (MCP²) drew upon the national expertise of midwives, family physicians, nurses, and obstetrician-gynecologists to create guidelines and implementation tools for the creation of collaborative teams for maternity care [109]. The MCP² manual provides a step-by-step guide for developing this new model of practice, from the inception and vision creation stage to the evaluation of the project. The incorporation of these useful tools should be promoted within our province and the guidance should be taken from this national collaboration [109]. At this point there is no evidence to show that this type of care will lower caesarean section rates, but models in which some of the key principles of midwifery care (which has been found to be associated with lower rates) are promoted show promise in this direction.

The Task Force recommends that the provincial government provide impetus and funding to implement the recommendations of the MCP² report.

5.5 EVIDENCED-BASED PROVIDER PRACTICES

Providers who believe that birth is a normal process where interventions are rarely required in a healthy full-term pregnancy will offer a different approach than a provider who believes otherwise. Thus, interventions that address only provider knowledge and not beliefs, such as traditional continuing education and dissemination of guidelines, are not enough to change practice behavior [109-111]. The next section details evidence-based recommendations for a number of interventions that have potential to impact caesarean rates; Table 21 summarizes these interventions. Please refer to Section 6: Evidence for Best Practice for further detail.

TABLE 21. SUMMARY OF INTERVENTIONS THAT COULD IMPACT CAESAREAN BIRTH RATES

TOPIC	SUMMARY DESCRIPTION
Induction of Labour	Induction of labour is indicated when the potential risks of continuing a pregnancy outweigh the benefits [112-114]. At times the clinical indication for induction is extremely clear but often the clinical scenario is less clear and the decision to induce is unduly influenced by the values and beliefs of the care providers.
Supporting a Trial of Labour (TOL)	TOL should be considered for women with a previous caesarean section. While repeat may be advised in certain situations, in most cases VBAC can be achieved safely [115, 116].
Pain Management in Labour	Pain management consistent with a woman's wishes is critical to a successful birthing outcome; impacts the woman's satisfaction with labour and delivery and may have immediate and long-term emotional and psychological effects [105]. Information about pain management options for labour and birth should be shared with every woman during her prenatal care, including indications for, as well as risks and benefits. A wide range of non pharmacological comfort measures and relaxation techniques should be available [117].
Prevention/Management of Dystocia	32% of caesarean sections in BC have dystocia as an indication. Management should include formulation of a documented plan: amniotomy, oxytocin augmentation, therapeutic rest with analgesia. For women with prolonged latent labour care should be taken to avoid over-diagnosing dysfunctional labour and triggering the cascade of interventions.
Intrapartum Fetal Surveillance	Electronic Fetal Monitoring (EFM) has low positive predictive value and significant limitations. EFM with fetal scalp sampling to confirm acidemia reduces fetal morbidity related to acidemia but, for a variety of reasons, FSS is not performed routinely. The effects of drugs and regional anesthesia on EFM should be recognized.
Management of Breech Presentation	Since the 1970's the rate of caesarean delivery for breech presentation has increased from 14% to 87% with most recent vaginal breech deliveries occurring as the second twin or as precipitous deliveries. The acceptance of vaginal breech delivery has decreased due to reports that CS may be associated with lower perinatal morbidity and mortality. Poor outcomes following breech vaginal delivery may be due to underlying conditions contributing to malpresentation rather than birth trauma.
Instrumental Delivery: Use of Forceps and Vacuum	In BC approximately 45% of primiparous women will need some assistance to complete delivery of which 15-20% will be assisted by instruments This skill set varies depending on the training and experience of the clinician.
Rural Maternity Care	Cross training of rural maternity care nurses in labour management and CS assistance is encouraged. Advanced maternity care skills for both physicians and nurses working in rural maternity care settings need to be expanded and funded. Innovative rural collaborative physician-midwife care and funding models need to be developed. Doula's need to be trained for rural practice and funded by the health care system.
Maternal Request Caesarean	Purported maternal benefits of this "caesarean on demand" are these claims have not been substantiated in follow-up studies [38].

5.6 SUMMARY OF STRATEGIES

- Reducing caesarean birth rates will require major shifts in attitudes for all concerned parties and the most effective means will most likely differ from institution to institution and region to region.
- Evidence suggests that significant reductions in caesarean birth rates of 10 – 30% and more can be achieved through quality improvement strategies that involves rapid cycles of “plan/do/study/act” in order to effect incremental change rapidly.
- Multi-faceted strategies that include peer review, audit and feedback and identification of barriers to change are more effective than isolated, single strategies.
- Successful implementation of the Evidence-based Practice Identification and Change (EPIC) protocol may have an impact on maternal and neonatal morbidity and neonatal mortality in BC.
- Data collection and feedback that involves a continuous cycle of accurate and timely data collection, information synthesis and dissemination, with interpretation in the proper context are necessary to the implementation and success of any caesarean section reduction strategy.
- Robson 10 caesarean classification could be a useful tool to implement provincially to compare caesarean section rates in similar populations across facilities and regions to identify benchmark and best practices.
- Lay media can be used to increase knowledge and prompt a social change. Public information campaigns could be developed to provide the general public and childbearing families with evidence-based information about modifiable factors that contribute to obstetric interventions in childbirth.
- There is evidence that one-on-one counselling may be more effective in addressing psychological reasons for favouring caesarean birth.
- Collaborative models of practice such as the Vancouver’s South Community Birth Program, the Maternity Care Enhancement Project, or the Multidisciplinary Collaborative Primary Maternity Care Project (MCP²) should be supported
- Provider practices that focus on specific interventions or processes (e.g. pain management in labour, management of dystocia) and have the potential to impact caesarean birth rates should be targeted.

6. EVIDENCE FOR BEST PRACTICE

The Caesarean Birth Task Force makes the following recommendations, based on evidence for best practice and the promotion of normal birth, that agencies participating in an EPIC process might consider incorporating.

6.1 INDUCTION OF LABOUR

Induction of labour should meet evidenced-based prerequisites and guidelines as outlined by the BCPHP Obstetric Guideline 1.

Avoid unnecessary induction, particularly if the cervix is unfavorable. Although the number of inductions has been stable in BC, studies have shown an increased likelihood of operative delivery, particularly in nulliparous women with an unripe cervix [118].

The Task Force Recommends:

1. As elective induction is associated with potential complications it should only be done: 1) when medically indicated, 2) after establishing accurate gestational age, 3) after fully informing the woman of the risks (including anticipated obstetric risk, advantages and limitations of local maternity care services, and transport risk), and 4) after obtaining informed consent [II-2 B].
2. If the cervix is unfavourable (Bishop Score < 6), ripening of the cervix should be completed prior to induction of labour. Oxytocin should not be used to ripen the cervix [II-2 A].
3. When using oxytocin to induce labour, use the minimum dose to achieve active labour, increasing intervals no more frequently than every 30 minutes [I to II-3 B]. Once a dose of 20 mu/min is reached, reassessment is reasonable [III-C].
4. High-dose oxytocin may be considered in specific clinical situations, e.g. where low-dose oxytocin is ineffective [I-A].

6.2 SUPPORTING A TRIAL OF LABOUR

Previous Caesarean section is a key predictive factor for subsequent caesarean section. A Trial of Labour after Caesarean (TOLAC) should be considered in women who present for pregnancy care after previous caesarean birth. While repeat caesarean section may be advised in certain situations, in most cases Vaginal Birth After Caesarean (VBAC) can be achieved safely [115, 116].

Predictors of successful VBAC include an absence of the indications for the prior caesarean birth, such as malpresentation and gestational hypertension, a previous vaginal delivery, maternal age <40 years, favorable cervical factors and spontaneous labour. Success rates have been reported from 50 to 85%. A 1996 Canadian study reported a success rate of 76% [119]. There is some evidence that risk assessment tools may predict the likelihood of successful TOLAC [120, 121]. The SOGC has a clear guideline that outlines the ideal setting, need for information about previous deliveries, and management of labour during TOLAC. The major risk for TOLAC is uterine rupture, which have been reported to be between 1.7% and 3.7% [122-129].

One area of controversy is induction during a TOLAC. The literature was somewhat controversial about induction with prostaglandin E2 until a large retrospective study from 2001 [130]. This showed that elective repeat caesarean section was associated with rupture rate of 0.16%; spontaneous labour 0.52% (RR 3.3; 95% CI 1.8-6.0); labour induced without prostaglandin 0.77% (RR 4.9; 95% CI 2.4-9.7) and labour induced with prostaglandin 2.45% (RR 15.6; 95% CI 8.1-30.0) [130]. Several studies looking at the risk of uterine rupture, maternal morbidity or perinatal morbidity or mortality with augmentation during a TOLAC have not shown increased risk [131-134].

Studies with small numbers of women with multiple gestation suggest VBAC is safe and effective with success rates between 69% and 84% [131, 135-140]. Studies have shown that success rates are slightly lower for diabetic women (64% vs. 77.2%), but maternal and newborn morbidities were comparable [141]. Similarly, studies have looked at babies with birth weights >4000 gm and have shown success rates of 58% to 57% [142-145].

A Canadian observational study reported rupture rates at intervals less than 24 months between caesarean and subsequent deliveries. If the interval was <12 months rupture rate was 4.8%, 2.7% from 13 to 24 months, 0.9% from 25 to 36 months and 0.9% at greater than 36 months [146]. Studies have shown comparable success rates in women who deliver after 40 weeks compared to those who deliver before 40 weeks and have also demonstrated no increased risk of rupture [145, 147, 148].

The Task Force recommends:

1. In the absence of contraindications a women with one previous transverse low-segment caesarean section should be offered a TOLAC with appropriate review of the risks and benefits for mother and baby [II-2B].
2. Informed consent with documentation should be incorporated to the birth plan of a woman with previous caesarean section. In obtaining this consent, caregivers should consider the use of a Shared Patient-Physician Decision Tool⁵ [II-2B].
3. Oxytocin augmentation and induction are not contraindicated in women undergoing TOLAC [II-2A]. Medical induction with Prostaglandin E2 is associated with an increased risk of rupture and should be used only in appropriate circumstances and with appropriate counseling [II-2B].
4. Women with more than one previous uterine scar who attempt labour are likely to be successful but there is a higher rate of uterine rupture [II-2B].
5. TOLAC can be considered in those with multiple gestation, diabetes, post-dates pregnancy and fetal macrosomia [II-2B].
6. Women who deliver within 24 months of previous caesarean section should be counseled about rates of risk of rupture [II-2B].

⁵ A Shared Patient Physician Decision Tool may be accessed through the American Academy of Family Physicians website: <http://www.aafp.org/online/en/home/clinical/patiented/counselingtools/tolac.html>

6.3 PAIN MANAGEMENT IN LABOUR

Labour is a highly individualized experience. A woman may choose medication for pain relief, complementary techniques in lieu of a medication or a combination of approaches. Her decision is influenced by past experience with pain, expectations and cultural beliefs, knowledge about relief modalities, level of support, complexity of labour and coping skills [57]. Her response to pain is also affected by the beliefs, expectations and values of the maternity care provider [149].

A wide range of non-pharmacologic measures is available to women during labour. The effectiveness of comfort measure and relaxation techniques varies among women, between births, and throughout the stages of labour.

Pain control options such as physical and emotional support, water therapy, position change and use of parenteral analgesia should be encouraged to promote normal labour. Epidural anesthesia can provide effective pain relief and also allow augmentation with oxytocin. However epidural analgesia has been reported to be associated with longer first and second stages of labour, an increased incidence of fetal malposition and increased use of oxytocin and instrumental vaginal delivery and increases of perineal trauma, with or without instrumentation [150]. Walking and low dose epidurals should be preferred because they decrease the impact of these changes.

Studies of the effect of ambulation have shown conflicting results. Several Randomized Clinical Trials (RCT) have shown that ambulation shortens the length of labour; some of these studies have actually measured the intrauterine pressure and have found this to be higher in women who were upright. While an RCT of 1000 women examined ambulation in women in early active labour and found no differences in length of first stage, augmentation, analgesia use or operative delivery, this study randomized women in the active phase of labour, when most of the ambulation had likely already taken place. The validity of this study, therefore, is in question [151].

The influence of pain management on caesarean section rates remains controversial. The IHI Breakthrough Series Guide on Reducing Caesarean Rates while Maintaining Maternal and Newborn Outcomes outlined optimal management of pain in labour as a key factor and suggested preparation of women for the pain of labour with adequate education [72]. Information about pain management options for labour and birth should be shared with every woman during her prenatal care. This information should include indications for, as well as risks and benefits of pain management options available in her community. Her preferences and concerns should be addressed. Prenatal referral to an anesthesiologist should be arranged when indicated. In addition, before any method of analgesia is initiated during labour, women should be made aware of the risks and benefits so that they can make an informed choice about the options.

A wide range of non-pharmacological comfort measures and relaxation techniques should be available and routinely offered to all women during labour before pharmacological methods are employed [117]. The effectiveness of each comfort measure and relaxation technique will vary among women, between births, and over the phase and stage of any labour. Women should be informed of options available to them and their choice should be supported where it is safe and reasonable to do so. Every effort should be made to ensure that continuous support is provided to women in active labour. Each woman's preferences and choices for her labour should be respected.

Deep water immersion during the first stage of labour is associated with a significant reduction in both pain scores and regional analgesia without affecting operative birth rates or neonatal outcomes including Apgar scores, NICU admissions, and infection [152]. Acupuncture and hypnosis may help relieve labour pain [153]. More research is needed to evaluate the effectiveness of commonly used alternative therapies such as: acupressure [154], visualization, biofeedback, music, patterned breathing, toning, chant, song, prayer, aromatherapy, homeopathy, and herbs.

Evidence for pain relief with Transcutaneous Electrical Nerve Stimulation (TENS) during labour was evaluated in a systematic review of eight randomized trials involving 712 women [155]. There was no difference in pain

scores between groups; however, there was a slight reduction in use of analgesia within the TENS group. Methodological problems were identified. Subcutaneous sterile water papules is a safe and simple technique that is easy to learn and appears effective for relieving back pain in first stage labour [156-158].

Subcutaneous injection has been found to be less painful than intracutaenous/intradermal injection, yet equally effective at relieving back pain. Nitronox or Entonox, a self-administered mixture of 50% oxygen and 50% nitrous oxide is a safe, inexpensive, and reasonably effective labour analgesic. A systematic review of eleven randomized controlled trials found it was safe for women, newborns and health care workers in attendance during its administration [159]. A modest level of intrapartum pain relief has been reported with the use of narcotic analgesia although others have found no effect [160, 161]. However, even with modest to no pain relief, sedation caused by narcotics may offer “therapeutic rest” for women who experience prodromal labour or irregular uterine contraction patterns of early labour that lead to exhaustion. Women need to be informed of the risks and benefits of narcotics.

Epidural analgesia (EA) is acknowledged as a highly effective pain relief method in labour and most women who have used it believe it to be helpful; however, considerable controversy exists in the literature about the effect of epidurals on caesarean section rates. A meta-analysis of 21 randomized trials in 6664 women comparing EA with non-epidural analgesia demonstrated that EA is more effective in reducing pain in labour and does not contribute to increased caesarean section rate. However, they also found EA use is associated with an increased risk of instrumental vaginal birth, longer second stages of labour, and increased use of oxytocin, urinary retention, maternal fever and maternal hypotension, but no difference in neonatal outcomes [57]. EA was associated with a trend towards an increase in fetal malposition, and caesarean section for fetal distress, but this trend did not achieve statistical significance.

Earlier studies that found higher caesarean section rates associated with EA have since been challenged in RCTs [162, 163]. The results of the current Cochrane meta-analysis do not have external validity to the conditions of practice in British Columbia, based on their inclusion of three studies of high-risk women with severe pre-eclampsia or the use populations/settings with very low caesarean section rates in the range of 10% and different care provider environment (e.g. labour managed by nurse-midwives with obstetricians functioning only as consultants as opposed to obstetricians functioning in a more primary care role). Studies included in the meta-analyses are beset with problems of heterogeneity (mixing nulliparous with mixed parity), high cross-over rates [164] and discrepancy in differences in oxytocin dosage employed. Specifically, some have suggested that the inclusion of trials with low baseline caesarean section rates, and high-dose oxytocin use reduced the impact of the epidural on caesarean rates and undermined the external validity of this meta-analysis [165-167].

The IHI breakthrough series guideline for caesarean reduction suggested that timing and dosage of the epidural should be planned to avoid interference with labour. The question regarding the impact of when in labour the epidural is administered on the mode of delivery cannot be answered in using BC Perinatal Database Registry as data on cervical dilatation at time of epidural is not currently collected.

In light of the evidence, women should be fully informed of the risks and benefits of EA, including the trade-off between optimal pain relief and higher rates of assisted birth. Patient controlled epidural anaesthesia with low dose infusions provides the woman with more control: there is increased maternal satisfaction and reduction in need for top-ups [168, 169].

The Task Force recommends:

1. Women should be educated prior to labour about what to expect regarding options for analgesia in relation to the characteristics of their labour [III-A].
2. Women need to be fully informed about the benefits and risks of all forms of analgesia [II-A].
3. 1:1 continuous supportive care for every woman in active labour is recommended. The role of the doula has been proven to be beneficial in improving outcomes and providing support in labour; therefore, doula support is recommended where possible [I-A].
4. Women should be encouraged to adopt positions and activities that increase their comfort [I-B] and should be allowed to choose whether or not to ambulate in labour [I-A].
5. Women should be offered alternative pain options as listed in Section 6.3. If epidurals are considered, women should be given information on their possible impact on labour (longer labour, increased malposition and increased need for oxytocin, increased instrumentation and perineal trauma), as well as the controversy surrounding the effect of epidurals on the caesarean section rate. When utilized as a pain management option, epidurals should be low dose [I-A].
6. Non-pharmacological modalities such as massage, hydrotherapy and thermal therapy acupuncture, hypnosis, acupuncture, TENS and sterile water injections may be helpful to support women in labour [I-C].
7. Nitronox or Entonox is a safe choice for analgesia and will provide relief in 50% of women
8. Narcotics may provide therapeutic rest and pain relief. Mothers should be made aware of risks and benefits [I-A].

6.4 INTRAPARTUM FETAL SURVEILLANCE⁶

Fetal hypoxia and resultant acidemia can result from maternal hypoxia, reduced maternal perfusion of the placenta and/or poor placental function. It has long been recognized that intermittent auscultation (IA) and electronic fetal monitoring (EFM) have significant limitations. Routine use of EFM has failed to reduce our rates of cerebral palsy and neurologic injury [170].

The prevalence of perinatal asphyxia in the low-risk population is rare at only 0.1%. Any test for fetal well-being applied to a low-risk population would have a very low positive predictive value (PPV). If emergent caesarean section were performed for all non-reassuring FHR tracings in a low-risk population, 99% of term fetuses would be shown NOT to have asphyxia [171, 172].

It has been shown that the use of EFM with fetal scalp sampling (FSS) to confirm acidemia reduces fetal morbidity (reduction in neonatal seizures). Asphyxia severe enough to result in hypoxic ischemic encephalopathy (HIE) will usually exhibit an umbilical artery pH of less than 6.90-7.00 and a base deficit of 12 mmol/L or greater. With FSS, preparation for immediate delivery is recommended for a pH of 7.20 or less. The use of fetal scalp or vibroacoustic stimulation can also provide reassurance of fetal well being in a less invasive fashion.

Saline amniotic infusion has been shown to treat non-reassuring FHR tracing secondary to cord compression with a success rate of 50-75% [173]. Subsequently caesarean section rates for non-reassuring FHR tracings are reduced by 65-80% with liberal amniotic infusion use for repetitive variable FHR decelerations. Neonatal acidemia has been shown to be reduced by as much as 60%. Further reassurance by fetal scalp stimulation or fetal scalp sampling should be considered as well to complement the use of saline amniotic infusion.

One should also recognize the effects of drugs and regional anesthesia on EFM. Epidural anesthesia can result in maternal hypotension and placental hypoperfusion. Spinal anesthesia is associated with fetal bradycardia. Corticosteroids, anti-hypertensives and narcotics are all associated with decreased fetal activity. These factors need to be considered, as the FHR tracing will often improve with observation alone.

Given the poor PPV of EFM, further evidence of fetal acidemia obtained by routine FSS would result in a number of emergent caesarean deliveries being avoided, or perhaps replaced by assisted vaginal delivery after further progress of labour. Emergent caesarean delivery is performed for intrapartum fetal concerns at a rate of 10%. FSS is rarely performed prior to emergent delivery even though fetal acidemia is confirmed postpartum in only about 30% of cases. The potential for reduction in overall caesarean rates is difficult to estimate as FSS is not often performed routinely. Serial FSS is considered cumbersome by many clinicians, especially when the cervix is less dilated and the vertex remains high in the pelvis. FSS also relies upon laboratory support and the absence of significant scalp edema. If FSS is not feasible, one is left with deciding for caesarean delivery despite the knowledge that EFM carries such a low PPV in low-risk women.

The Task Force recommends:

1. Intermittent auscultation for spontaneous labour in the low-risk population [I-A].
2. Women with induced labour and high-risk women should have continuous EFM [III-C].
3. Atypical or abnormal FHR tracings should initially be addressed by position changes, ensuring maternal hydration and ensuring the absence of maternal hypotension. Oxygen should be administered and cord prolapse should be ruled out by vaginal examination.
4. Uterine hypertonus should be addressed if present and oxytocin use reduced where appropriate. A complete review of management and interpretation of EFM is beyond the scope of this document [I-A].
5. Persistent abnormal FHR characteristics should prompt continuous EFM or FSS unless delivery is imminent. FSS is recommended for uninterpretable or abnormal FHR tracings such as absent

⁶ Please refer to joint SOGC-BCRCP guidelines (2007) for a full discussion of the topic and recommendations.

variability, fetal tachycardia, uncorrectable late decelerations and severe deep/prolonged variable decelerations. If the abnormal tracing continues, then FSS should be repeated every 30 minutes until delivery occurs. If FSS is not possible and delivery is not imminent, caesarean delivery or assisted vaginal delivery is recommended [I-A].

6. Patients where fetal acidemia on FSS is confirmed should be delivered immediately to prevent asphyxia and possible neurological deficits in the newborn. Fetal resuscitation in-utero prior to emergent caesarean delivery by use of tocolysis and maternal oxygenation is highly recommended [I-A].
7. The presence of deep or prolonged variable decelerations can be treated with amniotic infusion and reassurance can be achieved with serial FSS [II-A].
8. Umbilical cord blood sampling at birth for all patients with intrapartum concerns for fetal well-being or newborn concerns at delivery. SOGC recommendation is to routinely sample all births. It should be noted that routine sampling of cord blood is an after-the-fact risk-management strategy that has not been shown to provide information to assist care providers in managing labour [III-B].
9. Newer technologies such as computer-based algorithms, fetal pulse oximetry, ST waveform analysis and near-infrared spectroscopy are NOT recommended at present but warrant further clinical research [III-B].

6.5 MANAGEMENT OF BREECH PRESENTATION

At term the incidence of breech or non-vertex presentation is 4%. The incidence is 9% in multiparous patients when the first infant was breech [174]. Most women will be diagnosed prior to the onset of labour; however, a significant number of women are still diagnosed intrapartum.

Since the 1970's the rate of caesarean delivery for breech presentation has increased from 14% to 87% with most recent vaginal breech deliveries occurring as the second twin or as precipitous deliveries [174, 175]. The acceptance of vaginal breech delivery has decreased due to reports that planned caesarean delivery may be associated with lower perinatal morbidity and mortality. The TERM Breech Trial reported this as well as documented how much lower the success for vaginal birth (57%) with breech presentation was compared to a cephalic presentation (72%) [176]. This study did not conclude that vaginal breech delivery was not safe and in fact 57% of women did experience successful vaginal breech deliveries.

Poor outcomes following breech vaginal delivery may be due to underlying conditions contributing to malpresentation rather than birth trauma from delivery [177]. When correcting for these underlying conditions, the fetal outcomes seem very similar to planned caesarean delivery. In fact, the TERM Breech Trial reported no significant newborn outcome differences after two years of follow-up. The number of planned caesarean deliveries performed for breech may not be justified given the significant increased surgical risks to the mother. Planned caesarean delivery also decreases the opportunity for spontaneous version as this will occur 25% of the time even beyond 36 weeks gestation. With careful patient selection, a vaginal breech delivery has a reasonable success rate approaching 60% [175, 178]. Although cephalic presentation has a higher success rate for vaginal birth, the majority of this difference is accounted for by ability to offer an instrumental delivery (forceps or vacuum) for a cephalic presentation but not for a breech presentation.

Since publication of the TERM Breech Trial, there has also been a significant decrease in attempts at external cephalic version (ECV) and a marked increase in planned caesarean deliveries for breech [179-181]. The major additional risk of a term breech in labour is cord prolapse or significant cord compression. The risk of an entrapped head at term is in fact rare and can be minimized by proper patient selection. Birth trauma can also occur with planned caesarean delivery as well. In a facility with motivated obstetricians and the required skill set, a vaginal breech delivery can be a safe option for many women at term. If vaginal breech delivery continues to be a rare event due to the almost immediate recommendation for caesarean delivery, the training for and maintenance of this skill set may be lost.

ECV is an effective method of reducing breech presentation and overall caesarean section rates at term and varied success rates ranging from 25 to 60% have been reported [180, 182]. It is estimated that for every 4th patient that has an attempted ECV there will be one caesarean delivery avoided [181]. ECV at 34-36 weeks with repeat attempts as necessary has not clearly been shown to be advantageous; although larger early ECV studies are ongoing that may show a difference. One study did report a 9.5% reduction in non-cephalic births at term by early versus term ECV attempts [181]. Early recognition of malpresentation by clinical examination or ultrasound would also allow more patients to be offered an early or term attempt at ECV. The use of tocolysis with B-adrenergic agonists has been shown to increase ECV success rates. Nitroglycerine has not been shown to be effective. The use of a regional epidural anaesthesia also increases the overall success rate of ECV [180]. Patients should be made aware that ECV is a very uncomfortable procedure with potential negative psychological effects when failure occurs.

Multiparous patients may in fact have an unstable "lie" at term rather than a persistent breech presentation. This should be considered when patients present in early labour with no fetal parts palpable vaginally. Serial imaging may be required to document this clinically. If a clinician with the skill set is available, intrapartum ECV may also be performed in early labour with intact membranes. Women who fail or decline ECV but are found to have a very high presenting part should be allowed time for the lie to stabilize longitudinally at which time a planned caesarean section may not be required due to late spontaneous version to a cephalic presentation.

Twin gestation is associated with an overall caesarean section rate of over 60%. Many of these deliveries are preterm and this is a major factor when choosing mode of delivery although data is not clear that there is a benefit to planned caesarean delivery for preterm twins. Most twin gestations with a vertex presentation for twin A can be offered an attempt at vaginal birth with high success at or near term. The routine recommendation for elective caesarean delivery when twin A is breech (non-footling) has never been validated. The second twin is often non-vertex and will usually require some intervention to achieve successful vaginal delivery. The reluctance to add even minor birth trauma to prematurity has resulted in the higher caesarean section rate. At term however, dystocia is rare and almost all women will achieve full dilatation if there are no fetal concerns in labour. Only 10% of second twins will require caesarean delivery after vaginal birth of the first twin. The ability to perform external cephalic version, internal podalic version and/or breech extraction for the second twin will clearly affect what mode of delivery can be safely offered to the patient. The skill set for assisted vaginal delivery of the second twin is not available at all facilities and this should also be discussed with the patient when determining the facility for planned vaginal delivery of multiple infants

The Task Force recommends:

1. Clear documentation of a cephalic presentation from 34-37 weeks, with use of ultrasound as needed.
2. With a ballotable presenting part, rule out breech presentation and document placental location [II-A].
3. Women who have had a previous pregnancy with breech presentation should undergo routine ultrasound confirmation of presentation at 34-36 weeks [II-A].
4. Thorough review of all options and risks with the expectant mother and family when malpresentation is confirmed. The discussion should include risks and benefits of caesarean delivery (present and future), ECV and vaginal breech delivery.
5. Referral to a facility or obstetrician who can confirm findings and offer ECV to all women when there is no other contraindication present.
6. Consider having all ECV attempts performed by an ECV service made up of a small group of clinicians for that facility [II-B].
7. Performing ECV from 34-36 weeks may increase success rates [II-B].
8. Consider regional anaesthesia for those women who will not tolerate the discomfort of the ECV procedure. Tocolysis may be beneficial [I-A].
9. Recognize that repeat ECV is an option in most patients that convert back to breech after successful ECV. After successful ECV carefully assess presentation as re-conversion is common [II-B].
10. If the skill set is available, consider vaginal breech delivery in those patients who fail or decline ECV. If the local skill set is not available, referral to another facility for confinement if the woman is motivated and accepting of an attempted vaginal breech delivery. Criteria for patient selection for a vaginal breech delivery should be clear and confirmed by ultrasound. The training and experience of the clinician will play an important role in the decision to safely offer a vaginal breech delivery [II-A].
11. Prior to elective caesarean delivery, fetal lie should be confirmed, especially where the presenting part is high to rule out an unstable lie with late conversion rather than a persistent breech presentation. Consider performing elective caesarean delivery at 40 weeks to allow for late spontaneous version to cephalic [II-A].
12. With a twin gestation, when a vaginal delivery is planned, ensure there is an obstetrician available to perform assisted delivery of twin B as breech presentation is common even when the lie of twin B is vertex at the initiation of labour. Breech extraction of the second twin is a valuable skill to achieve successful delivery of the second twin [II-A].
13. Obstetrics and Gynecology Residency programs should continue to provide training in the skill set required to perform an ECV and an assisted vaginal breech delivery.
14. Emergency management of breech delivery should be reviewed.

6.6 PREVENTION AND MANAGEMENT OF DYSTOCIA

There is evidence that the simple “intervention” of providing trained labour support, particularly for first time mothers, prevents dystocia and operative deliveries. Management of latent phase labour is not well researched. There is evidence that women of similar perinatal risk admitted at less than 3 cm of dilation have increased number of interventions and more diagnoses of complicated labour. Generally speaking most guidelines suggest avoidance of admission to a labour delivery unit for those in latent labour.

Women with prolonged latent labour need careful management to avoid over-diagnosing dysfunctional labour and triggering the cascade of interventions. Canadian data suggests that dystocia is diagnosed in the latent phase of labour and that up to 40% of caesarean sections performed for dystocia are performed at this time. Management of dystocia should include formulation of a documented plan, amniotomy, oxytocin augmentation, and therapeutic rest with analgesia. Trials where amniotomy was used to manage an abnormal labour have not shown a difference in caesarean delivery rates [183]. Oxytocin combined with amniotomy has been shown to increase the dilation and shorten labour more than amniotomy alone or expectant management [183]. This suggests that amniotomy plays a role in the management of abnormal labour. Given possible risks it should be used selectively.

Oxytocin augmentation continues to be the main pharmacological approach to the management of dysfunctional labour. There is controversy about dosage, dosing interval, and duration of oxytocin treatment. In some settings “high dose oxytocin” has been used in an active management approach, but this has not been accepted in North America because of concerns about hyperstimulation and fetal and maternal morbidity.

In the management of the second stage, women should be encouraged to wait for up to two hours or until they feel the urge to push or the head is visible on the perineum, before initiating active pushing. This is sometimes referred to as the rest and descend phase. A Canadian RCT of women with epidural concluded that this reduced the numbers of difficult births particularly in those with babies in the occiput posterior position [184]. There were no negative effects on the fetus. These results have been verified in other settings [185]. For all nulliparous women and for multiparous women with epidural anesthesia, reassessment for assisted delivery should take place after two hours of active pushing [186].

Postpartum audit or review of all caesarean deliveries may also help prevent dystocia by encouraging adherence to guidelines and definitions regarding normal labour care. Studies have shown that care review may lead to an overall decrease in caesarean deliveries [187].

The Task Force Recommends:

1. The key elements of management for prolonged latent labour include:
 - a. Avoidance of admission to the labour delivery area until active labour is established. This assumes that a plan is established to meet the woman’s needs either at home or in a non-labouring hospital unit. This plan should include information about coping strategies and how and when to access further support [II].
 - b. Observation, rest, adequate hydration and therapeutic analgesia are favoured over a more active approach of amniotomy and oxytocin induction
2. Management of dystocia should include regular assessment, and intervention when necessary including analgesia, rest, amniotomy and oxytocin [IA].
3. Women with epidural anesthesia can wait up to two hours before pushing if there is continued descent of the head and reassuring fetal and maternal status and the head is not visible on the perineum or they lack the urge to push [IA]. For all nulliparous women and for multiparous women with epidural anesthesia, reassessment for assisted delivery should take place after two hours of active pushing [IIB].
4. Postpartum audit and review of caesarean sections based on clearly defined criteria for dystocia should be undertaken to insure that guidelines are followed [III].

6.7 INSTRUMENTAL DELIVERY: USE OF FORCEPS AND VACUUM

In BC approximately 40% of labouring primiparous women will need some assistance to complete delivery, mostly by instrumental delivery (14-15%) or caesarean section (28-30%). Often, caesarean deliveries are performed despite the presenting part being below spines and possibly could be avoided by offering an instrumental delivery.

Assistance in the second stage may be in the form of oxytocin augmentation, episiotomy, use of a vacuum, manual correction of malposition, use of forceps or caesarean section. The indications for assistance include maternal exhaustion, fetal health (FHR) concerns, soft tissue dystocia (relative CPD), malposition and some medical conditions that preclude strong maternal effort in the second stage [188].

With the presenting part above spines, caesarean section remains the only option for arrest of descent. There is certainly a role for therapeutic rest, hydration and oxytocin augmentation with women under dense regional anaesthesia. For those women where the fetal presenting part is within the pelvis, an instrumental delivery can be achieved in most cases if all options are explored [189, 190].

Increased availability of the skill set to offer assistance in the second stage is a clear strategy that would effectively reduce the overall caesarean section rate. This skill set varies depending on the training and experience of the clinician. In particular, the comfort level with mid-cavity forceps procedures, with or without rotation, has certainly declined with recently trained obstetricians. With its inherent medico-legal implications, there is an increasing trend to avoid even mildly difficult instrumental vaginal deliveries for second stage arrest.

Malposition with occiput transverse (OT) or occiput posterior (OP) positions contributes significantly to second stage arrest disorders. Manual rotation may be used alone or prior to instrumental delivery with good success in many patients as well as resulting in reduced pelvic soft tissue trauma. There has been a significant decline in the use of forceps for malposition and the caesarean section rate has risen accordingly. The training and clinical experience of our obstetricians has suffered as these procedures are being abandoned. The procedure of rotational forceps is beyond the scope of this document [188-190].

A careful assessment of fetal size, fetal position and shape of the maternal pelvis will allow for choice of the best instrument for each assisted delivery. Clearly there are advantages to the various types of forceps and vacuum devices available and a thorough knowledge of the use of these instruments is crucial to be able to offer an assisted delivery. Training and experience with these multiple instruments will increase the overall success of forceps and vacuum assisted vaginal births.

Patient awareness and understanding of the risks and benefits of instrumental delivery should ideally be documented prior to labour. Maternal short-term and long-term effects on pelvic floor function and sexual function should be discussed with the patient when obtaining consent. This topic has been discussed earlier in this document.

With proper counseling, the acceptance of instrumental delivery would hopefully increase as there is often the perception that these procedures are dangerous and contribute to significant maternal morbidity.

The Task Force Recommends:

1. Patients at high risk for dystocia should be offered delivery in a facility where assisted delivery is readily available. A discussion of dystocia and management options should be undertaken and documented prior to labour. The risks for future pregnancies if the woman requires caesarean section should also be discussed with the patient [II-A].
2. With arrest of progress in the second stage, clearly document position and adequate uterine contractions. Ensure patient hydration and comfort. Augment with IV oxytocin in the second stage where appropriate [II-A].

3. Diagnose and document the factors that are not allowing for progress in each patient individually. Uterine inertia, maternal exhaustion, malposition, fetal size and status of the maternal pelvis may all contribute to arrest of progress. Not all factors may be correctable, but a clear understanding of the mechanism for arrest of progress for an individual patient basis will help clarify which treatment options are reasonable to offer.
4. Consider assisted vaginal delivery when possible and safe to do so prior to opting for caesarean delivery. If clear risks are identified, a full discussion of risks should include management of shoulder dystocia. The obstetrician should undertake a careful assessment of those patients who should have a trial of forceps in the operating room [II-A].
5. Preventative measure for PPH should be in place for any patient with arrest of progress and/or prolonged second stage. IV access will be required [II-A].
6. Maintain the skill set of vacuum and forceps delivery in your facility. In those facilities where skill sets and comfort levels vary, identify those obstetricians who can offer a full complement of treatment options for second stage arrest. Obstetricians who do not have this skill set should be offered mentoring to achieve a higher comfort level for mid-cavity forceps assisted deliveries. Manual rotation should be attempted prior to instrumentation for arrest disorders secondary to malposition [II-A].
7. Obstetrics and Gynecology Residency programs need to continue teaching the skill set of instrumental vaginal delivery to our future obstetricians.

6.8 RURAL MATERNITY CARE

A variety of standard technologies are either unavailable or difficult to obtain in rural settings. In rural settings it is not unusual for ultrasound waitlists to be 4-6 weeks and ultrasound may not be available locally. This may affect the availability of dating ultrasound and definitely impacts post-dates monitoring for Amniotic Fluid Index (AFI). BCPHP Guidelines recommend induction at 41 weeks gestation if AFI is not available twice weekly. Non Stress Testing is unlikely to be available in a community that does not have maternity services. Thus these diagnostic deficits may contribute to an increase in elective caesarean sections as medical/nursing staff becomes uncomfortable with their ability to assure fetal well-being.

Increasingly and often rural women have to travel long distances to access maternity services. Close to term, this may require the mother to live away from home, family and usual supports, leading to less than optimal outcomes and increasing the pressure for induction of labour once the due date has passed, increasing the potential for caesarean birth secondary to failed inductions.

Unavailability of epidural analgesia to support inductions or linked oxytocin augmentation of labour to manage labour dystocia due to malpositions (OP/OT) has led increasingly to a decision to do a caesarean section as the only safe alternative. This is not optimal care, but for safety reasons it can be necessary. It has been shown that trained doulas will help keep caesarean section rates down [191-193] but doula support is especially scarce in rural settings. Moreover, the complex and often solitary role of the rural maternity nurse makes it even more unlikely that nurse will have the time to function as support person and may not be successful in this role [194-197]. Moreover, rural nurses are generalists and must provide care for patients of all types. It is not unusual for a hospital to be staffed by two nurses who must provide care to the emergency room, geriatric and medical/surgical patients at the same time as they care for labouring women.

In breech presentation, the guidelines have suggested an ultrasound monitored external cephalic version in hospital with immediate caesarean section back up at 37 weeks gestation. Version at this late gestation becomes more difficult, and there is a need to develop local expertise in performing external cephalic version to reduce elective CS for breech presentation.

In assisted vaginal birth, vacuum has been perceived as safer and easier than forceps [198]. Vacuum followed by forceps is discouraged. Manual rotation can often result in a spontaneous vaginal birth, or is used as a precursor to an assisted vaginal birth. Spontaneous rotation often occurs when using the Kiwi hard cup vacuum. Manual rotation skills appear to be scarce or are not being taught. Current funding models do not encourage or support collaboration between rural maternity care providers: physicians, nurses and midwives. Especially for midwives to work with rural physicians, new and innovative team models need to be developed.

The Task Force Recommends:

1. Enhance education in general maternity care for undergraduates nursing curricula and continuing education or retraining encouraged for practicing nurses [III].
2. Maternity care updates via ALSO/ALARM courses need to be encouraged and funded for maternity care providers including doctors, nurses and midwives [III].
3. Team-building exercises like MORE^{OB} need to be available and funded [III].
4. Cross training of rural maternity care nurses in both labour management and caesarean section assist [III].
5. Advanced maternity care skills for both physicians and nurses working in rural maternity care settings need to be expanded and funded [III].
6. The Ministry of Health encourages the development and evaluation of funded models of shared maternity care between midwives and family practice [III].
7. Doulas need to be trained for rural practice and funded by the health care system [III].

6.9 MATERNAL REQUEST CAESAREAN

Over the last 20 years significant social changes have taken place. We have become increasingly comfortable with technology, more risk averse, reluctant to experience pain, and assertive as consumers. Physicians, nurses, midwives and women have become dependent on technology in labour and birth, believing it offers choice, safety and control [4]. While technologies such as epidural analgesia have improved pain management dramatically [199] and others, such as caesarean section and pharmacological induction of labour, are associated with a decrease in perinatal mortality, the overuse of technology carries negative implications [5-9].

Family demographics and attitudes have also changed. The movement in the '60s and '70s among women to "take back birth" has given way to a desire to take advantage of modern technology accompanied by a sense of entitlement to a "pain free" birth; that is, birth without labour [7]. Large families are a rarity and, for a variety of reasons, many couples postpone starting a family and later seek medical intervention to achieve conception.

There is a wide spectrum of attitudes about pregnancy and childbirth. There is a perception on the part of many in the general public that caesarean section is a benign and "normal" procedure [5, 6, 200]. Some women believe it reduces the risks to both themselves and the baby. Negative attitudes about vaginal birth may be based on fear of pain and loss of control and an unpleasant previous experience. Thus, maternal preference, in the absence of medical indications, frequently favours a surgical birth [6, 201, 202].

A U.S. study using National Hospital Discharge Survey Data estimated the rate of primary elective caesarean sections resulting from maternal request to be 15%, but acknowledged the limits inherent in estimating intention using retrospective data [203]. Preliminary data from a random, representative survey of 6500 Canadian women indicates approximately 8.4% have requested caesarean section at some time during their last pregnancy.

In the current environment, obstetric caregivers are fielding increasing numbers of requests for caesarean birth in the absence of maternal or fetal indications [6, 201, 202]. Reasons for requesting caesarean section include fear of loss of control, fear of labour pain, previous negative birth experiences, the convenience of controlling the timing of birth, a belief that caesarean section is safer for the baby and/or associated with reduced physiological trauma for the mother, and a sense of empowerment related to the ability to choose [204, 205]. The degree to which this new phenomenon contributes to the rising caesarean section rate is not known.

Maternal request as an indication for caesarean section is not supported by the Society of Obstetricians of Canada [63] or the Federation International of Obstetricians and Gynecologists [64]. And, therefore, elective caesarean birth upon maternal request is "camouflaged" as resulting from other indications, such as "fibroids". Purported maternal benefits of this "caesarean on demand" are reduced urinary and fecal incontinence, reduced sexual dysfunction, avoidance of labour complications (prolapsed cord), and anxiety associated with fear of labour [32, 206-208]. However, these claims have not been substantiated in follow-up studies [38]. In the Canadian Term Breech Trial of planned caesarean section vs. planned vaginal birth, there were no differences between trial arms with respect to sexual function, urinary or fecal incontinence, pelvic pain or postpartum depression at two years of follow-up [209]. The only noted benefit of caesarean section vs. vaginal delivery was reduced short-term urinary incontinence [35, 208, 210].

Planned caesarean vs. vaginal birth is also associated with adverse maternal and neonatal outcomes. A recent study used Massachusetts birth certificates linked to hospital discharge data to compare cohorts of women without antepartum risk factors or intrapartum complications and without labour (planned caesarean birth) with those having planned vaginal births [211]. The adjusted odds ratio for rehospitalization in the first month after delivery was 2.25 (95% CI 1.74-2.90). The leading reason for readmission was surgical wound complications. Caesarean delivery on demand is associated with a significant increase in adverse neonatal outcomes including respiratory distress, persistent pulmonary hypertension, and admission to a neonatal intensive care nursery [212, 213].

Women considering elective caesarean should be provided with full information about the risks of pelvic floor dysfunction (prolapse, urinary and fecal incontinence, and sexual dysfunction) to facilitate the formulation of an informed decision. Pelvic floor information needs to be considered in conjunction with the classic maternal and newborn mortality and morbidity data [38].

The Task Force Recommends:

Evidence suggests that the majority of maternal requests for caesarean section are based on fear of pain or fetal compromise and pelvic floor concerns. A local process, such as supportive counseling or consultation, to address maternal motivations for requesting caesarean section should be implemented. Evidence does not support maternal request caesarean section and is not supported by this Task Force [III].

7. CONCLUSION

In a comparison of caesarean birth trends with changes in maternal health status and pregnancy characteristics, medical indications do not appear to be the primary drivers of increased caesarean section rates. Of particular concern is the increase in “repeat CS” and decrease in VBAC and the possible loss of assisted vaginal birth skills.

The evidence suggests that the increased rate of caesarean births and associated public health costs can be productively addressed through evidence-based quality improvement initiatives; including peer review, audit and feedback, collaborative models of practice, customized provider guidelines and programs and effective use of multi-media to educate childbearing women and the general public.

8. CONSENSUS CONFERENCE AND PANEL STATEMENT



January 24-26, 2008 - The Morris J. Wosk Centre for Dialogue - Vancouver, BC

Sponsored by:



Since the late 1970s, the cesarean birth rate has received considerable attention and has continued to climb with primary and repeat cesarean rates for all women now reaching their highest levels. The purpose of this consensus conference was to bring together the relevant stakeholders in maternity care to present and discuss the evidence regarding the trends, risks and benefits, perspectives, and future strategies regarding cesarean birth in BC. The conference was hosted by the UBC Collaboration for Maternal and Newborn Health and the BC Perinatal Health Program (formerly the BC Reproductive Care Program), and supported by the Provincial Health Services Authority, BC Women's Hospital and Health Centre, and the Ministry of Health Services.

This conference was building on the BC Perinatal Health Program's (BCPHP) report of the *Caesarean Birth Task Force*, commissioned by the Ministry of Health. The final draft of this report was released in February 2008. The conference objectives were:

1. To present and disseminate the report of the BCPHP *Caesarean Birth Task Force*.
2. To present and discuss evidence about the trends, risks and benefits of cesarean birth.
3. To present and discuss evidence of how cesarean birth rates can be reduced.
4. To discuss collaboration at the local, regional, and provincial levels to deliver optimal maternity care for all women of British Columbia.
5. To discuss a public information strategy to assure that BC women and their families have the best possible information regarding reproductive and maternity care.

Many audience participants attended by invitation and had the opportunity to provide feedback, discuss the presentations, including the *Caesarean Birth Task Force* recommendations, as well as the logistics of implementing these recommendations throughout the province. The participants were asked to consider the following questions when addressing the presenters and panel members:

1. How will the recommendations for the BCPHP *Caesarean Birth Task Force* be implemented in my institution/region of the province?
2. What support at the local, regional and provincial level is required to achieve optimal cesarean birth rates in my institution/region of the province?
3. What strategies can be put in place to support and encourage the optimal use of cesarean birth in BC?
4. How can we implement and evaluate these strategies throughout the province?

A conference about cesarean birth would not be complete without the voices of women. Having a consumer representative present a paper was considered, but the diversity and satisfaction of women's childbirth experiences could fill an entire conference program. Therefore, women who had recently given birth with a family physician, midwife or an obstetrician were invited to share the birth experiences on film. Of those stories, we selected 19 video clips of women talking about their varied birth experiences. The short clips were shown throughout the conference, before each speaker. These vignettes were well received by the audience and helped to keep the focus on women and brought their voices into the discussion.

The purpose of a consensus development conference is to evaluate available evidence on a health issue and develop a statement that answers a number of pre-determined questions. A group of maternity care experts presented evidence to a consensus panel, or "jury," which is an independent, broad-based, non-government and non-advocacy group. All of the panelists who participated in this conference and contributed to the writing of this statement were identified as having no financial or scientific conflict of interest, and all signed waivers attesting to this fact. The consensus statement reflects the panels' assessment of scientific knowledge available at the time the statement was written. The consensus statement is an independent report of the panel and is not a policy statement of the conference partners, conference sponsors, or the Government of BC.

The 16-member panel had representatives from rural, regional and tertiary centers and included obstetricians, nurses, family physicians and midwives, as well as a pediatrician, anesthetist, prenatal educator and a consumer. The panel was asked to address the following pre-determined questions regarding cesarean birth:

1. Is it possible to optimize the cesarean birth rate in British Columbia?
2. What are the roles of care providers in optimizing cesarean birth in British Columbia?
3. What support is required from government, health authorities, hospitals, and the BCPHP to optimize the cesarean birth rate throughout British Columbia?
4. What is an appropriate public education strategy regarding childbirth?

During and following two days of presentations, the panel members convened to develop the consensus statement, which was presented to the audience participants on Saturday, January 26, 2008. This statement will be widely distributed throughout British Columbia and across Canada to interested parties.

Question 1:

IS IT POSSIBLE TO OPTIMIZE THE CESAREAN BIRTH RATE IN BC?

Yes. It is possible to optimize the use of cesarean birth (CB) in BC. This will not mean identifying a single discrete rate for the whole province, as it will vary depending on a number of factors. Nonetheless, we believe that optimal use of cesarean birth in BC implies that several criteria have been fulfilled.

- a. We must as communities of care providers and as a province embrace that for the majority of women birth is a natural, physiologic process that deserves our respect and support. Values of individual families, cultures and communities must be reflected in our care models, respecting choice and autonomy. This includes respecting a woman's choice of birthplace.
- b. The best rate is one that is associated with optimal outcomes for mothers and for babies. This rate must reflect both a balance between established benefits and risks for mother and baby, and one that avoids unnecessary interventions.
- c. The focus should not be on the CB rate but on providing the best possible care and birth experience for individual women and their families. Most women will be satisfied with their childbirth experience if they are respected and involved in an optimal decision-making process. In this context, the safe birth of a baby is a cause for celebration regardless of the mode of delivery.
- d. All women in BC should have access to comprehensive and culturally sensitive maternity care as close to their home community as possible. Communities must be engaged in discussions about local maternity care services that are appropriate for their needs.
- e. Maternity care must always be provided in a respectful and woman-centred fashion. This includes accepting a broad definition of women's health:
 - Women's health involves their spiritual, emotional, cultural and physical well-being, and is determined by the social, political, cultural and economic context of women's lives, as well as by biology.
 - In defining women's health, we recognize the validity of women's life experiences, and women's own beliefs about, and experiences of, health.
 - We believe that a woman should be provided with the opportunity to achieve, sustain and maintain health, as defined by the woman herself, to her full potential.

BC is one of the safest places in the world to give birth and to be born. Safety should remain paramount.

We endorse in principle the BC Perinatal Health Program's (BCPHP) *Caesarean Birth Task Force (CBTF)* report (2008)⁷ and its recommendations to optimize the use of CB in BC.

Question 2:

WHAT ARE THE ROLES OF CAREGIVERS IN OPTIMIZING CESAREAN BIRTH IN BC?

Some of the factors that affect the optimizing of cesarean birth begin before the onset of pregnancy. Issues such as maternal age, preconception health, BMI, and the social determinants of health all affect the mother's health and the baby's outcome. While the trends affecting the timing and frequency of pregnancies are complex social and economic forces, or are related to biological issues that women face, we know that women in BC feel they need better information about the impact of these issues on childbirth and related complications. For women to exercise fully informed decision making regarding their health and reproductive

⁷ BC Perinatal Health Program, (2008) *Caesarean Birth Task Force Report*.

lives, it is critical to provide better information about the impact of age, weight and general health on fertility and childbearing.

Similarly, care providers need to ensure that the women in their care have full information about the impact of healthy weight and physical fitness on becoming pregnant, as well as on achieving the best possible outcomes and childbirth experience for themselves and their babies.

Some of the pivotal issues arising from the CBTF report and this conference are:

- a. Continuing education and ongoing training of all care providers including doulas,⁸ prenatal educators, nurses, midwives, family physicians, obstetricians, anesthesiologists and pediatricians. Collaborative multidisciplinary models of education should be developed and supported. Mentoring should be recognized as a core competency of professional practice and should be encouraged and supported appropriately.
- b. Human resource issues in maternity care are urgent in this province and demand innovative and collaborative approaches. Care should be woman and baby centered to ensure that every family gets the best possible care. Collaborative models should be implemented across the province with priority given to smaller centers. Such collaborative models could be facilitated by participation in patient safety-based team building programs.
- c. All care providers should regularly participate in ongoing Continuous Quality Improvement (CQI), local practice audit and review.
- d. Care providers need to understand and be able to discuss the risks and benefits of interventions with their patients. All care providers need to provide evidence-based (EB) information and be cognizant of their own practice patterns and biases. They must be able to offer informed choice and facilitate decision-making by giving women up-to-date, complete and balanced information.
- e. We embrace the concept that knowledge can be gained from multiple sources, and that while evidence-based practice developed from research remains the foundation of modern health care, other concepts such as practitioner experience, client values and local practices may also be of value and should be considered when appropriate.

Use of Best Practice

All care providers should adopt the best practice as appropriate to achieve optimal outcomes. Regional differences in resources and circumstances may require different implementation of best practice. Comprehensive maternity care, including CB capability, must be maintained in rural BC.

Existing guidelines (e.g. SOGC and BCPHP) steer us toward best practice in many areas, and will help us achieve optimal outcomes. In addition, we support the use of strategies that have been shown to have a positive effect on intervention rates without decreasing safety.

Strategies must address both primary and subsequent cesarean births. Approaches to decreasing unnecessary CB include:

- a. Accurate dating of pregnancy, including the use of first trimester dating ultrasound.
- b. Review of induction policies and avoiding unnecessary inductions.
- c. Support for the practice of avoiding admission to hospital in early labour.
- d. The promotion of appropriate support during labour, including doulas and nurses trained in labour support skills. We support the goal of having one-to-one nursing for all labouring women where possible.

⁸ Certification from Doulas of North America (DONA) International

- e. The promotion of judicious use of all forms of pain management in labour, including non-pharmacological forms. When required, modern low-dose epidural techniques should be used and ongoing care of these women should support physiological birth.
- f. Appropriate diagnosis of active labour, ongoing assessment of progress in labour, including the use of partograms, and the timely diagnosis and management of dystocia.
- g. The adoption and implementation of the new SOGC fetal surveillance guidelines⁹ to decrease inappropriate CB and enhance interprofessional communication.
- h. Recommending against non-medically indicated CB; however it is important to respect a woman's autonomy, realizing that the ultimate decision rests with the woman.
- i. Booking elective primary and repeat CB *after* 39 weeks gestation, when there is no medical indication for earlier delivery.
- j. The appropriate use of assisted reproductive technology to help families with infertility but with efforts to minimize multiple pregnancies.
- k. Offering External Cephalic Version for breech presentation in appropriate cases. We support development and enhanced training for ongoing skills for vaginal breech delivery.
- l. Appropriate and cautious use of operative vaginal delivery should be supported through enhanced training and skill development.
- m. Encouraging select mothers with twin pregnancy at term to deliver vaginally *if* the skill set and backup-support necessary is available. Referral to a centre that can support attempted vaginal delivery of twins may be an option.

The best way to avoid subsequent CB is to prevent the first one. In order to avoid subsequent CB, VBAC should be offered to all women, when clinically appropriate. For a woman with a prior cesarean section scar, the balance of short-term and long-term risks and benefits of a trial of labour (TOL) vs. elective repeat CB must be individualized and the ultimate decision rests with the woman. The majority of women with a prior cesarean scar are good candidates for a TOL. It is appropriate to recommend a TOL in women with a high probability of success and a low probability of morbidity.

Question 3:

WHAT SUPPORT IS REQUIRED FROM GOVERNMENT, HEALTH AUTHORITIES, HOSPITALS AND THE BCPHP TO OPTIMIZE THE CESAREAN BIRTH RATE ACROSS BC?

We support, in principle, the BCPHP *CBTF* report recommendations. In addition, we would like to highlight factors that are of high priority for the Ministry of Health:

- Address the looming human resource crisis in maternity care through planning, restructuring and improved remuneration.
- Improve capacity for data collection and analysis for health care providers locally, at the level of the Health Authority (HA), and at the BCPHP.
- Improve best practices through funding necessary research and CQI.

We urge the Ministry of Health to maintain the momentum from both the *CBTF* report and this consensus statement by immediately developing an implementation plan.

⁹ Liston, R., Sawchuck, D., Young, D., (2007) Fetal Health Surveillance: Antepartum and Intrapartum Consensus Guideline. *J of Obstet and Gyne Canada*. 29(9): Supplement 4.

Government:

- a. Develop a model for management of medical-legal issues that has arbitration and mediation at its core.
- b. Develop a province-wide strategy to provide culturally sensitive maternity care for First Nations women.
- c. Develop a province-wide strategy to ensure equal access and support for maternity care for women who are marginalized for social or geographical reasons.
- d. Develop a provincial strategy for implementation of a comprehensive electronic database and health record for maternity care in BC that includes incorporating primary care providers. Computer information system strategies must ensure individual HA choices do not impair the ability to share information and collect quality provincial data to guide future directions. Data in real time or of short turnaround is a priority.
- e. Enhance capacity through increased training for maternity care providers including midwives, nurses, family physicians, and consultant care, with a special emphasis on primary care providers.

Ministry of Health:

- a. Train, recruit and retain more care providers in maternity care, including perinatal nurses, midwives, primary care physicians, obstetric specialists, anesthesiologists, pediatricians, and doulas.
- b. Design a system to support and appropriately remunerate maternity care providers, including family physicians, midwives, doulas and others that will allow the obstetric specialist to practice in a consultant role. This may include alternate payment plans, salaries, and funding for doulas. In addition, family physicians should be compensated for obstetrical on-call services.
- c. Develop new funding models that provide access, retain and recruit midwives, family physicians and specialists in rural and remote communities. Barriers to family physicians, midwives and specialists collaborating and sharing care should be removed.
- d. Appropriately remunerate maternity care providers for currently non-funded activities such as CQI and counseling around pregnancy-related issues.

BC Perinatal Health Program:

- a. BCPHP should assist in providing feedback on obstetrical indicators and outcomes to individual hospitals using Robson's criteria.¹⁰

Regional Health Authorities:

- a. Regional Health Authorities, through internal designates, should take responsibility and assume accountability for perinatal health with co-operative local and provincial strategies.
- b. Regional Health Authorities should support comprehensive maternity care as close to a woman's home as possible.

Hospitals:

- a. Need to develop and support a strategy for hiring and retaining personnel.
- b. Need to establish and maintain CQI, internal audit and review.
- c. Need to provide timely data on obstetrical indicators and outcomes.
- d. Need to develop programs that build collaborative multidisciplinary teams.

¹⁰ Robson, M.S., (2001) Classification of caesarean sections. *Fetal and Maternal Medicine Review*. 12(1): p. 23-39.

Question 4:

WHAT IS AN APPROPRIATE PUBLIC EDUCATION STRATEGY REGARDING CHILDBIRTH?

Province-wide, women and their families need information on normal birth, the risks and benefits of interventions, as well as an understanding of factors such as age and healthy weight that affect CB rates.

Public Education is a pivotal part of assuring best care for women. Strategies should include both widespread campaigns and targeted learning strategies such as province-wide curriculum for accessible prenatal education. This should be done in partnership with community health colleagues.

We believe the public needs more balanced information regarding the risks and benefits of CB. Information and education that promote birth as a normal physiological event should be widely distributed and incorporated into the public school curriculum.

Implementation of these strategies is beyond the scope of this panel and requires consultation with consumers, experts in education and public relations to maximize impact on public awareness.

CESAREAN CONSENSUS CONFERENCE – PANEL MEMBERS

Jan Christilaw - MD, FRCSC, MHSc

Obstetrician-Gynecologist, Chair of the Panel

Dr Jan Christilaw completed her residency in Obstetrics and Gynecology at the University of British Columbia in 1986, and a Masters of Health Care and Epidemiology in 2002. She is the past-president of the Society of Obstetricians and Gynecologists of Canada and has served the SOGC in many capacities over the last 15 years, including many years on Council, as Co-Chair of the Women's Health Task Force, on the JOGC Editorial Board, and as chair of the Ethics Committee. She is currently VP of medicine for BC Women's Hospital and Health Centre in Vancouver, BC. Her portfolio includes being a Senior Medical Director of Provincial Women's Health Programmes, Medical Director of Aboriginal Women's Health and is a co-leader of the Provincial Women's Health Network. She is also a Clinical Professor in the Department of Obstetrics-Gynecology at UBC. This year, she has been working on creating a partnership between UBC and Makerere University in Kampala, Uganda for services in Obstetrics, Pediatrics and Public Health, traveling to Uganda three times in recent months. Birth, in its clinical, social, cultural and personal dimensions, remains an enduring passion. She is married to Dr. Warren Bourgeois, who is a Professor of Philosophy and Bioethics at Kwantlen College. She has two sons, David aged 19 and Tim, aged 13.

Grant Ayling - MB, ChB

Family Physician

Dr. Ayling graduated from Otago University, Dunedin, New Zealand in 1976. He worked for four years in London, England, from 1978 to 1981, principally in the areas of pediatrics, obstetrics, gynecology, neurosurgery, emergency medicine, orthopedics and dermatology. During this time he received his Diploma of Child Health and his Diploma from the Royal College of Obstetricians and Gynecologists. Subsequently, Dr. Ayling worked as a family physician in New Zealand for six months and then emigrated to Canada in 1982 where he spent a year as a resident in obstetrics and gynecology. Since July of 1983, he has been in full time family practice in Vancouver and continues in that capacity today. He is currently a clinical Assistant Professor in the Department of Family Medicine at the University of British Columbia where he is actively involved in teaching first and second year medical students in family practice, third year students in obstetrics and family practice residents.

Geoffrey Cundiff - MD, FACOG, FACS, FRCPSC
Obstetrician-Gynecologist

Dr. Cundiff is currently a Professor in the Department of Obstetrics and Gynecology at the University of British Columbia and Head of the Department of Obstetrics and Gynecology at Providence Health Care in Vancouver. He is also a researcher at the Centre for Health Evaluation & Outcomes Sciences. He received his medical degree from the University of Texas Southwestern Medical Centre in 1989 and completed his residency in Obstetrics and Gynecology at Parkland Hospital in Dallas, Texas in 1993. Since completing a fellowship in Urogynecology and Endoscopy at Greater Baltimore Medical Centre in Baltimore Maryland, and a second in Reconstructive Pelvic Surgery at Duke University Medical Centre in Durham North Carolina, he has been actively involved in academic medicine at John Hopkins University School of Medicine, and now at the University of British Columbia. His clinical research interests focus on women's health issues including epidemiology of the pelvic floor disorders, outcomes research for treatments of pelvic floor disorders, prevention of maternal obstetrical trauma, anatomy, and surgical education.

Jerome Dansereau - MD, FRCSC
Obstetrician-Gynecologist

Dr. Dansereau is the current Director of Perinatology Services, Medical Director of the Child/Youth and Family Program, and Chief of the Department of Obstetrics & Gynecology for the Vancouver Island Health Authority. He is also a Clinical Associate Professor, Perinatologist and Sonologist for the Division of Maternal-Fetal Medicine and the Department of Obstetrics & Gynecology at the BC Children's & Women's Hospital, the University of British Columbia, and the University of Victoria. Dr. Dansereau's areas of interest and expertise include maternal-fetal medicine/high risk obstetrics, fetal monitoring and fetal assessment, and prenatal diagnosis.

Nancy Dudek - MS
Consumer Representative

Nancy Dudek has an Masters in Science in biology and has conducted research in ecology, plant genomics, and the genetics of aging. She is currently a project manager at the Child and Family Research Institute where she is coordinating a laboratory expansion. Nancy is especially interested in translational research. She interacts daily with a team of scientists and clinicians who integrate knowledge that is gained at the laboratory bench with the delivery of health care. She doesn't have children but hopes to start a family someday. Nancy is a native of Chicago, IL and new to Vancouver.

Marlowe Haskins - MD, CCFP
Family Physician

Dr. Haskins received his medical training in Calgary, Alberta, and St. John's, Newfoundland. Subsequently, he received further training in obstetrics and surgery and has practiced as a GP/surgeon in rural British Columbia for the past 15 years. He currently lives and works in Smithers, BC, with his wife, four children, two dogs and one cat.

Linda Knox - RM
Midwife

Linda Knox is a Registered Midwife and the Assistant Head for the Department of Midwifery at BC Women's Hospital and Health Centre and Providence Healthcare (St. Paul's Hospital) in Vancouver, BC. She is a Clinical Assistant Professor in the Division of Midwifery, Department of Family Practice, at the University of British Columbia. Linda is a past President of the Midwives Association of BC and was involved in the work of establishing midwifery as a recognized profession within the healthcare system in BC. She has been a practicing midwife in the Lower Mainland for 20 plus years, and was a co-owner of the first community-based midwifery practice in Vancouver following regulation. She is currently working as a care provider in the South Community Birth Program (SCBP), a collaborative, multidisciplinary maternity care program. The SCBP team of midwives and family practice physicians equally share the primary care of pregnant women and also collaborate closely with community health nurses and doulas. She is the mother of two daughters and a son, and has two beautiful grandsons.

**Lily Lee - BN, MSN, MPH
Nurse**

Ms. Lee is a Perinatal Nurse Consultant at the BCPHP. She is responsible for providing strategic leadership in interdisciplinary support and education. She currently chairs the BCPHP Cesarean Birth Task Force and is a member of the Canadian Perinatal Surveillance System Steering Committee. She brings many years of experience in advanced nursing practice and management roles and has led several successful research utilization projects, which involved introducing evidence-based nursing care protocols. Lily is an Adjunct Professor at the UBC School of Nursing.

**Kathleen Lindstrom - LCCE, FACCE, CD DONA, CDT DONA
Prenatal educator**

Ms. Lindstrom is a Lamaze Certified Childbirth Educator and a Fellow of the American College of Childbirth Educator. She is also a DONA International Certified Doula and Doula Trainer, and the Perinatal Program Manager for the Faculty of Health Sciences at Douglas College.

**Luba Lyons Richardson - RM
Midwife**

Luba Lyons Richardson is a registered midwife who practices with the Victoria Midwifery Group. Luba has been in community midwifery practice for over 30 years. She was the first Midwifery Dept. Chief in VIHA South and is currently the Dept. Vice Chief. Luba was a Board member of the College of Midwives of BC from 1995 – 2003 and was the CMBC President for 6 years. As President, Luba was involved in all aspects of the integration of midwifery in BC. She was also the CMBC representative on the Ministry of Health's Home Birth Demonstration Project Advisory Committee. Luba is a Clinical Assistant Professor in the Division of Midwifery, Department of Family Practice, at the University of British Columbia, where she has been a preceptor for students since the program began. She also sits on the Midwifery Program's Advisory committee. Luba has 3 grown children and two grandchildren.

**Shiraz Moola - MD, FRCSC
Obstetrician-Gynecologist**

Dr. Shiraz Moola is currently a solo Obstetrician/Gynecologist practicing in Nelson, British Columbia. After completing an undergraduate medical degree at Queens University, he completed a postgraduate residency at the University of Toronto. During that time he had the opportunity to train and perform research in rural Zimbabwe and in South Africa. Following his residency he provided consultant care in the Yukon, Northwest Territories and Nunavut. He then worked as a surgical associate in the division of Gynecology Oncology at the University of Western Ontario before returning to the Arctic. Serendipity brought him to the Kootenays to take up his current post. He continues to pursue research as a co-investigator with the Rural Maternity Care New Emerging Team (RM-NET). His other research interests include critical care obstetrics, and health outcomes research. His clinical interests include ultrasound, minimally invasive surgery and oncology. He has two children, Rohan and Khalil that remain happily growing concerns.

**Maria J. Odulio - MD, FRCSC
Obstetrician-Gynecologist**

Dr. Maria J. (Marijo) Odulio graduated with an MD degree from the University of British Columbia in 1998. She has a BSN undergraduate degree and previously worked as a labour and delivery nurse for several years. She obtained her FRCSC in Obstetrics and Gynecology after residency at UBC in 2003. She is currently a member of the Department of Obstetrics and Gynecology at Prince George Regional Hospital and is a clinical instructor with the University of Northern BC Northern Medical Program.

Clarice Perkins - BSc, BSN, MA, Nurse

After completing her BSc (1984) and BSN (1986) degrees at UBC, Clarice worked for 2 years at BC Children's Hospital before joining BC Women's in 1988. She has been in a variety of different roles at BC Women's, including working as a bedside nurse in both Postpartum and Delivery Suite, and as a Charge Nurse, Team Leader, Perinatal Clinical Educator, and Program Coordinator in the Birthing Program. In 2002 she completed a Master's degree at Royal Roads University in Victoria. Since 2005 she has been acting as Manager, Access & Utilization for BC Women's Hospital, and has become acutely aware of the impact that cesarean births, particularly elective repeat cesareans, have on bed utilization. In 2006 she became one of the co-investigators in a research project sponsored by the BCW Department of Family Practice, entitled: "Maternal Choice: women's perceptions of the factors that influence their decision on how to give birth to their next baby after having had one previous Cesarean section (C/S) with their last baby". She is the mother of two daughters and a son, and the proud Nana of two little granddaughters.

Roanne Preston - MD, FRCPC

Anesthesiologist

Dr. Roanne Preston is currently the Department Head of Anesthesia at BC Women's Hospital, as well as a Clinical Associate Professor in the Faculty of Medicine at the University of British Columbia, and Division Head of Obstetric Anesthesia at UBC. She received her medical training in Ottawa and was on staff in the Department of Anesthesia at the Ottawa Hospital for 10 years and Obstetric Anesthesia Director for 4 years before moving to Vancouver. She is currently a Royal College Examiner in Anesthesia. Her research interests include patient safety in obstetric anesthesia, optimal labour epidural analgesia and optimizing spinal anesthesia for cesarean birth.

Glen Ward - MDCM, PhD, FRCP(C), Pediatrician

Dr. Glen Ward graduated from McGill University Medical School in 1986 and earned his PhD in 1990. He completed his Pediatric training at the Hospital for Sick Children in Toronto and has worked as a general consultant Pediatrician in Langley and White Rock for the past 17 years. His real life pediatric training began 15 years ago with the birth of his twin daughters.

Henry Woo - MD, FRCSC

Obstetrician-Gynecologist

Dr. Henry Woo received his medical training at the University of Toronto and completed his residency in Obstetrics & Gynecology at the University of British Columbia. He is currently a Clinical Assistant Professor in the Division of General Gynecology and Obstetrics at UBC. His main areas of interest are in Operative Obstetrics, MIS GYN surgery, Office Gynecology and Resident education.

APPENDICES

APPENDIX A: GLOSSARY OF TERMS

Absolute risk reduction - The absolute arithmetic difference in rates of outcomes between two groups (sometimes called the risk difference)

Amniotic fluid - Serous fluid that is contained within the amniotic sac and surrounds the unborn fetus during pregnancy

Amniotomy - Artificial rupture of the fetal membranes as a method of inducing or expediting labour

Analgesia - An agent that alleviates pain without causing loss of consciousness

Apgar - A newborn evaluation tool used to assess the baby's condition at one minute and at five minutes after birth. Apgar is rated on heart rate, breathing, muscle tone, reflex irritability, and colour.

Asepsis - Freedom from infection; sterile; prevention of contact with microorganisms

Assisted vaginal delivery - A vaginal delivery involving forceps or vacuum to facilitate delivery of the fetus

British Columbia Perinatal Database Registry (BCPDR) - One of the mandates of the British Columbia Perinatal Health Program is "the collection and analysis of data to evaluate perinatal outcomes, care processes and resources via a province-wide computerized database". This mandate led to the development of the British Columbia Perinatal Database Registry (BCPDR), with its stated mission to collect, maintain, analyze and disseminate comprehensive, province-wide perinatal data for the purposes of monitoring and improving perinatal care. Rollout of the Registry began in 1994, with collection of data from a small number of hospital sites. Participation increased every year, resulting in full provincial data collection commencing April 1, 2000.

British Columbia Perinatal Health Program (BCPHP) - The Ministry of Health (Hospital Programs) and the British Columbia Medical Association (BCMA) under the auspices of the Continuing Advisory Subcommittee on Perinatal Care (CASC) initiated the British Columbia Reproductive Care Program (BCRCP) in June 1988. The BCRCP is overseen by a Provincial Perinatal Steering Committee and has representation from the Ministry of Health Services (MOHS), the Provincial Health Services Authority (PHSA), Children's and Women's Health Centre of BC, health care providers, health authorities and academic organizations. In 2007, a new organizational structure – the BC Perinatal Health Program (BCPHP) – was created to coordinate both the BCRCP and the Provincial Specialized Perinatal Services (PSPS). The BCPHP continues to work towards optimizing neonatal, maternal and fetal health in the province through educational support to care providers, outcome analysis, networks and multidisciplinary perinatal guidelines.

Benchmarking - A point of reference for measurement or comparison

Body Mass Index (BMI) - A mathematical function defined as the ratio of a woman's weight to height, and in this report, as measured pre-pregnancy, or up to 12 weeks gestation, and calculated as: $BMI = \text{weight in kilograms} / (\text{height in meters})^2$

Breech presentation - Where the fetus is positioned head up in the uterus, to be born buttocks first or with one or both feet first

Caesarean - A delivery involving the surgical incision of the abdomen and uterine walls

Canadian Perinatal Surveillance System (CPSS) - A program of the Public Health Agency of Canada carried out in collaboration with health care professionals, researchers, public health representatives and voluntary and consumer organizations. The mission of the CPSS is to contribute to improved health for pregnant women, mothers and infants in Canada.

Cochrane and Effective Practice Organization of Care Group (EPOC) - A collaborative review group of the Cochrane Collaboration that produces systematic reviews of educational, behavioral, financial, regulatory and

organizational interventions designed to improve health professional practice and the organization of health care services, potentially spanning any clinical area

Cochrane Collaboration - An international organization that aims to help people make well informed decisions about health care by preparing, maintaining and ensuring the accessibility of systematic reviews of the effects of health care interventions

Confidence interval (CI) - A range that contains the true population prevalence estimate a specified percentage of the time, if repeated sampling of the population were performed. For example, the 95% confidence interval is a range that contains the true population estimate 95% of the time. Small sample sizes or cells with low numbers generate less precise estimates and will have wider confidence intervals.

Continuous Quality Improvement (CQI) - A management approach to improving and maintaining quality that emphasizes internally driven and relatively continuous assessments of indicators, followed by action aimed at avoiding decrease in quality or correction at an early stage

Diabetes - Indicates mothers who have gestational diabetes (includes insulin dependant and non-insulin dependant), pre-existing diabetes (includes insulin dependant and non-insulin dependant), or other abnormal glucose factors (denotes mothers who have other abnormal glucose factors, including patients with abnormal glucola or one (or more) abnormal Glucose Tolerance Test result)

Doula - A non-medical assistant who provides physical, emotional and informational support in prenatal care, during childbirth and during the postpartum period

Dystocia - Prolonged, painful, or otherwise difficult delivery or birth because of mechanical factors produced by either the fetus or the pelvis of the mother or because of inadequate powers (uterine and other muscular activity)

Dyspareunia - Painful sexual intercourse, due to medical or psychological causes

Eclampsia - A serious, life-threatening condition in late pregnancy in which very high blood pressure can cause a woman to have seizures

Ectopic pregnancy - A pregnancy in which the fertilized egg implants outside of the uterus usually in the fallopian tube, but also on the ovary, or the abdominal cavity

Elective Caesarean - A caesarean section delivery in which the decision for caesarean section is made prior to labour; a booked caesarean section

Emergent Caesarean - A caesarean section delivery in which there is a threat to maternal or fetal health; the patient may or may not be in labour at the time of emergent caesarean section delivery

Epidural - A form of regional anesthesia involving injection of drugs through a catheter placed into the epidural space, causing both a loss of sensation and a loss of pain by blocking the transmission of pain signals through nerves in or near the spinal cord. In the BCPDR, epidural refers to epidural received during any stage (1st, 2nd or 3rd) of labour

Evidence-based Practice Identification and Change (EPIC) – A continuous quality improvement initiative that involves accessing and critically appraising evidence, sharing this synthesis within a community of participating agencies, analyzing practice data within individual agencies to determine specific sources of variability in outcomes, undertaking rapid cycles of practice change, and sharing evaluations of change within the practice community

External cephalic version - A procedure that externally rotates the fetus from a breech presentation to a vertex presentation

Forceps Delivery - The use of an instrument that cups the fetal head (called an obstetric forceps) to help facilitate delivery

Gestational Age - In fetal development, the number of completed weeks counting from the first day of the last normal menstrual cycle

Health Authority (HA)/ Health Service Delivery Area (HSDA) - In this report, refers to the Health Authority in which the patient resided at the time of delivery. Statistics related to the patient's residence are determined via the Translation Master File (TMF). The TMF file is a comprehensive demographic mapping file, which consists of valid BC postal codes and their associated Health Service Delivery Areas (HSDA) and Health Authorities (HA). The geographic area to which a postal code belongs seldom changes over time but in cases where the postal code has changed, appropriate amendments have been made to reflect that postal code's associated HSDA for that particular year.

Hypertension - In the BCPDR, this describes where a care provider has indicated that the patient has gestational (pregnancy induced) hypertension

Induction of labour - A patient who received instrumental or pharmacological assistance to promote labour prior to the onset of first stage of labour

Intrapartum - The period between the onset of the first stage of labour and the delivery of the placenta

Morbidity - Illness, disease, abnormality

Multivariate Logistic Regression Analysis – A statistical method identifying the relationship between two or more independent variables in an effort to identify patterns within the relationship

Non-Stress Testing – A simple, non-invasive test performed in pregnancies over 28 weeks gestation, which involves attaching on belt to the mother's abdomen to measure fetal heart rate and another belt to measure contractions

Normal weight – Healthy body weight; in this report, normal weight refers to pre-pregnancy body mass indices between 18.5 and 24.9

Nulliparous - A woman who has never delivered a baby (of at least 500 grams birth weight or 20 weeks gestation) in a previous pregnancy

Obese - Increased body weight caused by excessive accumulation of fat; weight more than 20% above what is considered normal according to the body mass index; in this report, obese refers to pre-pregnancy body mass indices greater than or equal to 30.0

Odds Ratio (OR) - The ratio of the odds of a condition or disease (e.g. maternal mortality) in an exposed population (e.g. Caesarean delivery) to the odds of the same condition or disease in an unexposed population (e.g. vaginal delivery)

Overweight - Increased body weight caused by excessive accumulation of fat; in this report, overweight refers to pre-pregnancy body mass indices between 25.0 and 29.9

Oxytocin - A peptide hormone from hypothalamus that induces smooth muscle contraction in the uterus

Parity - The number of previous pregnancies delivered at equal to or greater than 20 completed week's gestation

Parity \geq 1 - A woman who has carried at least one previous pregnancy to a point of viability (500 grams birth weight or 20 weeks gestation) regardless of outcome

Post Dates (or Post term) - After 41 weeks completed weeks of gestation

Perinatal - Before, during and immediately after birth

Persistent pulmonary hypertension (PPHN) - A condition in which the blood continues to flow through an infant's heart the way it did in the uterus, causing cyanosis and extreme instability

Physiological Birth – Synonymous with normal labour and birth. The World Health Organization states that, “the aim of the care is to achieve a healthy mother and child with the least possible level of intervention that is compatible with safety. This approach implies that: in normal birth there should be a valid reason to interfere with the normal process.”

Placenta - A temporary organ required for the development of the embryo and fetus, allowing for the exchange of metabolic products between the fetus and the mother

Placenta accreta - A condition in which the placenta invades the muscles of the uterus and becomes firmly attached to the uterine wall, making it difficult to remove after delivery of the baby

Placental abruption - Separation of the placenta from the site of uterine implantation before delivery of the fetus

Placenta previa - Implantation of the placenta in the lower part of the uterus, so that it is close to or covering the cervical opening to the vagina

Practice Guideline (Clinical Practice Guideline) - Systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances

Primary caesarean - A first caesarean section; mother has either a history of only vaginal deliveries or this is her first delivery

Primary indication for caesarean - Indicates the one diagnosis that best describes the principle or primary reason for Caesarean delivery

Preterm birth - Birth after 20 and before 37 completed weeks of gestation

Relative risk - Ratio of the risk of outcome (e.g. caesarean section) among the exposed segment of the population (e.g. pregnant mothers with hypertension) to the risk among the unexposed (e.g. pregnant mothers without hypertension)

Repeat Caesarean - A second or subsequent caesarean section

Surveillance - The ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to improve health

Term birth - Birth between 37 and 41 completed weeks of gestation

Tocolysis - The inhibition of labour, the delaying or halting of labour

Trial of labour after Caesarean (TOLAC) – A woman undergoing an attempted labour and vaginal delivery in a current pregnancy after caesarean delivery in a previous pregnancy; the outcome may be vaginal or caesarean delivery

Underweight – Weight that is below what is considered to be normal; may be associated with some health problems; in this report, underweight refers to pre-pregnancy body mass indices less than 18.5

Ultrasound - A type of imaging technique that uses high-frequency sound waves

Uterotonics - An agent that overcomes relaxation of the muscular wall of the uterus

Vacuum Delivery - Procedure used to ease delivery by applying a metal or plastic cup to the baby's scalp and using suction to pull the baby gradually through the birth canal

VBAC - Vaginal birth after a previous caesarean section

World Health Organization (WHO) - The public health arm of the United Nations, is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends

APPENDIX B: LITERATURE SEARCH STRATEGY FOR MATERNAL AND INFANT HEALTH

Key words – cesarean, caesarean, caesarean section, cesarean section, research, mortality, morbidity

Years – 1998 to present

Languages – English

Type of studies – Randomized Controlled Trials (RCTs), systematic reviews, population-based, case-control studies

Other - Agency for Healthcare Research & quality

Source of documents – peer-reviewed journals, Cochrane review, Medline, CINAHL, PubMed databases

APPENDIX C: CIHI PROVIDER CODES

The Canadian Institute of Health Information (CIHI) captures coded data from delivery admissions. For purposes of analysis we used the CIHI codes to create three provider categories.

Midwife (MW +/- OB +/- FP) = Any patient with a midwife (MW) coded (CIHI provider code) during the delivery admission (may or may not be most responsible provider). This patient could also have an obstetrician (OB) or family physician (FP) coded in conjunction with the midwife (MW) code.

Family Physician (FP +/- OB – MW) = Any patient with a family physician (FP) coded (CIHI provider code) during the delivery admission (may or may not be the most responsible provider). This patient could also have an obstetrician (OB) coded in conjunction with the family physician (FP) but will not have a midwife (MW) coded.

Obstetrician (OB – MW –FP) = Any patient with an obstetrician (OB) coded (CIHI provider code) during the delivery admission (may or may not be the most responsible provider). This patient does not have either a family physician (FP) or midwife (MW) coded.

APPENDIX D: MULTIPLE REGRESSION ANALYSIS TABLES

TABLE A. ODDS RATIOS OF CAESAREAN SECTION DELIVERY AFTER SEQUENTIAL ADJUSTMENT FOR MATERNAL CHARACTERISTICS AND OBSTETRIC FACTS, 2000 TO 2005*

	Odds Ratio	95% Confidence Interval	
		Lower	Upper
Unadjusted			
2001	1.13	1.10	1.17
2002	1.24	1.20	1.28
2003	1.25	1.21	1.29
2004	1.35	1.30	1.39
2005	1.35	1.31	1.40
Adjusted for maternal age			
2001	1.13	1.09	1.17
2002	1.23	1.19	1.27
2003	1.24	1.20	1.28
2004	1.32	1.28	1.37
2005	1.33	1.29	1.37
Also adjusted for parity			
2001	1.14	1.10	1.17
2002	1.24	1.20	1.28
2003	1.25	1.21	1.29
2004	1.34	1.30	1.39
2005	1.35	1.31	1.39
Also adjusted for pre-pregnancy BMI			
2001	1.13	1.10	1.17
2002	1.24	1.20	1.28
2003	1.24	1.20	1.28
2004	1.34	1.29	1.38
2005	1.34	1.30	1.39
Also adjusted for smoking			
2001	1.13	1.10	1.17
2002	1.24	1.20	1.28
2003	1.25	1.21	1.29
2004	1.34	1.30	1.39
2005	1.35	1.31	1.39
Also adjusted for hypertension			
2001	1.14	1.10	1.17
2002	1.24	1.20	1.28
2003	1.25	1.21	1.29
2004	1.34	1.30	1.38
2005	1.35	1.31	1.39
Also adjusted for diabetes			
2001	1.14	1.10	1.17
2002	1.24	1.20	1.28
2003	1.25	1.21	1.29
2004	1.34	1.30	1.39
2005	1.35	1.30	1.39
Also adjusted for gestational age			
2001	1.13	1.10	1.17
2002	1.24	1.20	1.28
2003	1.25	1.21	1.29
2004	1.34	1.30	1.39
2005	1.36	1.32	1.40
Also adjusted for induction			
2001	1.13	1.10	1.17
2002	1.24	1.20	1.28
2003	1.24	1.21	1.29
2004	1.34	1.30	1.38
2005	1.35	1.30	1.39
Also adjusted for epidural			
2001	1.13	1.09	1.17
2002	1.24	1.20	1.28
2003	1.24	1.20	1.28
2004	1.34	1.29	1.38
2005	1.34	1.30	1.39
Also adjusted for care provider group			
2001	1.12	1.09	1.16
2002	1.20	1.16	1.24
2003	1.18	1.15	1.22
2004	1.27	1.23	1.32
2005	1.30	1.26	1.35

*2000 is the reference group

TABLE B. PREDICTORS OF CAESAREAN SECTION AFTER ADJUSTMENT FOR MATERNAL AND OBSTETRIC FACTORS IN BC MOTHERS, 2000 TO 2005

	Adjusted* Odds Ratio	95% Confidence Interval	
		Lower	Upper
Calendar Year			
2000 (reference)	1.00		
2001	1.14	1.10	1.17
2002	1.20	1.16	1.24
2003	1.17	1.13	1.21
2004	1.24	1.19	1.27
2005	1.27	1.22	1.31
Maternal age group			
25.00-29.99	1.00		
<=19.99	0.55	0.52	0.58
20.00-24.99	0.76	0.74	0.78
30.00-34.99	1.28	1.25	1.31
35.00-39.99	1.63	1.58	1.68
40+	2.02	1.92	2.13
Parity			
Nulliparous (reference)	1.00		
Parity>=1	0.62	0.60	0.63
Pre-pregnancy BMI			
Normal weight	1.00		
Underweight	0.77	0.74	0.81
Overweight	1.44	1.40	1.49
Obese	2.04	1.97	2.11
Unknown	1.41	1.38	1.45
Smoking in pregnancy			
No (reference)	1.00		
Yes	1.19	1.16	1.23
Diabetes			
No diabetes	1.00		
Diabetes in pregnancy	1.32	1.27	1.37
Pre-existing diabetes	2.26	1.96	2.60
Abnormal glucose tolerance	1.07	1.00	1.13
Hypertension in pregnancy			
No (reference)	1.00		
Yes	2.12	2.03	2.21
Gestational age group			
37+ (reference)	1.00		
<28	0.94	0.82	1.06
28-31	2.27	2.04	2.53
32-33	1.68	1.52	1.85
34-36	1.59	1.53	1.66
unknown	0.65	0.51	0.82
Induction			
Not induced	1.00		
Induced preterm	0.26	0.24	0.29
Induced term	0.59	0.57	0.61
Induced post-term	1.10	1.06	1.14
Epidural			
Yes	1.19	1.16	1.21
Care provider group			
Midwife (reference)	1.00		
Family/general practitioner	1.65	1.56	1.74
Obstetrician	4.29	4.06	4.53

* Adjusted for calendar year, maternal age, parity, pre-pregnancy BMI, smoking in pregnancy, diabetes, hypertension, gestational age, induction, epidural and care provider group

TABLE C. PREDICTORS OF CAESAREAN SECTION AFTER ADJUSTMENT FOR MATERNAL AND OBSTETRIC FACTORS IN PRIMIPAROUS MOTHERS, BC, 2000 TO 2005

	Adjusted* Odds Ratio	95% Confidence Interval	
Calendar Year		Lower	Upper
2000 (reference)	1.00		
2001	1.14	1.09	1.20
2002	1.21	1.15	1.26
2003	1.13	1.08	1.19
2004	1.21	1.15	1.27
2005	1.20	1.14	1.26
Maternal age group			
25.00-29.99	1.00		
<=19.99	0.57	0.53	0.61
20.00-24.99	0.77	0.74	0.80
30.00-34.99	1.28	1.23	1.32
35.00-39.99	1.75	1.67	1.82
40+	2.59	2.37	2.83
Pre-pregnancy BMI			
Normal weight	1.00		
Underweight	0.81	0.76	0.87
Overweight	1.44	1.38	1.49
Obese	1.90	1.80	2.01
Unknown	1.26	1.21	1.30
Smoking in pregnancy			
No (reference)	1.00		
Yes	1.15	1.10	1.20
Diabetes			
No diabetes	1.00		
Diabetes in pregnancy	1.28	1.21	1.35
Pre-existing diabetes	2.32	1.88	2.87
Abnormal glucose tolerance	1.07	0.98	1.17
Hypertension in pregnancy			
No (reference)	1.00		
Yes	1.92	1.82	2.02
Gestational age group			
37+ (reference)	1.00		
<28	0.98	0.82	1.18
28-31	2.27	1.95	2.64
32-33	1.62	1.42	1.84
34-36	1.34	1.28	1.44
unknown	0.80	0.57	1.11
Induction			
Not induced	1.00		
Induced preterm	0.51	0.45	0.56
Induced term	1.07	1.03	1.12
Induced post-term	1.80	1.71	1.88
Epidural			
Yes	1.44	1.40	1.48
Care provider group			
Midwife (reference)			
Family/general practitioner	1.29	1.21	1.38
Obstetrician	2.18	2.03	2.33

* Adjusted for calendar year, maternal age, pre-pregnancy BMI, smoking in pregnancy, diabetes, hypertension, gestational age, induction, epidural and care provider group

APPENDIX E: PLANNED CHANGE USING THE EPIC PROCESS

PLANNING PRACTICE CHANGE

1. Members of the BCPHP leadership team will work with the Regional Health Authority designated perinatal leads to engage the perinatal leadership within the 5 Health Authorities in investing in the EPIC process to reduce Caesarean delivery rates.
2. The project team will utilize the perinatal registry to report on demographic, clinical practice, process and outcome data related to caesarean section.
3. Within each Health Authority, perinatal leads will facilitate collaboration between the project team/BCPHP and key maternity care leaders to identify site leaders within hospitals.
4. Key maternity care leaders will assemble multidisciplinary teams within identified hospital birthing programs.
5. The BCPHP will disseminate synthesized systematic reviews of practices identified by the teams as being relevant to caesarean section. Systematic reviews are currently undertaken and synthesized by the BCPHP as part of guideline development.
6. Hospital teams will meet to review findings of systematic reviews, identify areas for practice change, develop indicators and benchmarks to monitor change and develop critical pathways to implement changes.
7. Hospital teams will identify barriers to change and incorporate strategies to overcome barriers as part of the critical pathways.
8. The BCPHP will prepare and distribute anonymous data comparing baseline outcome data for each participating health authority.
9. Regional health authorities will assist with the recruitment of pregnant and newly mothering women for focus groups for the purpose of exploring how women want to learn about risks and benefits associated with caesarean section. Potential focus group participants will be purposively sampled to seek diversity in terms of age, parity, and ethnicity.

IMPLEMENTING CHANGE

1. Materials to support change will be developed (posters, cheat sheets, standard orders, documentation forms, procedure manuals) as defined by each health authority.
2. Hospital staff are informed of changes and provided with training as necessary.
3. Practice change is implemented.
4. Patient education tools are disseminated.

EVALUATING CHANGE

1. BCPHP provides feedback on selected indicators every three months.
2. Process and outcome indicators are reviewed within and among EPIC teams in health authorities.
3. A random sample of women will be surveyed with regard to changes in knowledge, attitudes and preferences for mode of delivery before and after exposure to education materials.
4. Strategies are reviewed and revised as necessary.

EPIC OUTCOMES

Overall, outcomes will measure the process of implementation of EPIC, the development of quality improvement activities, efficacy of EPIC in changing health outcomes, and sustainability of the program. Outcomes may differ according to the particular caesarean delivery strategies adopted by participating hospitals. Examples of process and clinical outcomes are described below. Given the two-year time frame of this funding opportunity, our primary outcome variable is adoption of the EPIC framework within health authorities but we will measure changes caesarean delivery as a secondary outcome.

Process - Planning	Process – Practice Change	Clinical Outcomes
<ul style="list-style-type: none"> • Time to develop EPIC Teams • Composition of EPIC teams • Process and resources developed for education of hospital staff with respect to planned change • Family education strategies developed in concert with planned practice change • Measurable indicators identified for ongoing monitoring • Identification of facilitators and barriers to change • Development of communication aids by BCRCF – listserv, expansion of website to encompass a bulletin board, monthly teleconferences, newsletter, new data fields for perinatal database 	<ul style="list-style-type: none"> • Attributes of hospitals/health authorities that develop EPIC teams within three months vs. those that don't. • Practice change is based on syntheses of best evidence • Development of benchmarks for practice change • Proportion of staff aware of practice change and reasons for it • Uptake of practice change among relevant staff • Consistency of practice after change initiated within health authorities • New practice is consistently documented and monitored • PDSA cycles initiated every three months • Responsibility for quality improvement is included in job descriptions of nursing and physician leaders • Resource implications of EPIC are subsumed into operating budgets 	<ul style="list-style-type: none"> • Overall caesarean section rate among selected groups: <ul style="list-style-type: none"> - Nulliparous women at term carrying a singleton fetus in cephalic position - Healthy women with one prior caesarean delivery • Maternal knowledge re risks/benefits of caesarean section and procedures predisposing to caesarean • Rates of maternal request for caesarean

APPENDIX F: CURRENT BCPHP REPORTS AND REPORTING TOOLS

The BCPHP Perinatal Database Registry Annual Report - This statistical report, which has been published on an annual basis since 2003, tracks a number of maternal and newborn indicators in the singleton population only. The objective of this report is to provide a high-level description of the current state of perinatal health within the province, highlighting trends within clinically relevant and modifiable factors. This report is distributed widely across the province and country, and is also available on the BCPHP website

The BCPHP Perinatal Facility Comparison Report – These statistical hospital-based reports, which have been published on an annual basis since 2003, is customized for each facility that provides obstetrical services in BC. The objective of these reports is to present data for individual facilities that will allow each hospital to benchmark its own results against the appropriate peer hospital group as well as within the health authority and across the province. These reports are distributed to select staff with each facility and are not available to the public.

The BC Perinatal Database Registry Reporting Tool – This CD containing a summarized dataset that has been abstracted from the BC Perinatal Database Registry has been produced annually since 2002. The Reporting Tool was designed to allow for comparative reporting between institutions and against the provincial totals for some of the most common or important practices and health outcomes related to perinatal care.

The BCPHP Facility Maps – These charts provide a count of deliveries by hospital, stratified by maternal residence, for each fiscal year, beginning with 2000/2001. As well, they include a province-wide map that denotes the highest level of service provided at each facility and the total number of births per facility. These reports are distributed widely and are also available on the BCPHP website.

One commonality between these three BCPHP reports is that the reporting time period is the fiscal year (e.g. April 1 to March 31). To study indicators over a different time frame, other BC Perinatal Health Program reports and tools may be accessed:

The BCPDR Hospital Reports – As part of the PDR database application, a number of standard hospital-specific reports can be run at the hospital site (if the PDR database is installed) or on request by the BCPDR (if the PDR database is not installed at the requesting facility). The user defines the reporting period for these reports at the time the report is generated, and therefore can comprise any discharge date range the user desires (and is contained in the hospital data).

Ad hoc Requests – Individuals or groups who require information that cannot be acquired via the above-mentioned reports can request more specific analysis directly from the BCPDR offices or directly from the hospital of interest. These individualized reports can be produced using any timeframe and data within the BCPDR.

These reports and reporting tools help to fulfill the BCPHP's mandate of 'collection, maintenance and dissemination of comprehensive, province-wide perinatal data for the purpose of improving perinatal care' and have been extensively used by clinicians, researchers, administrators, and other health care providers throughout BC and beyond.

APPENDIX G: LEVELS OF EVIDENCE

<http://www.ctfphc.org/>

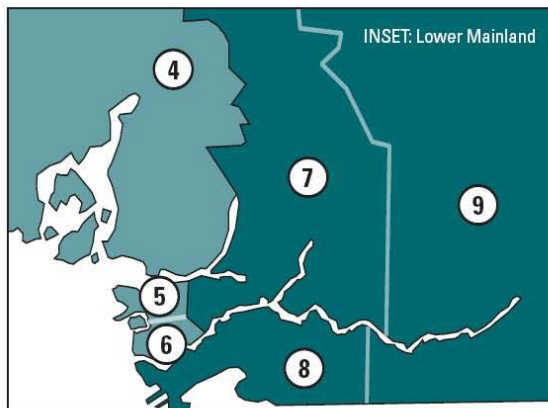
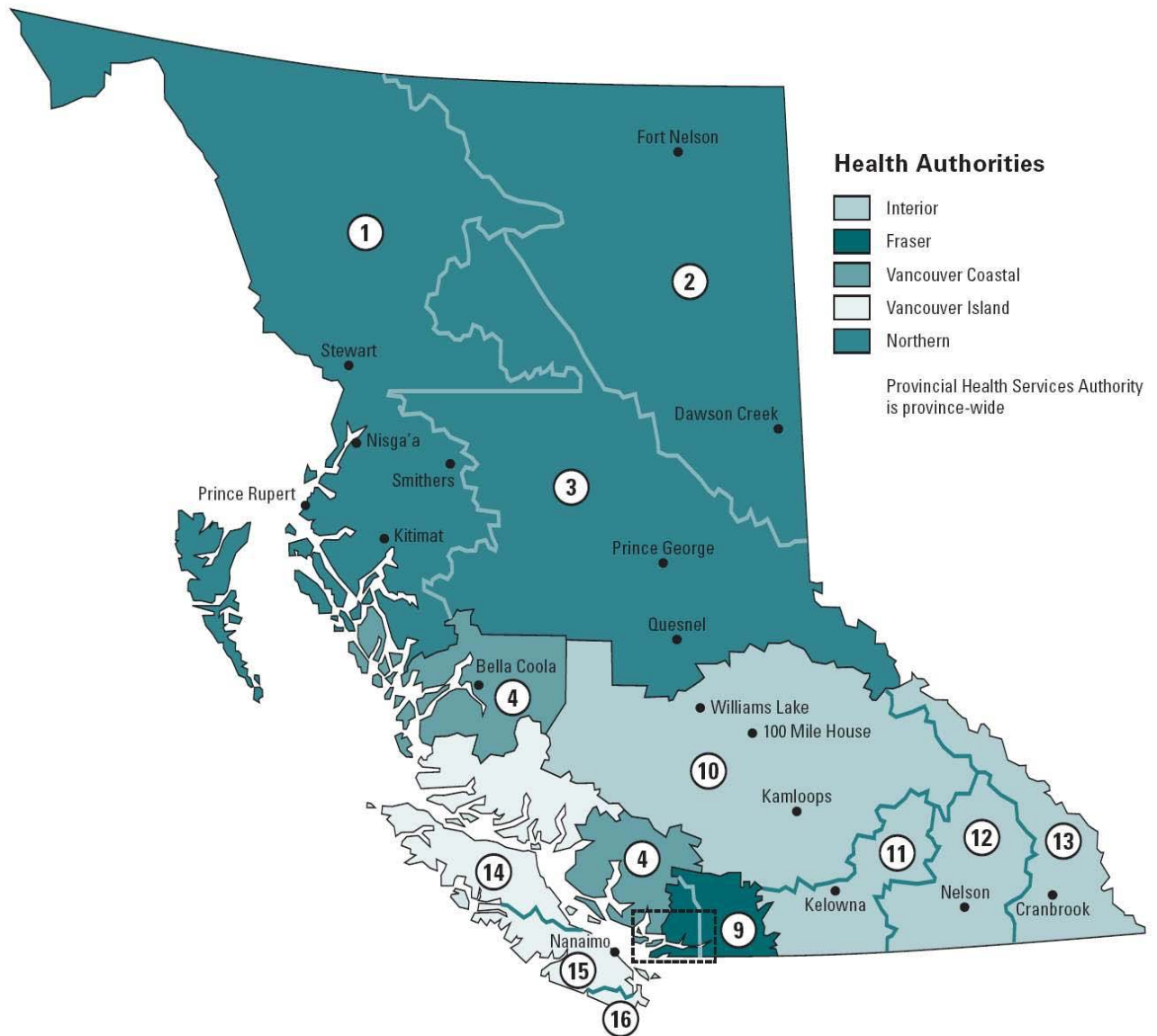
Table 1. Recommendations Grades for Specific Clinical Preventive Actions

A	The CTF concludes that there is good evidence to recommend the clinical preventive action.
B	The CTF concludes that there is fair evidence to recommend the clinical preventive action.
C	The CTF concludes that the existing evidence is conflicting and does not allow making a recommendation for or against use of the clinical preventive action, however other factors may influence decision-making.
D	The CTF concludes that there is fair evidence to recommend against the clinical preventive action.
E	The CTF concludes that there is good evidence to recommend against the clinical preventive action.
I	The CTF concludes that there is insufficient evidence (in quantity and/or quality) to make a recommendation, however other factors may influence decision-making.
<p><i>The CTF recognizes that in many cases patient specific factors need to be considered and discussed, such as the value the patient places on the clinical preventive action; its possible positive and negative outcomes; and the context and /or personal circumstances of the patient (medical and other). In certain circumstances where the evidence is complex, conflicting or insufficient, a more detailed discussion may be required.</i></p>	

Table 2. Levels of Evidence - Research Design Rating

I	Evidence from randomized controlled trial(s)
II-1	Evidence from controlled trial(s) without randomization
II-2	Evidence from cohort or case-control analytic studies, preferably from more than one centre or research group
II-3	Evidence from comparisons between times or places with or without the intervention; dramatic results in uncontrolled experiments could be included here
III	Opinions of respected authorities, based on clinical experience; descriptive studies or reports of expert committees

APPENDIX H: BC HEALTH AUTHORITIES AND BC HEALTH SERVICE DELIVERY AREAS



Health Service Delivery Areas

- | | |
|-------------------------------|----------------------------|
| ① Northwest | ⑨ Fraser East |
| ② Northeast | ⑩ Thompson Cariboo Shuswap |
| ③ Northern Interior | ⑪ Okanagan |
| ④ North Shore/Coast Garibaldi | ⑫ Kootenay Boundary |
| ⑤ Vancouver | ⑬ East Kootenay |
| ⑥ Richmond | ⑭ North Vancouver Island |
| ⑦ Fraser North | ⑮ Central Vancouver Island |
| ⑧ Fraser South | ⑯ South Vancouver Island |

Based on a map prepared by: BC STATS, June 2003

Note: Nisga'a is a separate governance health board.

REFERENCES

1. Canadian Institute of Health Information. *Giving Birth in Canada: Regional Trends from 2001-2002 to 2005-2006*. 2007 [cited 2007 August 3]; Available from: http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=reports_gbic_bulletins_e.
2. Liu, S., 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. **176**: p. 455-60.
3. Canadian Institute of Health Information, *Giving birth in Canada: The costs*. . 2006. p. ISBN 1-55392-815-6.
4. Royal College of Midwives. *Campaign for Normal Birth*. 2005 [cited 2007 May 27]; Available from: <http://www.rcmnormalbirth.org.uk/>.
5. Hannah, M., *Planned elective cesarean section: a reasonable choice for some women?* Can Med Assoc J, 2004. **170**: p. 813-16.
6. National Institutes of Health, *State-of-the-Sciences Statement. Cesarean delivery on maternal request*. Obstet Gynecol, 2006. **107**: p. 813-16.
7. Klein, M., *Quick fix culture: the cesarean-section-on-demand debate*. BIRTH, 2004. **31**: p. 161-4.
8. Janssen, P., et al., *A randomized controlled trial of early labour assessment and support at home vs. telephone triage on rates of cesarean section*. Obstet Gynecol, 2006. **108**: p. 1463-9.
9. Liston, R., et al., *SOGC Clinical Practice Guidelines: fetal health surveillance in labour*. J Obstet Gynaecol Canada, 2002. **112**: p. 1-13.
10. Canadian Nurses Association. *Building the Future: An Integrated Study of Nursing Human Resources in Canada*. 2005 [cited 2007 May 21]; Available from: <http://www.buildingthefuture.ca/e/study/phase1/reports/Phase1-Final-Report.pdf>.
11. Liu, S., et al., *Risk of maternal postpartum readmission associated with mode of delivery*. Obstet Gynecol, 2005. **105**: p. 836-842.
12. British Columbia Reproductive Care Program. *Guidelines for Perinatal Care*. 2006 [cited 2006 May 21]; Available from: <http://www.rc.gov.bc.ca>.
13. Joseph, K., et al., *Changes in maternal characteristics and obstetrics practice and recent increases in primary cesarean delivery*. Obstet Gynecol, 2003. **102**: p. 791-800.
14. CIHI. *Health Indicators 2007*. 2007 [cited 2007 July 25, 2007].
15. Depp, R., *Cesarean Delivery*, in *Obstetrics: Normal and Problem Deliveries*, S. Gabbe, J. Neibyl, and J. Simpson, Editors. 1996, Churchill Livingstone: New York. p. 561-642.
16. Baskett, T. and C. O'Connell, *Severe obstetric maternal morbidity: a 15-year population-based study*. . J Obstet Gynecol, 2005. **25**: p. 7-9.
17. Liu, S., et al., *Risk of maternal postpartum readmission associated with mode of delivery*. Obstet Gynecol, 2005. **105**: p. 836-42.
18. Wen, S.W., et al., *Severe maternal morbidity in Canada, 1991-2001*. CMAJ, 2005. **173**(7): p. 759-64.
19. Hemminki, E., J. Shelly, and M. Gissler, *Mode of delivery and problems in subsequent births. A register-based study from Finland*. . Am J Obstet Gynecol, 2005. **193**(169-77.): p. 169-77.
20. Hemminki, E., *Impact of cesarean section on future pregnancy*. Paed Perinat Epidemiol, 1996. **10**: p. 366-70.
21. Myers, S. and T. Bennett, *Incidence of significant adhesions at repeat cesarean setion and the relationship to method of prior peritoneal closure*. . J Reprod Med, 2005. **50**: p. 659-62.
22. Kennare, R., et al., *Risks of adverse outcomes in the next birth after a first cesarean delivery*. Obstet Gynecol, 2007. **109**: p. 270-6.
23. Gray, R., et al., *Caesarean delivery and risk of stillbirth in subsequent pregnancy: a retrospective cohort study in an English population*. BJOG, 2007. **114**: p. 264-270.
24. Yang, Q., et al., *Association of cesarean delivery for first birth with placenta praevia and placental abruption in second pregnancy*. BJOG, 2007. **114**: p. 609-613.
25. McMahon, M., et al., *Comparison of a trial of labor with an elective second cesarean section*. New Engl J Med, 1996. **335**: p. 689-95.
26. Wen, S., et al., *Comparision of maternal mortality and morbidity between trial of labor and elective cesarean among women with previous cesarean delivery*. Am J Obstet Gynecol, 2004. **191**: p. 1263-9.
27. Smith, G., et al., *Risk of perinatal death associated with labor after previous cesarean delivery in uncomplicated term pregnancies*. JAMA, 2002. **287**: p. 2684-90.
28. Pare, E., J. Quinones, and G. Macones, *Vaginal birth after caesarean section versus elective repeat caesarean section: assessment of maternal downstream health outcomes*. BJOG, 2006. **113**: p. 75-85.
29. Cahill, A., et al., *Is vaginal birth after cesarean (VBAC) or elective repeat cesarean safer in women with a prior vaginal delivey?* Am J Obstet Gynecol, 2006. **191**: p. 1263-9.
30. Dodd, J. and C. Crowther, *Vaginal birth after caesarean versus elective repeat caesarean for women with a single repeat prior caesarean birth: a systematic review of the literature*. Aust NZ J Obstet Gynaecol, 2004. **44**: p. 387-91.

31. Fritel, X., et al., *Stress urinary incontinence 4 years after the first delivery: a retrospective cohort survey*. Acta Obstet Gynecol Scand, 2004. **83**(10): p. 941-5.
32. MacArthur, C., et al., *Persistent urinary incontinence and delivery mode history: a six year longitudinal study*. BJOG, 2006. **113**: p. 218-24.
33. Rortveit, G., et al., *Vaginal delivery parameters and urinary incontinence: the Norwegian EPINCONT study*. Am J Obstet Gynecol, 2003. **189**(5): p. 1268-74.
34. Press, J., M. Klein, and P. von Dadelnszen. *Mode of Delivery and Pelvic Floor Dysfunction: a Systematic Review of the Literature on Urinary and Fecal Incontinence and Sexual Dysfunction by Mode of Delivery*. 2006 [cited 2007 November 15]; Available from: <http://www.medscape.com/viewarticle/521510>.
35. McKinnie, V., et al., *The effect of pregnancy and mode of delivery on the prevalence of urinary and fecal incontinence*. Am J Obstet Gynecol, 2005. **193**: p. 512-8.
36. Nelson, R.L., M. Westercamp, and S.E. Furner, *A systematic review of the efficacy of cesarean section in the preservation of anal continence*. Dis Colon Rectum, 2006. **49**(10): p. 1587-95.
37. Barrett, G., et al., *Women's sexual health after childbirth*. Bjog, 2000. **107**(2): p. 186-95.
38. Klein, M., et al., *A comparison of urinary and sexual outcomes in women experiencing vaginal and cesarean births*. J Obstet Gynaecol Canada, 2005. **27**: p. 332-39.
39. Melville, J.L., et al., *Urinary incontinence in US women: a population-based study*. Arch Intern Med, 2005. **165**(5): p. 537-42.
40. Thompson, J.F., et al., *Prevalence and persistence of health problems after childbirth: associations with parity and method of birth*. Birth, 2002. **29**(2): p. 83-94.
41. Villar, J., et al., *Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study*. BMJ, 2007.
42. Eccles, M. and J. Mason, *How to develop cost-conscious guidelines*. Health Technol Assess, 2001. **5**(16): p. 1-69.
43. Liston, F.A., et al., *Neonatal Outcomes With Cesarean Delivery At Term*. Arch Dis Child Fetal Neonatal Ed, 2007.
44. Towner, D., et al., *Effect of mode of delivery in nulliparous women on neonatal intracranial injury*. N Engl J Med, 1999. **341**(23): p. 1709-14.
45. Gardella, C., et al., *The effect of sequential use of vacuum and forceps for assisted vaginal delivery on neonatal and maternal outcomes*. Am J Obstet Gynecol, 2001. **185**(4): p. 896-902.
46. Hansen, A.K., et al., *Elective caesarean section and respiratory morbidity in the term and near-term neonate*. Acta Obstet Gynecol Scand, 2007. **86**(4): p. 389-94.
47. Hansen, A.K., et al., *Risk of respiratory morbidity in term infants delivered by elective caesarean section: cohort study*. Bmj, 2007.
48. Hernandez-Diaz, S., et al., *Risk factors for persistent pulmonary hypertension of the newborn*. Pediatrics, 2007. **120**(2): p. e272-82.
49. MacDorman, M.F., et al., *Infant and neonatal mortality for primary cesarean and vaginal births to women with "no indicated risk," United States, 1998-2001 birth cohorts*. Birth, 2006. **33**(3): p. 175-82.
50. Villar, J., et al., *Caesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America*. Lancet, 2006. **367**(9525): p. 1819-29.
51. Baicker, K., K.S. Buckles, and A. Chandra, *Geographic variation in the appropriate use of cesarean delivery*. Health Aff (Millwood), 2006. **25**(5): p. w355-67.
52. Tjepkema, M., *Adult Obesity in Canada: Measured height and weight*. . Statistics Canada, (Cat. No. 82-620-MWE2005001).
53. Weiss JL, M.F., Emig D, Ball RH, Nyberg DA, Comstock CH, Saade G, Eddleman K, Carter SM, Craigo SD, Carr SR, D'Alton ME, *Obesity, obstetric complications and cesarean delivery rate - A population-based screening study*. Am J Obstet Gynecol, 2004. **190**: p. 1091-7.
54. Ehrenberg HM, D.C., Catalano P, Mercer BM, *The influences of obesity and diabetes on the risk of caesarean delivery*. Am J Obstet Gynecol, 2004. **191**: p. 969-74.
55. Health Canada, *Body Mass Index Nomogram*, Office of Nutrition Policy and Promotion: Ottawa.
56. BCRCP. *Obstetric guideline 1. Cervical Ripening and Induction of Labour*. 2005 [cited.
57. Anim-Somuah, M., R. Smyth, and C. Howell, *Epidural versus non-epidural or no analgesia in labour*. Cochrane Database Syst Rev, 2005(4): p. CD000331.
58. Chaillet, N. and A. Dumont, *Evidence-based strategies for reducing cesarean section rates: a meta-analysis*. BIRTH, 2007. **34**(1): p. 53-64.
59. Enkin, M.W., et al., *Beyond evidence: the complexity of maternity care*. Birth, 2006. **33**(4): p. 265-9.
60. Reime, B., et al., *Do maternity care provider groups have different attitudes towards birth?* Bjog, 2004. **111**(12): p. 1388-93.
61. Landon, M., et al., *Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery*. New Engl J Med, 2004. **351**: p. 2581-9.
62. Sachs, B.P., et al., *The risks of lowering the cesarean-delivery rate*. N Engl J Med, 1999. **340**(1): p. 54-7.
63. Society of Obstetricians and Gynaecologists of Canada, *C-Sections on demand - SOGC's position [press release]*. March 10, 2004.

64. Schenker, J. and J. Cain, *FIGO Committee Report: FIGO Committee for the Ethical Aspects of Human Reproduction and Women's Health. International Federation of Gynecology and Obstetrics*. Int J Gynaecol Obstet, 1999. **64**: p. 317-22.
65. Janssen, P.A., et al., *Outcomes of planned hospital birth attended by midwives compared with physicians in British Columbia*. Birth, 2007. **34**(2): p. 140-7.
66. Janssen, P.A., et al., *Outcomes of planned home births versus planned hospital births after regulation of midwifery in British Columbia*. CMAJ, 2002. **166**(3): p. 315-23.
67. World Health Organization, *Appropriate technology for birth*. Lancet, 1985(ii): p. 436-437.
68. Liang, W.H., et al., *Effect of peer review and trial of labor on lowering cesarean section rates*. J Chin Med Assoc, 2004. **67**(6): p. 281-6.
69. Lagrew, D. and M. Morgan, *Decreasing the cesarean section rate in a private hospital: success without mandated clinical changes*. Am J Obstet Gynecol, 1996. **174**: p. 184-91.
70. Althabe, F., et al., *Mandatory second opinion to reduce rates of unnecessary caesarean sections in Latin America: a cluster randomised controlled trial*. Lancet, 2004. **363**(9425): p. 1934-40.
71. Flamm, B., D. Berwick, and A. Kabacene, *Reducing cesarean section rates safely: lessons from a breakthrough series collaborative*. BIRTH, 1998. **25**(3): p. 117-124.
72. Institute of Healthcare Improvement., *The Breakthrough Series: IHI's Collaborative Model for Achieving Breakthrough Improvement. IHI Innovation Series White Paper*. 2003, IHI.
73. Ontario Women's Health Council. *Assessing and maintaining best practices in the use of caesarean section*. 1999 [cited 2007 November 13]; Available from: <http://www.womenshealthcouncil.on.ca/English/Caesarean.html>.
74. Bickell, N.A., et al., *Effect of external peer review on cesarean delivery rates: a statewide program*. Obstet Gynecol, 1996. **87**(5 Pt 1): p. 664-7.
75. Robson, M., S. I., and S. Walsh, *Using the medical audit cycle to reduce cesarean section rates*. Obstet Gynecol, 1996. **174**: p. 199-205.
76. Frigoletto, F., et al., *A clinical trial of active management of labour*. N Engl J Med, 1995. **333**: p. 745-50.
77. Lopez-Zeno, J., et al., *A controlled trial of a program for the active management of labour*. New Engl J Med, 1992. **126**: p. 150-4.
78. Homer, C., et al., *Collaboration in maternity care: a randomized controlled trial comparing community-based continuity of care with standard hospital care*. BJOG, 2001. **108**: p. 16-22.
79. Socol, M., et al., *Reducing cesarean births at a primarily private university hospital*. Am J Obstet Gynecol, 1993. **168**: p. 1748-58.
80. Poma, P., *Effect of departmental policies on cesarean delivery rates: a community hospital experience*. Obstet Gynecol, 1998. **91**: p. 1013-8.
81. Chaillet, N., et al., *Evidence-based strategies for implementing guidelines in obstetrics*. Obstet Gynecol, 2006. **108**: p. 1234-45.
82. Lee, S., et al., *EPIC reduced nosocomial infection and bronchopulmonary dysplasia in a cluster randomized controlled trial of Canadian NICUs*. J Pediatr Child Health 2006. **11**: p. Supp 8.
83. Network, T.C.N. *EPIC PHSI Training Workshop 2006*. 2006 [cited 2007 May 14]; Available from: <http://www.canadianneonatalnetwork.org/epicphsiWorkshop.shtml>.
84. Murray, M. *APIC/PHSI Quality Improvement Workshop*. 2006 [cited 2007 May 14]; Available from: http://www.canadianneonatalnetwork.org/EPICPHSI/Murray_Nov%209%20QI%20Presentation.pdf.
85. Deming, W., *The New Economics for Industry, Government, Education*. 2nd ed. 2000, Cambridge, Massachusetts, USA: The MIT Press.
86. Health Canada, *Canadian Perinatal Health Report*. 2003, Minister of Public Works and Government Services Canada: Ottawa. p. 32.
87. Gregory, K.D., *Monitoring, risk adjustment and strategies to decrease cesarean rates*. Curr Opin Obstet Gynecol, 2000. **12**(6): p. 481-6.
88. Bailit, J. and J. Garrett, *Comparison of risk-adjustment methodologies for cesarean delivery rates*. Obstet Gynecol, 2003. **102**(1): p. 45-51.
89. Main, E., *Reducing cesarean birth rates with data-driven quality improvement activities* Pediatrics 1999. **103**: p. 374-383.
90. Robson, M.S., *Classification of caesarean sections*. Fetal and Maternal Medicine Review, 2001. **12**(1): p. 23-39.
91. Florica, M., O. Stephansson, and L. Nordstrom, *Indications associated with increased cesarean section rates in a Swedish hospital*. Int J Gynaecol Obstet, 2006. **92**(2): p. 181-5.
92. Robson, M.S., *Can we reduce the caesarean section rate?* Best Pract Res Clin Obstet Gynaecol, 2001. **15**(1): p. 179-94.
93. Denk, C.E., L.K. Kruse, and N.J. Jain, *Surveillance of cesarean section deliveries, New Jersey, 1999-2004*. Birth, 2006. **33**(3): p. 203-9.
94. Fischer, A., et al., *Differences between hospitals in cesarean rates for term primigravidas with cephalic presentation*. Obstet Gynecol, 2005. **105**(4): p. 816-21.
95. Erickson, A.C., J.W. McKenna, and R.M. Romano, *Past lessons and new uses of the mass media in reducing tobacco consumption*. Public Health Rep, 1990. **105**(3): p. 239-44.

96. O'Driscoll, K., D. Meagher, and P. Boylan, *Active Management of Labor*. third ed. 1993: Mosby.
97. Janssen, P., et al., *A randomized controlled trial of early labour assessment and support at home vs. telephone triage on rates of cesarean section*. *Obstet Gynecol*, 2005.
98. Shorten, A., et al., *Making choices for childbirth: a randomized controlled trial of a decision-aid for informed birth after cesarean*. *Birth*, 2005. **32**(4): p. 252-61.
99. O'Cathain, A., et al., *Use of evidence based leaflets to promote informed choice in maternity care: randomised controlled trial in everyday practice*. *Bmj*, 2002. **324**(7338): p. 643.
100. Walker, R., et al., *The development and process evaluation of an information-based intervention for pregnant women aimed at addressing rates of caesarean section*. *Bjog*, 2005. **112**(12): p. 1605-14.
101. Nerum, H., et al., *Maternal request for cesarean section due to fear of birth: can it be changed through crisis-oriented counseling?* *Birth*, 2006. **33**(3): p. 221-8.
102. Horey, D., J. Weaver, and H. Russell, *Information for pregnant women about caesarean birth*. *Cochrane Database Syst Rev*, 2004(1): p. CD003858.
103. Fraser, W., et al., *Randomized controlled trial of a prenatal vaginal birth after cesarean section education and support program*. *Childbirth Alternatives Post-Cesarean Study Group*. *Am J Obstet Gynecol*, 1997. **176**(2): p. 419-25.
104. Saisto, T., et al., *A randomized controlled trial of intervention in fear of childbirth*. *Obstet Gynecol*, 2001. **98**(5 Pt 1): p. 820-6.
105. Hodnett, E., et al., *Continuous support for women during childbirth*. *Cochrane Database Syst Rev*, 2007(3): p. CD003766.
106. Hodnett, E., et al., *Effects of nurses as providers of birth labor support in North American Hospitals*. *J Am Med Assoc*, 2002. **288**(11): p. 1373-1381.
107. *The South Community Birth Program Final Report: 2003-2006*. 2006: Vancouver, BC. p. 1-40.
108. *Supporting Local Collaborative Models for Sustainable Maternity Care in British Columbia*. Recommendations from the Maternity Care Enhancement Project 2004 [cited 2007 October 3, 2007]; Available from: http://www.health.gov.bc.ca/library/publications/year/2004/mcep_recommend_dec2004.pdf.
109. *Guidelines for Development of a Multidisciplinary Collaborative Primary Maternity Care Model*. The Multidisciplinary Collaborative Primary Maternity Care Project 2006 [cited 2007 October 1, 2007]; Available from: <http://www.mcp2.ca/english/documents/D-FinalGuidelinestoModelDev1May06.pdf>.
110. Davis, D.A. and A. Taylor-Vaisey, *Translating guidelines into practice. A systematic review of theoretic concepts, practical experience and research evidence in the adoption of clinical practice guidelines*. *CMAJ*, 1997. **157**(4): p. 408-16.
111. Thomson O'Brien, M.A., et al., *Audit and feedback versus alternative strategies: effects on professional practice and health care outcomes*. *Cochrane Database Syst Rev*, 2000(2): p. CD000260.
112. Bebbington, M., et al., *Induction of labour: current concepts*, Upjohn, Editor. 1996, BC Women's Hospital and Health Centre, Department of Obstetrics and Gynecology, Division of Maternal Fetal Medicine: Vancouver, BC.
113. Hannah, M.E., et al., *Induction of labor as compared with serial antenatal monitoring in post-term pregnancy. A randomized controlled trial*. *The Canadian Multicenter Post-term Pregnancy Trial Group*. *N Engl J Med*, 1992. **326**(24): p. 1587-92.
114. Walker, M.P.R. and R. Resnik, *Prolonged pregnancy, cervical ripening and induction of labour*, in *Gynecology & Obstetrics: a longitudinal approach*, T. Moore, et al., Editors. 1993, Churchill Livingstone: New York. p. 541-59.
115. Flamm, B.L., et al., *Vaginal birth after cesarean section: results of a multicenter study*. *Am J Obstet Gynecol*, 1988. **158**(5): p. 1079-84.
116. Socol, M.L. and A.M. Peaceman, *Vaginal birth after cesarean: an appraisal of fetal risk*. *Obstet Gynecol*, 1999. **93**(5 Pt 1): p. 674-9.
117. Simkin, P., *Reducing pain and enhancing progress in labor: a guide to nonpharmacologic methods for maternity caregivers*. *Birth*, 1995. **22**(3): p. 161-71.
118. Seyb, S.T., et al., *Risk of cesarean delivery with elective induction of labor at term in nulliparous women*. *Obstet Gynecol*, 1999. **94**(4): p. 600-7.
119. Davies, G.A., P.M. Hahn, and M.M. McGrath, *Vaginal birth after cesarean. Physicians' perceptions and practice*. *J Reprod Med*, 1996. **41**(7): p. 515-20.
120. Flamm, B.L. and A.M. Geiger, *Vaginal birth after cesarean delivery: an admission scoring system*. *Obstet Gynecol*, 1997. **90**(6): p. 907-10.
121. Troyer, L.R. and V.M. Parisi, *Obstetric parameters affecting success in a trial of labor: designation of a scoring system*. *Am J Obstet Gynecol*, 1992. **167**(4 Pt 1): p. 1099-104.
122. Asakura, H. and S.A. Myers, *More than one previous cesarean delivery: a 5-year experience with 435 patients*. *Obstet Gynecol*, 1995. **85**(6): p. 924-9.
123. Bretelle, F., et al., *Vaginal birth following two previous cesarean sections*. *Eur J Obstet Gynecol Reprod Biol*, 2001. **94**(1): p. 23-6.
124. Caughey, A.B., et al., *Rate of uterine rupture during a trial of labor in women with one or two prior cesarean deliveries*. *Am J Obstet Gynecol*, 1999. **181**(4): p. 872-6.

125. Chattopadhyay, S.K., M.M. Sherbeen, and C.C. Anokute, *Planned vaginal delivery after two previous caesarean sections*. Br J Obstet Gynaecol, 1994. **101**(6): p. 498-500.
126. Farmakides, G., et al., *Vaginal birth after two or more previous cesarean sections*. Am J Obstet Gynecol, 1987. **156**(3): p. 565-8.
127. Miller, D.A., F.G. Diaz, and R.H. Paul, *Vaginal birth after cesarean: a 10-year experience*. Obstet Gynecol, 1994. **84**(2): p. 255-8.
128. Phelan, J.P., et al., *Twice a cesarean, always a cesarean?* Obstet Gynecol, 1989. **73**(2): p. 161-5.
129. Porreco, R.P. and P.R. Meier, *Trial of labor in patients with multiple previous cesarean sections*. J Reprod Med, 1983. **28**(11): p. 770-2.
130. Lydon-Rochelle, M., et al., *Risk of uterine rupture during labor among women with a prior cesarean delivery*. N Engl J Med, 2001. **345**(1): p. 3-8.
131. Delaney, T. and D.C. Young, *Spontaneous versus induced labor after a previous cesarean delivery*. Obstet Gynecol, 2003. **102**(1): p. 39-44.
132. Ravasia, D.J., S.L. Wood, and J.K. Pollard, *Uterine rupture during induced trial of labor among women with previous cesarean delivery*. Am J Obstet Gynecol, 2000. **183**(5): p. 1176-9.
133. Sanchez-Ramos, L., F.L. Gaudier, and A.M. Kaunitz, *Cervical ripening and labor induction after previous cesarean delivery*. Clin Obstet Gynecol, 2000. **43**(3): p. 513-23.
134. Zelop, C.M., et al., *Uterine rupture during induced or augmented labor in gravid women with one prior cesarean delivery*. Am J Obstet Gynecol, 1999. **181**(4): p. 882-6.
135. Miller, D.A., et al., *Vaginal birth after cesarean section in twin gestation*. Am J Obstet Gynecol, 1996. **175**(1): p. 194-8.
136. Myles, T., *Vaginal birth of twins after a previous Cesarean section*. J Matern Fetal Med, 2001. **10**(3): p. 171-4.
137. Odeh, M., et al., *Evidence that women with a history of cesarean section can deliver twins safely*. Acta Obstet Gynecol Scand, 1997. **76**(7): p. 663-6.
138. Sansregret, A., E. Bujold, and R.J. Gauthier, *Twin delivery after a previous caesarean: a twelve-year experience*. J Obstet Gynaecol Can, 2003. **25**(4): p. 294-8.
139. Strong, T.H., Jr., et al., *Vaginal birth after cesarean delivery in the twin gestation*. Am J Obstet Gynecol, 1989. **161**(1): p. 29-32.
140. Wax, J.R., et al., *Twin vaginal birth after cesarean*. Conn Med, 2000. **64**(4): p. 205-8.
141. Coleman, T.L., et al., *Vaginal birth after cesarean among women with gestational diabetes*. Am J Obstet Gynecol, 2001. **184**(6): p. 1104-7.
142. Elkousy, M.A., et al., *The effect of birth weight on vaginal birth after cesarean delivery success rates*. Am J Obstet Gynecol, 2003. **188**(3): p. 824-30.
143. Flamm, B.L. and J.R. Goings, *Vaginal birth after cesarean section: is suspected fetal macrosomia a contraindication?* Obstet Gynecol, 1989. **74**(5): p. 694-7.
144. Phelan, J.P., et al., *Previous cesarean birth. Trial of labor in women with macrosomic infants*. J Reprod Med, 1984. **29**(1): p. 36-40.
145. Zelop, C.M., et al., *Trial of labor after 40 weeks' gestation in women with prior cesarean*. Obstet Gynecol, 2001. **97**(3): p. 391-3.
146. Bujold, E., et al., *Interdelivery interval and uterine rupture*. Am J Obstet Gynecol, 2002. **187**(5): p. 1199-202.
147. Callahan, C., N. Chescheir, and B.D. Steiner, *Safety and efficacy of attempted vaginal birth after cesarean beyond the estimated date of delivery*. J Reprod Med, 1999. **44**(7): p. 606-10.
148. Yeh, S., X. Huang, and J.P. Phelan, *Postterm pregnancy after previous cesarean section*. J Reprod Med, 1984. **29**(1): p. 41-4.
149. Lowe, N.K., *The nature of labor pain*. Am J Obstet Gynecol, 2002. **186**(5 Suppl Nature): p. S16-24.
150. Hemminki, E. and R. Simukka, *The timing of hospital admission and progress of labour*. Eur J Obstet Gynecol Reprod Biol, 1986. **22**: p. 85-94.
151. Bloom, S.L., et al., *Lack of effect of walking on labor and delivery*. N Engl J Med, 1998. **339**(2): p. 76-9.
152. Cluett, E.R., et al., *Immersion in water in pregnancy, labour and birth*. Cochrane Database Syst Rev, 2004(2): p. CD000111.
153. Smith, C.A., et al., *Complementary and alternative therapies for pain management in labour*. Cochrane Database Syst Rev, 2006(4): p. CD003521.
154. Betts, D., *Natural pain relief techniques for childbirth using acupressure*. 2003.
155. Carroll, D., et al., *Transcutaneous electrical nerve stimulation in labour pain: a systematic review*. Br J Obstet Gynaecol, 1997. **104**(2): p. 169-75.
156. Bahasadri, S., et al., *Subcutaneous sterile water injection for labour pain: a randomised controlled trial*. Aust N Z J Obstet Gynaecol, 2006. **46**(2): p. 102-6.
157. Martensson, L., K. Nyberg, and G. Wallin, *Subcutaneous versus intracutaneous injections of sterile water for labour analgesia: a comparison of perceived pain during administration*. Bjog, 2000. **107**(10): p. 1248-51.
158. Trolle, B., et al., *The effect of sterile water blocks on low back labor pain*. Am J Obstet Gynecol, 1991. **164**(5 Pt 1): p. 1277-81.

159. Rosen, M.A., *Nitrous oxide for relief of labor pain: a systematic review*. Am J Obstet Gynecol, 2002. **186**(5 Suppl Nature): p. S110-26.
160. Olofsson, C., et al., *Lack of analgesic effect of systemically administered morphine or pethidine on labour pain*. Br J Obstet Gynaecol, 1996. **103**(10): p. 968-72.
161. Tsui, M.H., et al., *A double blinded randomised placebo-controlled study of intramuscular pethidine for pain relief in the first stage of labour*. Bjog, 2004. **111**(7): p. 648-55.
162. Howell, C.J., *Epidural versus non-epidural analgesia for pain relief in labour*. Cochrane Database Syst Rev, 2000(2): p. CD000331.
163. Thorp, J., et al., *The effect of intrapartum analgesia on nulliparous labor: a randomized, controlled, prospective trial*. Am J Obstet Gynecol, 1993. **169**: p. 851-8.
164. Lieberman, M. and C. Donoghue, *Unintended effects of epidural analgesia during labor: A systematic review*. Am J Obstet Gynecol, 2002. **186**: p. S31-68.
165. Klein, M., et al., *The effect of family physician timing of maternal admission on procedures in labour and maternal and infant morbidity*. J Obstet Gynaecol Can, 2004. **26**(7): p. 641-5.
166. Klein, M.C., *Does epidural analgesia increase rate of cesarean section?* Can Fam Physician, 2006. **52**: p. 419-21, 426-8.
167. Kotaska, A.J., M.C. Klein, and R.M. Liston, *Epidural analgesia associated with low-dose oxytocin augmentation increases cesarean births: a critical look at the external validity of randomized trials*. Am J Obstet Gynecol, 2006. **194**(3): p. 809-14.
168. Bremerich, D.H., et al., *Comparison of continuous background infusion plus demand dose and demand-only parturient-controlled epidural analgesia (PCEA) using ropivacaine combined with sufentanil for labor and delivery*. Int J Obstet Anesth, 2005. **14**(2): p. 114-20.
169. Missant, C., et al., *Patient-controlled epidural analgesia following combined spinal-epidural analgesia in labour: the effects of adding a continuous epidural infusion*. Anaesth Intensive Care, 2005. **33**(4): p. 452-6.
170. Liston, R., D. Sawchuck, and D. Young, *Recommendations*. J Obstet Gynaecol Can, 2007. **29**(9 Suppl 4): p. S5-6.
171. Liston, R., *Fetal health surveillance: Antepartum and Intrapartum Consensus Guideline*. JOGC, 2007. **29**(9, supplement): p. s1-s56.
172. Liston, R., et al., *Fetal health surveillance in labour*. J Obstet Gynaecol Can, 2002. **24**(3): p. 250-76; quiz 277-80.
173. Miyazaki, F.S. and F. Nevarez, *Saline amnioinfusion for relief of repetitive variable decelerations: a prospective randomized study*. Am J Obstet Gynecol, 1985. **153**(3): p. 301-6.
174. Mukhopadhyay, S. and S. Arulkumaran, *Breech delivery*. Best Pract Res Clin Obstet Gynaecol, 2002. **16**(1): p. 31-42.
175. Bingham, P. and R.J. Lilford, *Management of the selected term breech presentation: assessment of the risks of selected vaginal delivery versus cesarean section for all cases*. Obstet Gynecol, 1987. **69**(6): p. 965-78.
176. Hannah, M.E., et al., *Planned caesarean section versus planned vaginal birth for breech presentation at term: a randomised multicentre trial*. Term Breech Trial Collaborative Group. Lancet, 2000. **356**(9239): p. 1375-83.
177. Su, M., et al., *Factors associated with adverse perinatal outcome in the Term Breech Trial*. Am J Obstet Gynecol, 2003. **189**(3): p. 740-5.
178. Alarab, M., et al., *Singleton vaginal breech delivery at term: still a safe option*. Obstet Gynecol, 2004. **103**(3): p. 407-12.
179. Glezerman, M., *Five years to the term breech trial: the rise and fall of a randomized controlled trial*. Am J Obstet Gynecol, 2006. **194**(1): p. 20-5.
180. Hofmeyr, G.J., *External cephalic version facilitation for breech presentation at term*. Cochrane Database Syst Rev, 2000(2): p. CD000184.
181. Varma, R., D. Horwell, and S. Burrell. *The impact of external cephalic version at term in a district general hospital. in 29th British Congress of Obstetrics and Gynaecology*. 2001. Birmingham, UK.
182. Hutton, E.K., et al., *External cephalic version beginning at 34 weeks' gestation versus 37 weeks' gestation: a randomized multicenter trial*. Am J Obstet Gynecol, 2003. **189**(1): p. 245-54.
183. Fraser, W.D., et al., *Amniotomy for shortening spontaneous labour*. Cochrane Database Syst Rev, 2000(2): p. CD000015.
184. Fraser, W.D., et al., *Multicenter, randomized, controlled trial of delayed pushing for nulliparous women in the second stage of labor with continuous epidural analgesia. The PEOPLE (Pushing Early or Pushing Late with Epidural) Study Group*. Am J Obstet Gynecol, 2000. **182**(5): p. 1165-72.
185. Hansen, S.L., S.L. Clark, and J.C. Foster, *Active pushing versus passive fetal descent in the second stage of labor: a randomized controlled trial*. Obstet Gynecol, 2002. **99**(1): p. 29-34.
186. Sprague, A.E., et al., *The Ottawa Hospital's Clinical Practice Guideline for the Second Stage of Labour*. J Obstet Gynaecol Can, 2006. **28**(9): p. 769-79.
187. Boylan, P., *Active management of labour. Continuous audit is the most important component*. Bmj, 1997. **314**(7080): p. 606.
188. Dennen, P., *Dennen's Forceps Deliveries*. 4th ed. 2001: FA Davis.
189. Creasy, R., *Management of labour and delivery*. 1st ed. 1997: Blackwell Publishing.

190. Cunningham, F., *Williams Obstetrics*. 21st ed. 2001: McGraw-Hill Professional.
191. Kennell, J., et al., *Continuous emotional support during labor in a US hospital. A randomized controlled trial.[see comment]*. JAMA, 1991. **265**(17): p. 2197-201.
192. Sosa, R., et al., *The effect of a supportive companion on perinatal problems, length of labor, and mother-infant interaction*. New England Journal of Medicine, 1980. **303**(11): p. 597-600.
193. Campbell, D.A., et al., *A Randomized Control Trial of Continuous Support in Labor by a Lay Doula*. Journal of Obstetric, Gynecologic, & Neonatal Nursing, 2006. **35**(4): p. 456-464.
194. Gagnon, A.J. and K. Waghorn, *Supportive care by maternity nurses: a work sampling study in an intrapartum unit*. Birth, 1996. **23**(1): p. 1-6.
195. Gagnon, A.J., K. Waghorn, and C. Covell, *A randomized trial of one-to-one nurse support of women in labor.[see comment]*. Birth, 1997. **24**(2): p. 71-7.
196. Hodnett, E.D., et al., *Continuous support for women during childbirth*. Cochrane Database of Systematic Reviews, 2003(3): p. CD003766.
197. Hodnett, E.D., et al., *Effectiveness of nurses as providers of birth labor support in North American hospitals: a randomized controlled trial.[see comment]*. JAMA, 2002. **288**(11): p. 1373-81.
198. Yarrow, C., G. Benoit, and M.C. Klein, *Outcomes after vacuum-assisted deliveries. Births attended by community family practitioners*. Can Fam Physician, 2004. **50**: p. 1109-14.
199. Anim-Somuah, M., R. Smyth, and C. Howell, *Epidural versus non-epidural or no analgesia in labour*. 2005, Cochrane Database of Systematic Reviews.
200. National Institutes of Health, *State-of-the-Science Conference Statement on Cesarean Delivery on Maternal Request*, in *Volume 23, Number 1*. March 2006.
201. Meikle, S., et al., *A national estimate of the elective primary cesarean delivery rate*. Obstet Gynecol, 2005. **105**: p. 751-6.
202. Scott, J., *Cesarean delivery on request: Where do we go from here?* Obstet Gynecol, 2006. **107**: p. 1222-3.
203. Gossman, G., J. Joesch, and K. Tanfer, *Trends in maternal request cesarean delivery from 1991 to 2004*. Obstet Gynecol, 2006. **108**: p. 1506-16.
204. Newton, E., *Vaginal birth after cesarean prediction: A self-fulfilling prophecy?* Obstet Gynecol, 2007. **109**: p. 796-797.
205. McCourt, C., et al., *Elective cesarean section and decision making: a critical review of the literature*. BIRTH, 2007. **34**(1): p. 65-79.
206. McFarlin, B., *Elective cesarean birth: Issues and ethics of informed decision*. J Midwifery Women's Health, 2004. **49**: p. 421-9.
207. Bump, R., *Advising prospective mothers about the maternal morbidity of vaginal childbirth*. Am J Obstet Gynecol, 2002. **187**: p. 823.
208. Wax, J., et al., *Patient choice cesarean: an evidence-based review*. Obstet Gynecol Surv, 2004. **59**: p. 601-616.
209. Hannah, M., et al., *Maternal outcomes at 2 years after planned cesarean section versus planned vaginal birth for breech presentation at term: The international randomized Term Breech Trial*. Am J Obstet Gynecol, 2004. **191**: p. 917-27.
210. Farrell, S., W. Allen, and T. Basket, *Parturition and urinary continence in primiparas*. Obstet Gynecol, 2001. **97**: p. 350-356.
211. Declercq, E., et al., *Maternal outcomes associated with planned primary cesarean births compared with planned vaginal births*. Obstet Gynecol, 2007. **109**: p. 669-77.
212. Richardson, B., et al., *The impact of labor at term on measures of neonatal outcome*. Am J Obstet Gynecol, 2005. **192**: p. 219-26.
213. Fogelson, N., et al., *Neonatal impact of elective repeat cesarean delivery at term: A comment of patient choice cesarean delivery*. Am J Obstet Gynecol, 2005. **192**: p. 1433-6.