Induction of Labour In Nova Scotia

Report from the Provincial Quality Assessment Review

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Abbreviations

ACOG – American Congress of Obstetricians and Gynecologists

ARM – artificial rupture of the membranes

BP – blood pressure

BMI – body mass index

C/S – cesarean section

DHA – District Health Authority

EDD – estimated date of delivery

EFM – electronic fetal monitor

FHR – fetal heart rate

FHS – fetal health surveillance

GBS – Group B Streptococcus

HDP – hypertensive disorders of pregnancy

IOL – induction of labour

ISMP – Institute for Safe Medication Practices

IUGR – intrauterine growth restriction

LMP – last menstrual period

mU/min – milliunits per minute

NSAPD – Nova Scotia Atlee Perinatal Database

PGE_2 – Prostaglandin E_2

PROM – prelabour rupture of the membranes

QA Review – Quality Assessment Review

RCP of NS – Reproductive Care Program of Nova Scotia

RCT – randomized controlled trial

RDS – respiratory distress syndrome

SOGC – Society of Obstetricians and Gynaecologists of Canada

VBAC – vaginal birth after cesarean

VD – vaginal delivery

> - greater than

< - less than

≥ - greater than or equal to

≤ - less than or equal to

Executive Summary

Induction of labour (IOL) is defined as the 'artificial initiation of labour before its spontaneous onset'.[1] Similar to other parts of Canada, the rate of induction in Nova Scotia has increased steadily and dramatically over the last 20 years, to more than 30% of all births in the province in the years since 2000. In spite of a changing demographic that includes an older childbearing population and an increased proportion of obese women, it seems unlikely that pregnant women with medical complications could account for all of the rapid and steady rise in the rate of induction of labour. Elective or non-medical indications, including those for which medical indications are implied but not well-defined, have impacted the overall rate in an obvious way.

The Society of Obstetricians and Gynaecologists of Canada (SOGC) advises that induction be considered when vaginal birth is expected and the benefits to the mother and/or fetus of accomplishing birth before spontaneous labour outweigh the risks of the intervention itself.[1] Childbirth Connection in the United States has proposed that practices such as induction of labour that were introduced to improve outcomes in situations of maternal or fetal complications have become routine, exposing many mothers and babies to risk of harm with limited or non-existent benefit.[2]

Commonly cited risks of induction include neonatal morbidity related to inadvertent delivery before term, prolonged labour, postpartum hemorrhage and cesarean section.[3, 4, 5, 6] Cesarean section carries an additional potential for morbidity including postpartum hemorrhage and infection, the risks of which increase when cesarean section is undertaken during labour and with each subsequent cesarean section.[7, 8] Canadian studies have demonstrated increased healthcare costs associated with induction of labour. These costs are related to staffing and length of hospitalization and are compounded when induction is followed by cesarean section.[7]

For these reasons, induction of labour is a topic of concern and study in Canada and around the world. From April 2007 to January 2009, the Reproductive Care Program (RCP) of Nova Scotia completed a series of *Quality Assessment (QA) Reviews of Induction of Labour* in 3 District Health Authorities and the IWK Health Centre. This report will summarize findings from the QA Reviews and from the literature. Data from the Nova Scotia Atlee Perinatal Database (NSAPD) is presented.

Recommendations

The following recommendations are intended to emphasize the importance of inducing women appropriately in order to avoid unnecessary interventions, utilize resources effectively and promote safe care:

Pregnancy Dating

Caregivers should follow a consistent process for accurately determining pregnancy gestation. If the last menstrual period (LMP) is not known or the date is uncertain, a first trimester dating ultrasound (10 to 14 weeks) should be requested. A reliable estimated date of delivery (EDD) established from a known LMP should be adjusted only if there is a difference of more than 5 days based on a first trimester ultrasound, or more than 10 days based on a second trimester ultrasound (18 to 20 weeks). Rationale for changing the EDD should be discussed with the woman. If both a first and a second trimester ultrasound were obtained, determination of the EDD should be based on the earlier ultrasound. Once established, the most appropriate EDD should be used consistently by all members of the team.

Cervical Ripening

The condition of the cervix must always be a factor in decisions about whether and when to induce labour. A Bishop score of 8 or more is associated with labour that progresses and a successful induction, particularly when this score has been achieved spontaneously. If expectant management remains an option, it is preferable to delay an induction until spontaneous ripening of the cervix has occurred.[9, 10, 11, 12] If delivery must be expedited, vaginal birth is appropriate and the Bishop score is 6 or less, artificial methods to promote ripening should be carried out.

Booking and Scheduling Inductions

Each local perinatal team should develop a policy or guideline that describes the process for booking inductions. An individual or team responsible for overseeing requests for induction and making decisions about prioritization should be identified. A medically indicated induction should be postponed only when absolutely necessary. Follow-up that includes regular fetal and maternal assessments should be provided until the induction is initiated. The type, timing and process for this follow-up should be clearly described in the policy or guideline.

Priorities for Induction

A complete prenatal record and all other necessary information must be accessible in order to prioritize inductions. Information must include the appropriately assigned EDD, the indications for the induction, and information that supports the indication including but not limited to laboratory results, ultrasound reports, electronic fetal monitoring tracings, and recent and early pregnancy blood pressure (BP) readings.

Non-medically indicated inductions should be rarely required. However, there are times when it is appropriate to accommodate maternal requests or significant concerns by offering elective induction.

Postterm Pregnancy

Induction for postterm pregnancy should be considered and discussed with women as pregnancy extends beyond 41+0 weeks gestation. In the absence of other pregnancy or medical indications and provided fetal surveillance has been carried out with normal results, it is appropriate for many women to wait for the onset of spontaneous labour for several more days, up to 42+0 weeks. Fetal health surveillance should include at a minimum a non-stress test and measurement of amniotic fluid volume every 3 to 4 days.[13, 14]

Induction for postterm pregnancy should *not* be undertaken prior to 41+0 weeks gestation, and that includes methods for cervical ripening. Avoiding unnecessary inductions such as those prior to 41+0 weeks gestation without medical indications will reduce the overall number of inductions (exposing fewer women to the associated risk), and lessen the strain on human and fiscal resources. Further, it will reduce the likelihood of competing priorities for medically indicated inductions.

Safe Use of Oxytocin

There should be a single protocol for mixing and administering oxytocin within each Labour and Birth Unit. Oxytocin should be initiated at a low dose and carefully titrated based on maternal and fetal response, to induce contractions of normal frequency, strength and duration. Throughout labour, oxytocin should be maintained at the lowest rate possible to achieve these results. This may involve reducing the rate of the infusion as active labour is established.[15] The term ‘max pit’ should be avoided.

If tachysystole (more than 5 contractions in 10 minutes averaged over 30 minutes) or hypertonus (the uterus does not relax completely between contractions) occur the infusion should be quickly adjusted downward until a normal contraction pattern, i.e. every 2 to 3 minutes with 30 to 60 seconds of relaxation between contractions, is reestablished.[16, 17] The infusion should be discontinued if tachysystole or hypertonus do not resolve within 10 minutes, or an atypical or abnormal fetal heart rate (FHR) pattern develops[a].[18, 19] The primary care provider responsible for the woman during the induction should be notified in the event of tachysystole, hypertonus or abnormal FHR.

Fetal Health Surveillance during Cervical Ripening and Induction of Labour

Fetal health surveillance should be carried out as recommended by the SOGC.[18] Continuous electronic monitoring should be applied for at least 1 to 2 hours following insertion of prostaglandin, and maintained if the tracing is atypical or abnormal. During oxytocin induction, continuous monitoring may be interrupted for brief periods to allow for ambulation once the infusion rate is stable, and provided the contraction pattern and the FHR are normal. It is important to ensure that the tracing reflects the actual contraction pattern including a normal resting tone. Frequent adjustments of the tocotransducer may be necessary.

There should be regular participation in interdisciplinary fetal health surveillance education by all members of the perinatal team in order to promote consistent terminology, tracing interpretation and interventions in response to tachysystole, hypertonus or atypical or abnormal fetal heart rates.

[a] Although not supported by clinical testing, some experts have proposed that if oxytocin was discontinued for less than 30 minutes, the infusion should be restarted at one-half the rate at which tachysystole occurred; if discontinued for more than 30 minutes, oxytocin should be restarted at the initial dose[15].

Audit and Quality Improvement

Local perinatal teams are encouraged to carry out regular clinical audit for quality improvement related to induction of labour. Topics to be reviewed might include, among others: establishment and consistent use of an appropriate EDD, accuracy of induction indications, management of cervical ripening, safe use of oxytocin, fetal health surveillance and electronic fetal monitoring, appropriate response to tachysystole and hypertonus, and quality documentation.

Description of the Review

More than 250 health records of women undergoing induction, and their babies, were reviewed along with the electronic fetal monitor (EFM) tracings for the majority of the cases selected. Records were identified from the Nova Scotia Atlee Perinatal Database (NSAPD) to include a sample of inductions for all indications, and a variety of maternal and neonatal outcomes. Meetings were held with members of the administration and the clinical team at each site, including maternal fetal medicine specialists, obstetricians, pediatricians, family physicians, maternal newborn nurses, public health nurses, anesthetists, radiologists and sonographers. Midwives participated on a limited basis at one site only as midwifery was just becoming regulated in the province at the time of the Reviews. External clinical and administrative consultants participated with the RCP. At the conclusion of each of the QA Reviews, a written report was sent to the district or facility outlining findings supported by site specific and provincial data.

A number of discussion groups were held with pregnant women and with mothers who had experienced induction of labour. Although the number of participants was small, the perspectives of women and families were essential to

consider. A focus on the requirements of the population as a whole, and the unique needs and circumstances of each woman, baby and family are critical components of **Accreditation Canada Quality Dimensions**. The eight Quality Dimensions served as a framework to guide the Review and to help ensure that the evaluation of induction of labour in our province was comprehensive, promoted best practice and considered the effects on the health of the population and the health care system overall.

The Accreditation Canada Quality Dimensions and their tag lines are listed below.[20]

- Population focus – working with communities to anticipate and meet their needs
- Accessibility – providing timely and equitable services
- Safety – keeping people safe
- Worklife – supporting wellness in the work environment
- Client-centred services – putting clients and families first
- Continuity of services – experiencing coordinated and seamless services
- Effectiveness – doing the right thing to achieve the best possible results
- Efficiency – making the best use of resources

Overview of Induction of Labour

Medical Indications

The most common medical indications for induction in Nova Scotia are postterm pregnancy, prelabour rupture of the fetal membranes, and hypertension. Other medical indications involve additional maternal or fetal conditions that pose risk of perinatal mortality or morbidity that potentially increases as the pregnancy advances. Examples include diabetes, intrauterine growth restriction, oligohydramnios and abnormal fetal heart rate prior to labour. The three most

common Nova Scotia indications will be reviewed in some detail. Others will be grouped, outlining factors that influence decisions to intervene.

Postterm Pregnancy

Postterm pregnancy by definition is pregnancy that extends at least two full weeks beyond term i.e. 42+0 weeks, or 294 days from the last menstrual period (LMP). The reported incidence of postterm pregnancy is estimated to be 7%.[13] The *actual* incidence is difficult to determine in part because of interventions such as induction or planned cesarean section that are undertaken before many pregnancies reach 42 weeks and can thus be labeled postterm. Another factor suggested is that the EDD is often inaccurately predicted resulting in a large proportion of pregnancies being mislabeled as postterm.[13] Nulliparity, advanced maternal age and obesity have been proposed as significant risk factors for postterm pregnancy.[13, 21] One large study suggested that there is greater than a 50% increase in risk of postterm pregnancy among older women and nulliparous women, and a 60% increase in risk among obese women.[22]

Concern about fetal well being as pregnancy advances beyond the EDD has led to a commonly held belief that 'postterm' applies to gestation beyond 41 weeks (and in some cases beyond 40 weeks). There have been numerous studies looking at perinatal mortality and morbidity associated with postterm pregnancy, comparing the incidence in pregnancies managed expectantly with those in which induction was undertaken. Several reported fewer perinatal deaths with induction of labour at 41+0 weeks or later while acknowledging that the results were not statistically significant and the absolute risk was small.[23, 24, 25, 26]

Maternal risks associated with postterm pregnancy include dystocia and cesarean section.[13, 14] Perhaps surprisingly given the link between induction and cesarean section, there is evidence to suggest that those women induced for postterm pregnancy are less likely to undergo a cesarean section (20.1% to 21.2%) than those managed expectantly (22% to 24.5%).[24, 25, 27] Researchers

observed a lower rate of cesarean section for abnormal fetal heart rate (previously classified as 'fetal distress') among women induced than in the expectant management group. Hannah et al (1992) reported that 5.7% of women induced for postterm pregnancy underwent a cesarean section for 'fetal distress' compared to 8.3% of women managed expectantly.[24]

The results noted above seem to favour induction. However, comparing the outcomes of induction with expectant management is not always straightforward. Some meta-analyses report variability in the planned duration of expectant management. For example, in one systematic review of randomized controlled trials (RCTs)[25], researchers found that duration of expectant management was not specified in 2 of 16 studies. In 6 trials duration was not limited, in 4 trials induction or cesarean section was undertaken after 43 weeks and in the remaining 4 studies intervention was carried out at 44 weeks. In one well known RCT that looked specifically at cesarean section as an outcome, cervical ripening was not an option for women in the expectant management group even for those women who eventually underwent induction.[24]

The evidence in favour of routine induction at 41+0 weeks is not overwhelming. Some propose that women whose pregnancies reach 41 weeks be given the option of expectant management or induction.[13, 21] Awaiting spontaneous labour for several more days (up to 42 +0 weeks) may be appropriate for many women, provided there are no medical or pregnancy complications and fetal surveillance has been carried out with normal results. Expectant management may be particularly appropriate for those women with a low Bishop score.[14] Fetal surveillance should include at a minimum a non-stress test and measurement of amniotic fluid volume every 3 to 4 days.[13, 14]

Of note, the overall rate of induction will be impacted by the timing of postterm induction between 41 and 42 weeks. Studies reported by Pavicic et al (2009) estimated that 15% to 20% of women will be induced if there is a policy of routine

induction at 41+0 weeks compared to 3% to 5% if the policy aims for 42+0 weeks.[28]

Sweeping membranes may be offered to women at 38 to 41 weeks gestation in order to potentially avoid postterm pregnancy and promote spontaneous labour. The practice has been found to have benefits for nulliparous women with a low Bishop score. Separation of the fetal membranes from the cervix and lower uterine segment is thought to result in the release of endogenous prostaglandin. Many women have reported discomfort with the procedure. However, in one study most indicated that they would choose to have their membranes swept in a subsequent pregnancy despite the discomfort in order to facilitate the onset of labour.[14]

Pre-labour Rupture of the Membranes (PROM)

Fetal membranes rupture prior to the onset of labour for reasons that are not well understood in approximately 8% of term pregnancies.[29, 30] It is important to confirm that PROM has occurred. This may require a speculum examination that allows visualization of fluid passing from the cervical canal. Additionally a sample of fluid can be taken by swab from the posterior fornix and allowed to dry on a glass slide. If amniotic fluid is present, the slide will have a fern-like appearance when examined under a microscope.

PROM is a common indication for induction of labour because of concerns about neonatal and/or maternal infection. When there is a positive group B streptococcus (GBS) result from culture screening or a history of GBS bacteriuria during pregnancy, immediate induction with oxytocin is recommended following PROM as a means of preventing early-onset neonatal GBS disease.[31]

The risk of chorioamnionitis and endometritis increases with the length of time from membrane rupture until birth.[30, 32] With the exception of situations involving

GBS however, there is a lack of consensus about how soon following PROM induction should be initiated and what method of induction is preferred. It is estimated that 80% of women with PROM at term will begin to labour spontaneously within 12 hours, and 95% within 24 hours.[33] The time at which induction will be initiated following PROM may be influenced by preference of the care provider, unit workload, and women's choice, as well as speculation about when labour might begin without intervention.

Studies comparing methods of induction for PROM showed little difference between oxytocin or prostaglandin with respect to time to delivery or cesarean birth.[30, 34] Once a decision to intervene with induction has been made, it is important to include a digital vaginal examination as part of the process, in part to determine if cervical ripening is advisable. As for all inductions, methods to promote cervical ripening may be helpful in accomplishing vaginal birth and are promoted as part of induction for PROM. It should be noted that controlled-release PGE_2 (Cervidil®) is contraindicated when membranes have ruptured.[1]

Vaginal examinations should be carried out following PROM only when induction is planned immediately or active labour is obvious. Women who would have preferred to await spontaneous labour may be denied that option because a digital vaginal examination was done as part of a routine initial assessment. Studies have shown that the incidence of infection is significantly influenced by the timing and frequency of digital vaginal examinations. This effect has been shown to be independent of other risk factors for infection including duration of labour or time from rupture of membranes to the onset of labour.[30, 35, 36] Studies utilizing data from the TERMPROM study[34] found that of women with PROM who had 3 or fewer vaginal examinations during labour, 2% developed chorioamionitis whereas the incidence of chorioamnionitis increased to 20% among women who had more than 8 vaginal examinations.[36, 37]

Care should be taken to consider the necessity of each vaginal examination during labour, regardless of the type of labour or status of fetal membranes. In addition to increasing the risk of infection, these examinations are uncomfortable for women. Those caring for women during labour need to be watchful for subtle signs of labour progress such as changes in a woman's perception of, and response to contractions. Additionally there should be a single, consistent examiner throughout labour whenever possible in order to more accurately estimate labour progress.

PROM complicates approximately one-third of preterm labours (less than 37 weeks gestation) and contributes to an increase in the risk of neonatal infection that already exists by virtue of the prematurity.[30] The incidence of infection in preterm PROM increases with earlier gestations and with the number of digital vaginal examinations.[30] Decisions to intervene with induction in cases of preterm PROM may be complex and are influenced by gestation, fetal status and timing of corticosteroids given to promote lung maturity.

Hypertensive Disorders of Pregnancy

Hypertensive disorders of pregnancy (HDP) are a primary cause of maternal and perinatal mortality and morbidity in Canada and throughout the world.[38] Preeclampsia is defined by hypertension in association with proteinuria and/or maternal morbidity or 'adverse conditions' such as symptoms of headache, visual disturbances, or epigastric pain, and/or abnormal laboratory values. Fetal morbidity includes oligohydramnios, intrauterine growth restriction, and absent or reversed end-diastolic flow in the umbilical artery. Maternal stroke, pulmonary edema, eclampsia, and abruption are potential complications that result in significant morbidity for mother and baby.[38] Preeclampsia is progressive, with symptoms and adverse conditions often worsening as pregnancy advances. The pathogenesis is multifactoral and appears to be related to impaired maternal and placental circulation.[38]

For years the adage has been that 'the only known cure for preeclampsia is delivery'. However, there is variability about when and how to intervene. Prior to term the need for delivery is balanced against the potential for fetal morbidity related to prematurity. With severe hypertension (systolic BP ≥160mmHg or a diastolic BP ≥ 110mmHg), delivery is often advisable even at preterm gestations. Development of new or worsening adverse conditions will provide incentive to expedite delivery.

When the decision to deliver has been made, vaginal birth should be planned when possible and induction offered, with cervical ripening as necessary.[38, 39] As expected there is a greater likelihood of a vaginal birth as gestation advances. The rate of successful induction has been reported as 60% beyond 32 weeks gestation, decreasing to 10% at less than 26 weeks.[38, 39]

Other Medical Indications

Inductions are undertaken for additional reasons with a goal to protect the health and well being of the mother or fetus. Obesity and advanced maternal age have become more prevalent in the pregnant population in recent years. Both have been identified as independent risk factors for stillbirth though there is variation in the reported level of risk.[40, 41, 42, 43] While it may be appropriate that either figure into a decision to induce labour, some studies have suggested that intervening in the absence of other risks or complications may not be appropriate.[41, 44, 45] Another point to consider is that women of advanced maternal age are more likely to undergo cesarean sections than younger women.[45] In one large cohort study, advanced maternal age more than doubled the risk of cesarean section among postterm women induced.[22] Various reasons for this increase have been suggested, including maternal medical complications, pre-existing chronic diseases and ineffective uterine action; however, many of these have been disputed.[44, 45] Further study is needed.

Women with insulin-requiring diabetes may be offered induction at 38 to 40 weeks because of the associated risk of perinatal mortality and morbidity, particularly when glycemic control is poor.[46] The UK Confidential Enquiry into Maternal and Child Health (2007) concluded that infants of mothers with diabetes were 5 times more likely to be stillborn compared to those whose mothers were not diabetic.[47]

Induction may also be offered to women who require insulin in order to reduce the risk of morbidity resulting from fetal macrosomia and subsequent shoulder dystocia.[48] Macrosomia, variably defined as birth weight greater than 4 to 4.5 Kg or greater than the 90th percentile for gestational age, is more common among women with either pregestational or gestational diabetes requiring insulin[49, 50] The risk of macrosomia and shoulder dystocia is small overall, and must be weighed against the maternal and neonatal risk of induction. Infants of mothers with diabetes are more likely to develop respiratory distress syndrome (RDS), in general and at later gestations, as hyperglycemia and hyperinsulinemia are thought to contribute to a delay in maturation of the fetal lungs.[50, 51] Macrosomia is not an appropriate indication for induction in women who are not insulin-requiring diabetic because the level of associated risk does not supersede the known risk of morbidity linked to induction.[49]

Intrauterine growth restriction (IUGR) may be associated with significant fetal and neonatal risks resulting from an insufficient supply of nutrients and oxygen across the placenta. IUGR is commonly suspected when the fetal abdominal circumference falls below the 10th percentile for gestation[52]. It may be more accurately determined by performing serial fetal measurements and plotting them on a growth curve. Some researchers suggest that IUGR is a factor in more than 50% of unexplained stillbirths at term.[53] Long-term neonatal complications range from minor developmental delay or behavioral problems, to cerebral palsy.[54] In very preterm neonates, these complications may also be aggravated by extreme

prematurity. At early preterm gestation, expectant management with serial monitoring may be the preferred strategy in order to reduce the risk of adverse neonatal effects associated with prematurity. Decisions about induction at or before term will be influenced by an assessment of fetal well-being that may include measurement of amniotic fluid volume, and umbilical artery and middle cerebral artery Doppler ultrasound.

Non-Medical Indications

'Non-medical' or 'elective' refers to those inductions undertaken in the absence of medical or obstetrical indications. The rate has increased over the last 20 years and has contributed to the dramatic increase in the overall rate of induction of labour in North America. Induction is occasionally requested in order to help ensure a controlled event with the appropriate team and clinical supports available to attend to the mother's or the baby's needs. At times this may be related to a woman's place of residence. Multiparous women who live a significant distance from the hospital, particularly those with a history of precipitous labour, may be offered induction in order to avoid delivery enroute.

Other proposed reasons are related to maternal request.[12] Most women have accepted induction as a safe and reliable intervention to meet their personal objectives. Some have important reasons related to their personal lives that prompt them to seek, and care providers to offer, elective induction. Others are anxious to proceed with induction in order to avoid (or end) the discomforts associated with late pregnancy. Convincing a woman to await spontaneous labour, particularly beyond the EDD, is often challenging for the care provider. This may be more difficult if the EDD was changed during the pregnancy, especially if the change resulted in a later date of expected birth.

Taking into account the definition of postterm pregnancy, inductions carried out for a reported indication of 'postterm pregnancy' at less than 41+0 weeks gestation are more appropriately classified as non-medical. [12, 14] Some

researchers argue that inductions without other indications at less than 42+0 weeks should also be classified as non-medical.[55]

In many studies, elective induction is associated with a significant increase in the likelihood of delivery by cesarean section when compared with spontaneous labour.[9, 10, 56] This reported increase is most striking in nulliparous women, and among both nulliparous and multiparous women who require cervical ripening as part of an elective induction process.[12, 57, 58, 59] Dystocia, or non-progressive labour, is a common indication for cesarean sections carried out during elective induction. Decisions to perform a cesarean section for dystocia may be influenced by a longer latent and slow progressing early active phase of labour among women induced, particularly for those whose induction included cervical ripening.[10, 60]

Prior to any induction, a careful evaluation of gestation to consider fetal lung maturity is essential, and a thorough review of the risks of the intervention should be explained to the woman. When induction is being considered for non-medical reasons, it is particularly advisable to wait until the woman's cervix has ripened spontaneously. Studies have shown that the likelihood of cesarean section for dystocia during induction was considerably decreased if *spontaneous* ripening of the cervix had occurred.[10, 61, 62]

Methods of Cervical Ripening and Induction

Methods of induction include all interventions carried out to facilitate labour. A number of these interventions are aimed at cervical ripening, a process the cervix normally undergoes in the days or weeks prior to the onset of labour. Collagen begins to break down so that the cervix becomes 'favorable' as it softens, thins, becomes more pliable and begins to dilate.[63, 64] The condition of the cervix affects the likelihood that induced contractions will be effective and result in vaginal birth.

Cervical readiness for labour is generally quantified by the Bishop score. Features assessed for the Bishop score include dilatation, effacement, consistency and position of the cervix, and station. For each feature 0-3 points are assigned. A Bishop score of more than 8 is associated with a high likelihood of vaginal delivery following induction of labour[63], particularly if this score was achieved without artificial means to ripen the cervix.[9, 11, 57] A Bishop score of 6 or less indicates an unfavourable cervix. If induction is indicated and the Bishop score is 6 or less, taking steps to promote cervical ripening is recommended.[1, 63]

Methods of cervical ripening include application of mechanical devices such as balloon catheters, or administration of vaginal or intracervical prostaglandin. Many times these methods will be sufficient to stimulate contractions and induce labour. If labour does not ensue, or the cervix is already favorable for labour, the fetal membranes may be ruptured artificially and/or oxytocin used.

Mechanical Methods of Cervical Ripening

Mechanical methods of cervical ripening include application of a Foley catheter or cervical ripening balloon. These devices stimulate local release of prostaglandin by applying direct pressure on the cervix.[65] Mechanical methods have an advantage in terms of less risk of uterine tachysystole or hypertonus with an associated abnormal FHR when compared to administration of prostaglandin gel.[65] These methods currently offer the only option for a woman with a low Bishop score for whom delivery is advised and who chooses induction over repeat cesarean section. Another advantage involves those cases when there is an unripe cervix and an urgent need to proceed immediately with induction. Oxtyocin can be initiated at the time the balloon or Foley catheter is inserted.

Prostaglandin

There is much that remains unknown about the mechanisms that influence the onset and progress of labour, making it difficult to mimic spontaneous labour by medical or pharmacologic means. In addition to the practical challenges associated with the study of pregnant and labouring women, variations among women make it difficult to describe with certainty the physiologic activities and interactions that are factors in the process.

Prostaglandin breaks down connective tissue in the cervix, relaxing smooth muscle and facilitating dilatation by actions unrelated to uterine contractions.[66, 67] In addition to the local effect on the cervix, prostaglandin stimulates contractions by affecting calcium channels and intracellular calcium in the myometrium.[67] Prostaglandin has also been shown to facilitate sensitization of the myometrium to both endogenous and exogenous oxytocin.[68, 69] Additional studies have shown a complex association between prostaglandin and oxytocin in spontaneous labour, suggesting that each enhances the effect of the other.[69]

In the United Kingdom, guidelines of the National Collaborating Centre for Women's and Childrens' Health have recommended vaginal prostaglandin gel (PGE_2) (Dinoprostone, Prostin®) as the preferred agent for induction.[70, 71] Although acknowledging that administration of prostaglandin often results in labour, North American guidelines, i.e. the SOGC and the American Congress of Obstetricians and Gynecologists (ACOG) have focused on the use of prostaglandin for the purpose of cervical ripening. The exception in the United States is misoprostol (a synthetic PGE_1) which ACOG has described both for cervical ripening and induction.[63] Although widely used for these purposes in the United States, as of February 2012 misoprostol has not been approved for either ripening or induction in Canada, except in cases of induction following fetal demise, due to concerns about excessive uterine activity with use of misoprostol.[1]

In women with unfavourable cervices, PGE_2 has been shown to increase the success of achieving a vaginal birth within 24 hours.[72] As mentioned, the most commonly cited complication associated with the administration of prostaglandin is excessive uterine activity with or without resultant fetal heart rate changes.[1, 71] This complication is more commonly associated with controlled-release prostaglandin e.g. Cervidil® and has been reported 0.4 hours to 12 hours following insertion.[1, 71, 73] A distinct feature of Cervidil® is a retrieval string that allows for removal in the event of tachysystole, hypertonus or abnormal FHR. A reduction in the rate of cesarean section when Cervidil® is used compared to vaginal PGE_2 gel has not been demonstrated.[71] As noted previously, Cervidil® is not advised for use when the membranes have ruptured.

Prostaglandin is currently contraindicated for women attempting a VBAC (Vaginal Birth after Cesarean) because of an increased risk of uterine rupture.[74] Some researchers in the United States have suggested that, for those women who have had a previous vaginal birth in addition to a cesarean section, judicious use of prostaglandin might be considered.[75, 76] However, additional studies are required.

Studies looking at outpatient use of prostaglandin were insufficient to make recommendations about the practice[71] although many Canadian care providers have elected to give women the option to return home following administration of PGE_2 gel.

Dosing protocols are variable. A conservative approach is frequently advised in order to minimize the risk of adverse effects. Administration of 1 milligram of Prostin® gel may be followed, if necessary, with a subsequent dose of 2 milligrams in 6 or more hours. A maximum number of doses has not been established. Similarly, there is little advice about repeat applications of Cervidil®. Cervidil® is removed if fetal membranes rupture, labour begins, uterine

tachysystole or hypertonus occur and/or the EFM tracing becomes abnormal. Some references advise removing the insert after 12 hours while others suggest that if the desired effect is not achieved, it is acceptable to keep the Cervidil® in place for 24 hours.[77, 78] Oxytocin may be initiated 6 or more hours following administration of PGE_2 gel and 30 to 60 minutes after removal of Cervidil®.[1, 63]

Some clinicians have stated a preference for intracervical PGE_2 gel (Prepidil®) although ease of use and fewer reports of discomfort expressed by women during insertion have led to more widespread use of intravaginal PGE_2. No improvements in outcomes have been demonstrated when intracervical applications are used compared to intravaginal PGE_2.[72]

Amniotomy

Amniotomy or artificial rupture of the membranes (ARM) may be undertaken as the sole planned intervention to induce labour or more commonly in combination with other methods of induction. Amniotomy has been shown to increase levels of prostaglandin in the amniotic fluid and maternal plasma in much the same manner although perhaps in greater quantity as sweeping of the membranes.[79] ARM alone may be chosen to avert a potential excessive effect from pharmaceutical agents, particularly for women attempting a VBAC, or may be related to a woman's preference to avoid those medications.

Potential risks of amniotomy include prolapsed cord, particularly in the presence of a high presenting part, variable FHR decelerations, and infection, the risk of which increases with the length of time from rupture of the membranes until birth.[33, 80] There have also been reports that labour is more painful following rupture of the membranes.

Several studies have shown that most women with a favourable cervix will begin labour at some point following an ARM although the time interval may be longer

than preferred, particularly when there are significant medical reasons for proceeding with induction.[80] A retrospective study of nearly 5000 women induced in Ireland showed that 90% of women who had undergone an ARM for induction began to labour within 24 hours of the ARM.[81]

The Cochrane Review of Amniotomy plus Oxytocin for Induction of Labour (2010) reports a lack of evidence to promote these simultaneous interventions while acknowledging that they have been used in combination for many years. [82] Two studies found no difference in cesarean section rate when comparing induction by oxytocin alone versus oxytocin and amniotomy. A single study looking at amniotomy and comparing immediate with delayed oxytocin (4 or more hours following the ARM) found a shorter time to active labour, a shorter interval from amniotomy to birth and increased maternal satisfaction among those women induced with an ARM and immediate oxytocin.[83] There were no significant differences in the time to vaginal birth or births by cesarean section when comparing oxytocin and amniotomy with administration of vaginal prostaglandin.[82]

Oxytocin

Endogenous oxytocin is synthesized primarily in the maternal hypothalamus and transported to the pituitary from where it is released in a pulsatile fashion. The frequency of the pulses increases over the course of spontaneous labour. Studies have shown that oxytocin is also produced in the ovaries, uterus and fetal membranes with high levels found in umbilical cord blood, suggesting production of oxytocin by the fetus during labour.[64, 67] The mechanism of production and the triggers for its release into the maternal circulation are largely unknown.[69] The plasma concentration of oxytocin is relatively constant during latent and active labour, increasing significantly during second stage.

Oxytocin binds to receptor cells, which increase in number prior to the onset of spontaneous labour, particularly in the fundus. This corresponds to a parallel increase in uterine responsiveness to oxytocin.[64] Oxytocin stimulates the actions of muscle fibers in the myometrium by increasing the intracellular concentration of calcium.[67, 69] Gap junctions have been described as 'specialized protein units' within the cell membrane. They promote synchronization of muscle action, resulting in contractions that are coordinated and effective.[69]

Oxytocin for labour induction is given by intravenous infusion with the dosage titrated in a step-wise fashion according to a prescribed protocol. Potential adverse effects include tachysystole or uterine hypertonus.[18] Tachysystole and hypertonus have been known to result in severe maternal and fetal consequences including abruption, uterine rupture, fetal hypoxia, and fetal acidosis.[84]

In spite of widespread use in Labour and Birth Units in Canada, oxytocin was added to the Institute of Safe Medication Practices (ISMP) list of 12 high-alert medications in 2007. High-alert medications are those for which there is a 'heightened risk of causing significant patient harm' when used in error.[85] The list includes, among others, potassium chloride, methotrexate, nitroprusside, and promethazine.

There have been efforts to understand factors that contribute to errors related to oxytocin use. First, there is a wide range in uterine response to this medication. Most significant is what has been described as an unpredictable therapeutic index that may vary widely among women. For example, a relatively small dose may have a negligible effect for some women, while in others, hypertonus will occur at that same small dose.[86]

Second is a tendency for those caring for women during oxytocin induction to disregard tachysystole and hypertonus that occur in the absence of an abnormal

FHR. There is an inclination to accept excessive uterine activity as harmless until such time as the EFM tracing suggests adverse fetal effects. Patient safety experts have classified this acceptance as 'normalization of deviance'. Some have speculated that because of the frequency that tachysystole is seen in clinical practice in the absence of an abnormal FHR, many health professionals have come to dismiss this finding and have failed to act according to recommended standards and guidelines.[17]

Another term commonly used to describe this approach is 'pit to distress'. In this situation, the caregiver continues to increase the rate of oxytocin infusion in spite of excessive contractions, until the fetus shows signs of compromise. This practice was frequently acknowledged during the RCP QA Reviews. There are many examples in the literature that describe conflict between physicians and nurses with respect to this approach.[17, 87] Nurses acknowledged that although it contravenes hospital policies and standards of care, many continue to follow an order from a physician who encourages the nurse to 'push the pit' and to increase oxytocin at regular intervals regardless of uterine response.

During contractions, maternal blood flow to the uterus and placenta is interrupted. Relaxation of the uterus between contractions allows the placenta to be re-perfused and the oxygen supply for the fetus to be replenished.[88] The interruption in blood flow is generally well tolerated by the healthy fetus during normal, physiologic contractions. Excessive uterine activity i.e. tachysystole or hypertonus is associated with an increased risk of fetal acidosis at birth.[16] Some have argued that acidosis is less likely to occur when contractions, although frequent, are mild and non-painful, and that a normal FHR pattern offers reassurance that these excessive contractions are well tolerated. However, this cannot be confirmed. One study evaluating fetal oxygenation in the presence of tachysystole concluded that desaturation begins within 5 minutes of excessive uterine activity and more than 20 minutes before FHR changes appear.[15] Another

study, also utilizing fetal pulse oximetry, noted that recovery from desaturation is incomplete when there is insufficient relaxation between contractions.[89]

Administration of oxytocin is an issue in many cases of litigation related to fetal injury. What might not be expected is that excessive uterine activity has been cited as a factor in court decisions even when a direct causal relationship between the excessive uterine activity and the adverse outcome cannot be made.[90] A Canadian decision in 1997 highlights the peril of discounting features of the EFM tracing such as excessive uterine contractions. In that case the defendants were found negligent for disregarding what the judge described as 'very frequent contractions with inadequate periods of relaxation in between'. The FHR portion of the tracing in that case was described only as 'somewhat flat' with no mention of decelerations or other abnormal features.[91]

Much has been written about the safe use of oxytocin. Patient safety experts recommend standardized order sets in which oxytocin is ordered and documented in milliunits per minute (mU/min) and the process for preparing and titrating the infusion is clearly described.[19, 84, 92] Protocols are broadly classified as high-dose and low-dose and differ with respect to starting dose, incremental dose and dosage interval. Following the high-dose protocol, oxytocin is initiated at 4 to 6 mU/min and increased by 4 to 6 mU/min every 15 to 30 minutes.[63, 93, 94, 95] Advocates of the high dose protocol cite a decreased length of labour and a trend towards a reduced cesarean section rate when this protocol is used. [93, 94] However, tachysystole is more commonly associated with the high-dose protocol. Water intoxication, although rare, is another complication that has been linked to administration of high doses of oxytocin, particularly when non-electrolyte intravenous solutions are used.[93] A recent study of severe postpartum hemorrhage found that women exposed to greater amounts of oxytocin, high maximum doses of oxytocin, and/or longer durations of oxytocin infusion were more likely to experience severe postpartum hemorrhage secondary to uterine atony.[96]

Many patient safety advocates recommend a conservative approach, using the lowest dose of oxytocin possible to stimulate contractions that are of normal intensity, frequency and duration, mimicking normal labour.[15, 84] Using the low-dose protocol, oxytocin is initiated at 0.5 to 2 mU/min and increased by 1 to 2 mU/min every 30 to 60 minutes.[93, 94] The rate of the infusion should be increased with care to avoid tachysystole and according to maternal and fetal response. Contractions and uterine resting tone should be constantly assessed. It is important that all who care for women during induction of labour (and cervical ripening) use the EFM safely and appropriately, as recommended by the SOGC.[18]

There is no universally accepted maximum dosage of oxytocin for induction. Studies have shown that the majority of women will achieve adequate contractions with oxytocin infusions of 6 to 8 mU/min.[93, 97] There has been debate about how long oxytocin should be maintained once labour becomes established. A study in the U.K. concluded that uterine receptors become desensitized after more than 10 hours *of labour* i.e. after labour is established during intravenous oxytocin administration.[98] Another concluded additionally that continuing oxytocin once active labour is reached is of no advantage.[97] Both studies demonstrated a decreased sensitivity of receptors to exogenous oxytocin with increased cervical dilatation. Interestingly this effect was not seen in labour that was spontaneous and progressing without augmentation.[97, 98]

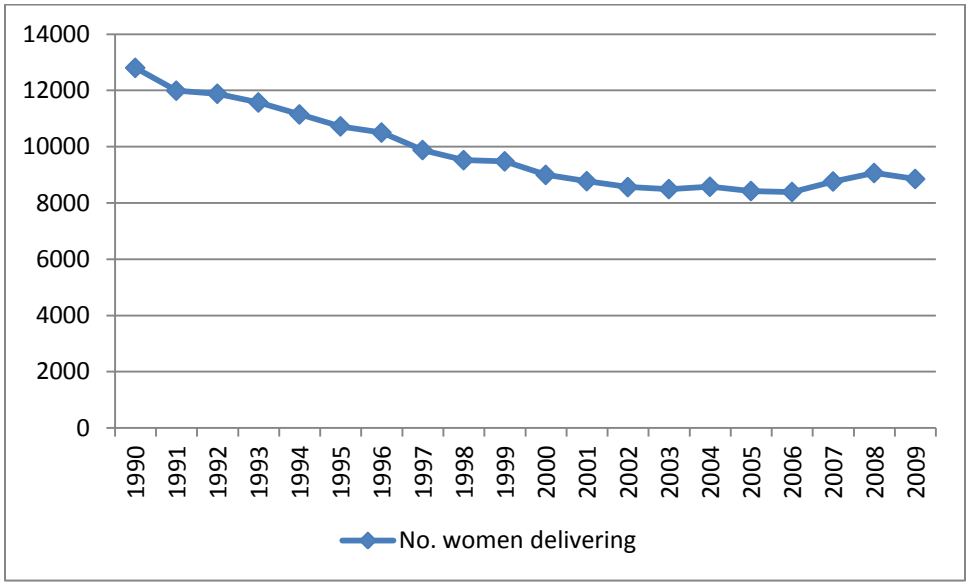
In recent years patient safety advocates have further proposed using basic, procedure-specific checklists to promote safety around the use of oxytocin. Checklists have successfully contributed to safety improvements in the aviation industry. They have gained favour in health care for reducing complications among surgical patients and others undergoing procedures with a high-risk of adverse outcomes, including administration of high-alert medications.[99, 100, 101] While some clinicians have objected to a perceived lack of appreciation for

individual practice preferences, experience has shown a dramatic reduction in errors and adverse events with consistent use of checklists.[99, 100] The major benefits have resulted from improved team work and communication[99] and utilizing a single, uniform practice.[100, 102] Examples of checklists related to oxytocin developed by the Perinatal Safety Division of the Hospital Corporation of America (HCA) are appended to this report and can be found at:
http://www.idahoperinatal.org/documents/FinalMedicationSafetyOxytocinInUse2009.pdf
http://www.idahoperinatal.org/documents/FinalMedicationSafetyOxytocinList2009.pdf
Please note that these are samples only and reflect practices that are standard in the United States.

The Nova Scotia Experience: Quantitative Findings

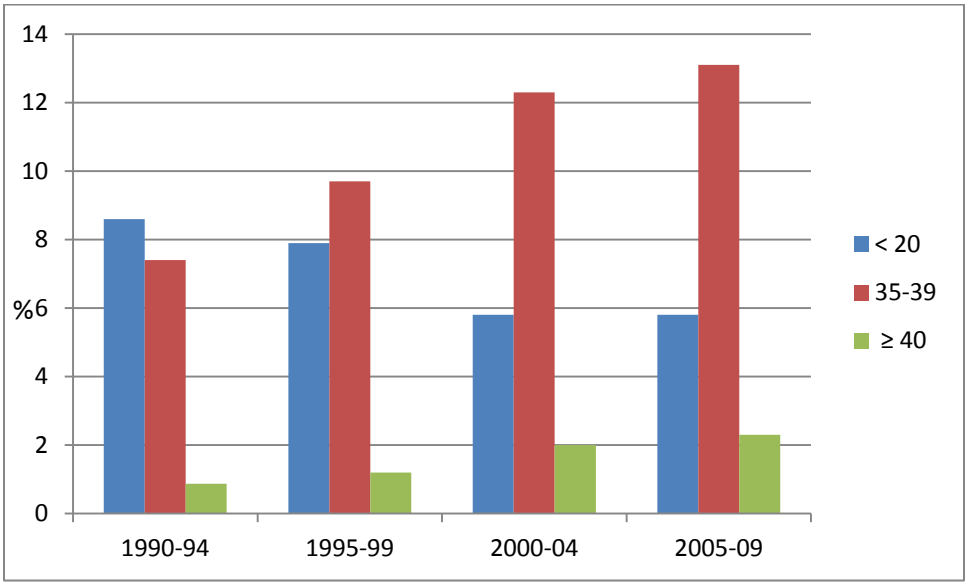
The number of women giving birth in Nova Scotia declined steadily during the 1990's, with a gradual leveling off since 2000 (figure 1).

Figure 1 - Total births at facilities in Nova Scotia 1990 to 2009



The proportion of women giving birth at less than 20 years of age decreased slightly over the 20 year period from 8.6% in 1990 to 1994 to 5.8% in 2005 to 2009 (figure 2). The most obvious change was among women 35 to 39 years old. The proportion in that age range increased from 7.4% in 1990 to 1994 to 13.1% in 2005 to 2009. The proportion of women aged 40 and over, although smaller, has shown a steady increase in the 20 year period.

Figure 2 - % of women delivering at < 20 years, 35-39 years and ≥ 40 years

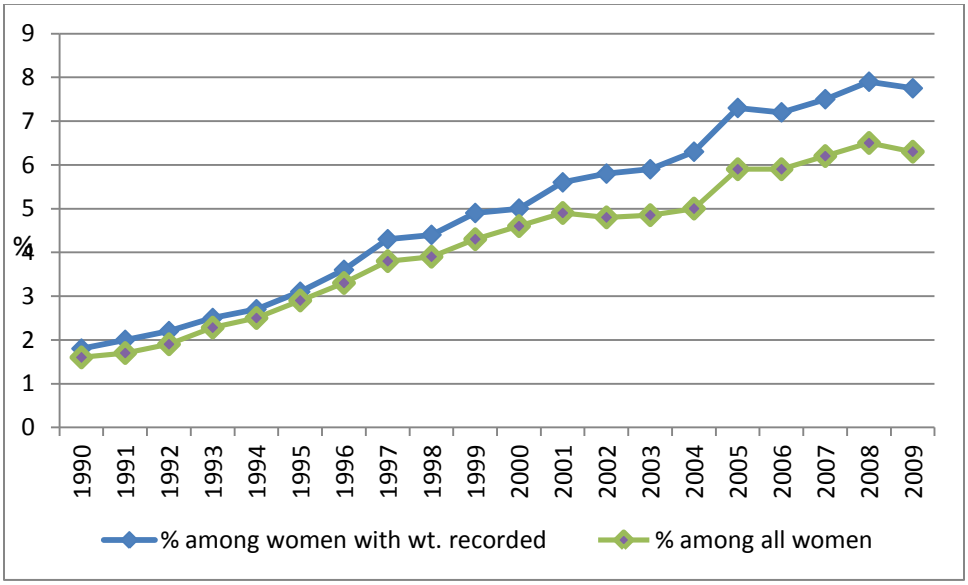


Much has been written about the rising incidence of obesity in the population of pregnant women. Maternal and perinatal risks associated with obesity include hypertension, increased likelihood of cesarean section, anesthetic complications, gestational diabetes, placental dysfunction, postpartum hemorrhage and stillbirth.[103, 104, 105] Concern about the extent of the problem of obesity was raised many times and in all facilities during the QA Review.

BMI (body mass index) has been captured in the NSAPD since 2009. Prior to 2009, a pre-pregnancy weight of 100 Kg or more was the variable that indicated

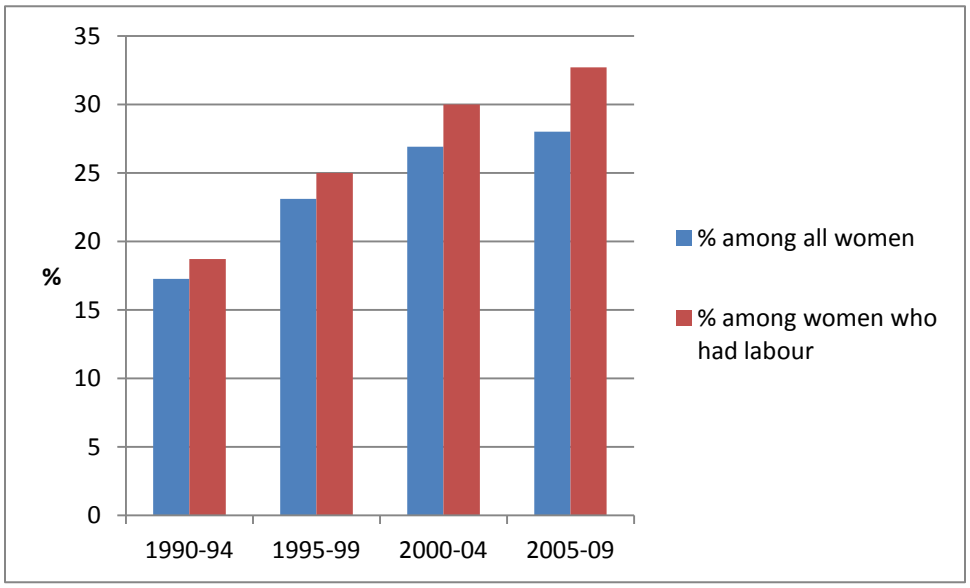
obesity. In spite of widespread concern, maternal weight was not recorded for a large number of births, in 8.3% of cases in 1990 to a high of 20.8% in 2008. Because of this the following graph is presented to illustrate the rate of pregnancy weight ≥ 100 Kg as calculated for only those for whom weight was recorded and for all women delivering (figure 3). Among women with weight recorded, the percentage with weight ≥ 100 Kg increased from 1.8% in 1990 to 7.8% in 2009.

Figure 3 - % of women with pregnancy weight ≥ 100 Kg



From 1990 to 1994, 17.6% of all women giving birth in NS had labour induced (figure 4). This percentage increased to 28% in 2005 to 2009. Conversely, the number of women experiencing spontaneous labour decreased from 71.7% in 1990 to 1994 to 57.4% in 2005 to 2009. Data were further selected to look at labour only, taking the cases of cesarean section without labour out of the equation. Considering only those women who had labour, the rate of induction increased from 18.7% in 1990 to 1994 to 32.7% in 2005 to 2009. Additionally, 77.6% of women who laboured experienced spontaneous labour in 1990 to 1994 decreasing to 67.2% in 2005 to 2009.

Figure 4 - Induction of labour all NS 1990 to 2009



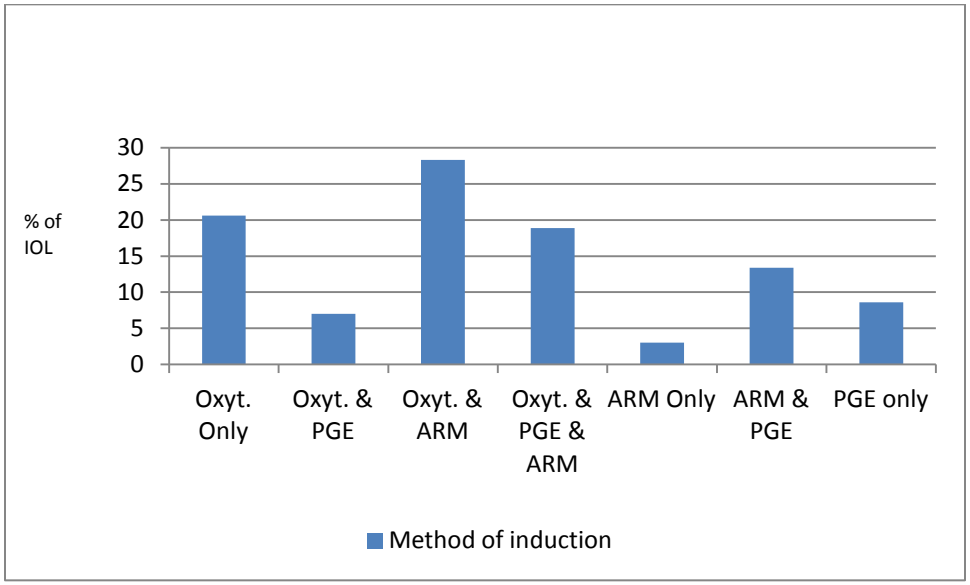
From 2004 to 2009 the rate of induction of labour among all women delivering varied by District Health Authority (DHA), with a low of 18.6% to a high of 31%. A rate of more than 30% was recorded in 3 provincial Districts. The rate of induction among women with labour exceeded 30% in 5 Districts (figure 5)[b].

Figure 5 - Induction of labour by DHA 2004 to 2009

[b] District specific data is provided to each DHA; however, individual Districts are not identified in this report.

A variety of methods have been utilized to induce labour (figure 6). In the years 2004 to 2009, oxytocin was used most often for induction, administered either alone or in combination with other methods in 74.5% of inductions. Three percent of inductions were carried out by artificial rupture of the membranes (ARM) alone. ARM was utilized in combination with other methods in more than 60% of inductions. Prostaglandin E_2 was administered alone in 8.6% of inductions and in combination in 39.4% of inductions. Mechanical methods involving insertion of a Foley catheter or cervical ripening balloon were not captured in the NS Atlee Perinatal Database (NSAPD) prior to 2010.

Figure 6 - Method of induction 2004 to 2009



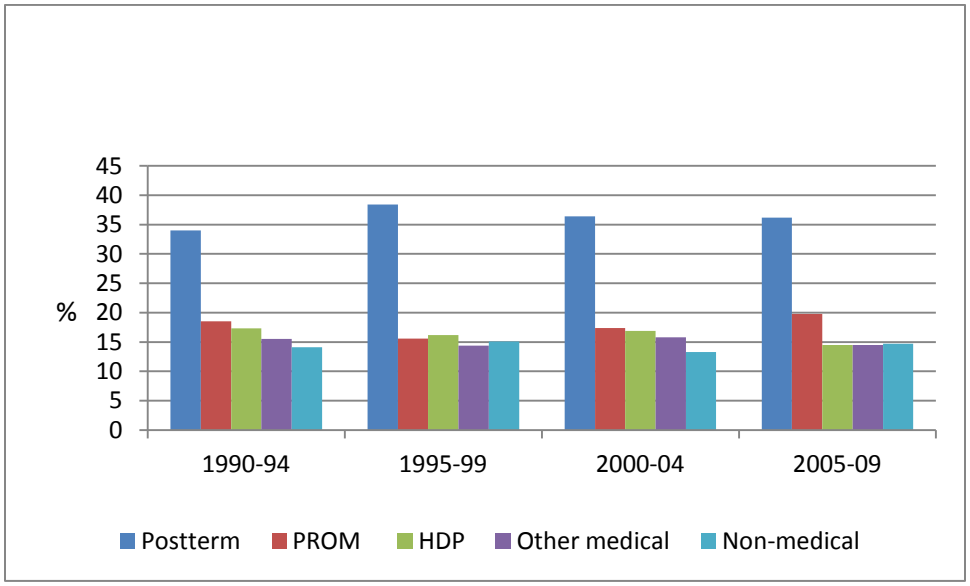
Indications for Induction

For each woman induced the indication is recorded on the health record and entered, as documented, into the NSAPD by health information professionals in Health Records Departments. In addition to the most common reasons for induction i.e. postterm pregnancy, PROM and hypertensive disorders of

pregnancy, other documented indications include, among others, diabetes, low fetal planning score, fetal death, advanced maternal age and maternal choice. For the purposes of this report, except for the most common, indications have been organized according to 'other medical' or 'non-medical' indications. In addition to maternal choice, examples of non-medical (or elective) reasons for induction include a history of precipitous labour, 'social', and 'geographic' i.e. maternal residence a significant distance from the hospital for birth.

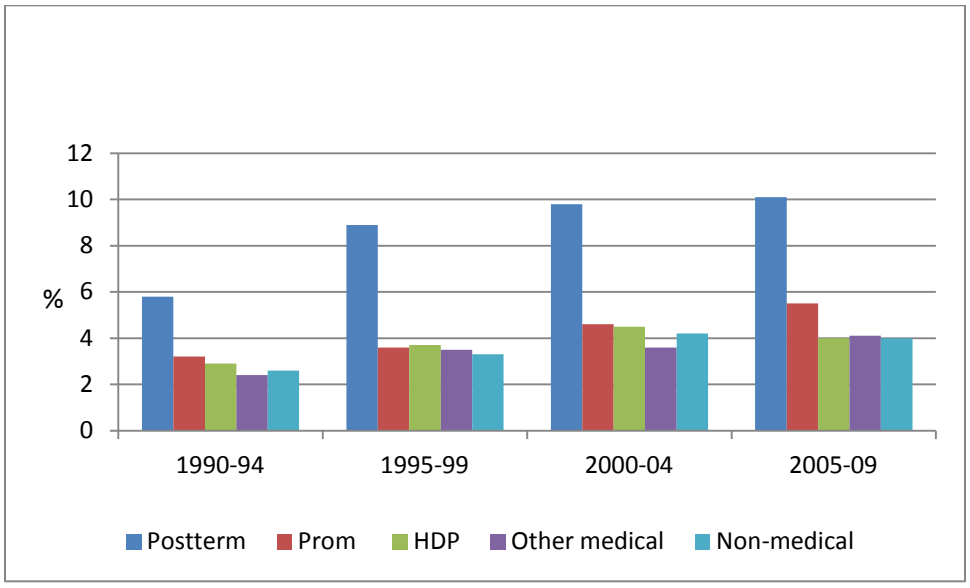
From 1990 to 2009 the indications for induction remained consistent for the most part in terms of contribution to the induction rate (figure 7). Postterm pregnancy was cited as the indication in 34% of all inductions in 1990 to 1994 and in 36.2% of inductions in 2005 to 2009.

Figure 7 - Indications for IOL; % of all inductions 1990 to 2009



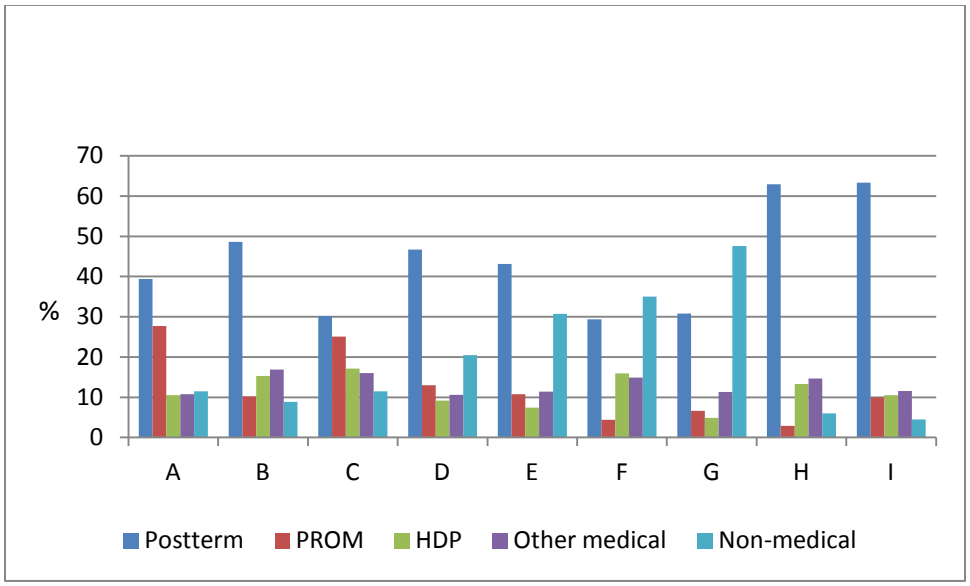
Induction as a percentage of births increased for all indications in each 5-year epoch from 1990 to 2009 with the exception of 'non-medical' which remained essentially constant at 4% from 2000 to 2009 (figure 8). The percentage of inductions for postterm pregnancy among all women delivering increased dramatically, nearly doubling, from 5.8% in 1990 to 1994 to just over 10% in 2005 to 2009.

Figure 8 - Indications for IOL; % of all births 1990 to 2009



Indications for induction varied by DHA (figure 9). For example, from 2004 to 2009 postterm pregnancy was the most common indication for induction in all but two districts. In those two Districts, non-medical indications accounted for the majority of the inductions.

Figure 9 - Indications for IOL by DHA; % of all inductions 2004 to 2009



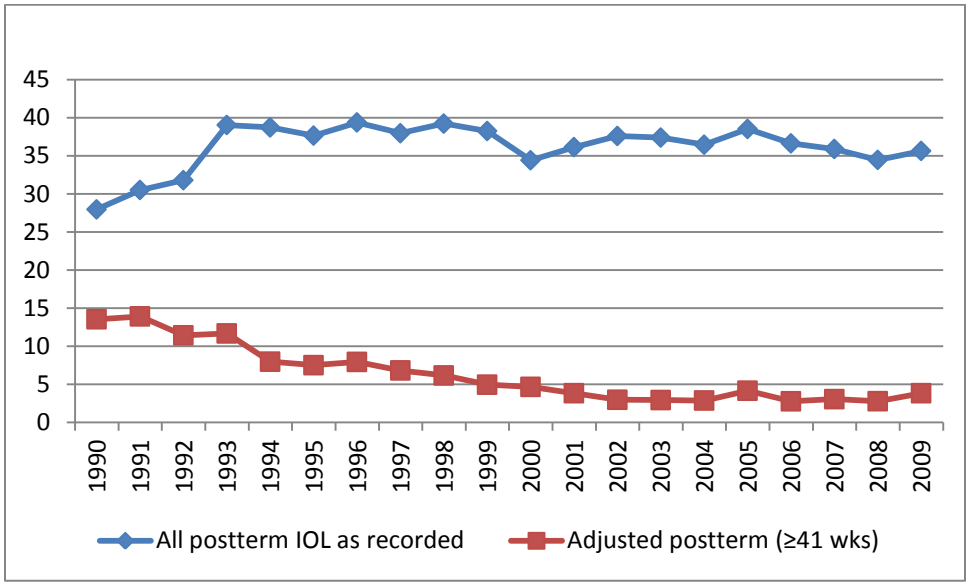
As mentioned, the number of inductions for postterm pregnancy has continued to rise. Variability exists both in the literature and in clinical practice regarding the appropriate timing of induction for postterm pregnancy. Adhering to the definition of postterm pregnancy, those inductions for postterm pregnancy at less than 41+0 weeks (and some may argue at less than 42+0 weeks) are inaccurately categorized. Unless there are other medical indications for inducing labour, these inductions should perhaps be classified as 'non-medical'.

Gestation has traditionally been determined in the NSAPD using the LMP and comparing it with the gestational age assigned at the time of birth. The gestational age estimated by clinical assessment is used only if it differs from the gestational age calculated from the LMP by more than 21 days. Additional

database algorithms for determining gestation have been developed and allow gestation to be calculated from prenatal variables only, i.e. LMP and results of prenatal ultrasounds. Using only LMP and ultrasound estimates of gestation, more than 80% of women induced for postterm pregnancy were less than 41+0 weeks gestation at the time of delivery.

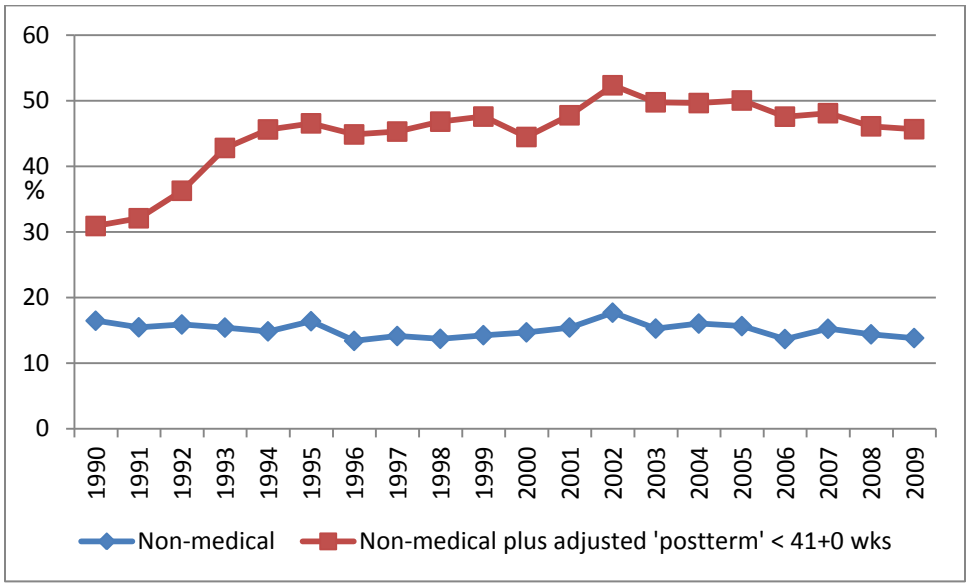
Reorganizing the data to restrict inductions for postterm pregnancy to only those with gestation at least 41+0 weeks dramatically alters the results (figure 10). For the years 1990 to 2009, postterm pregnancy as a proportion of inductions decreased from 36.4% (8.4% of all women) to 6% (1.4% of all women) when inductions for postterm pregnancy were limited to only those at ≥ 41+0 weeks.

Figure 10 - Postterm induction as % of all inductions 1990 to 2009



When postterm inductions for women less than 41+0 weeks were categorized as non-medical, non-medical inductions as a percentage of all inductions increased from 15% (3.5% of all women) to 45.4% (10.6% of all women) (figure 11).

Figure 11 - Non-medical induction as % of all inductions 1990 to 2009



Maternal Outcomes

Operative birth is frequently cited as a risk factor of induction of labour[1, 57, 59] In Nova Scotia, women induced were more likely to undergo cesarean section than those who experienced spontaneous labour without augmentation. From 2004 to 2009, 21.7% of women induced were delivered by cesarean section while 8.3% of women who laboured spontaneously underwent a cesarean section. Women undergoing induction were more likely to experience an operative vaginal birth than women who laboured spontaneously, 12.2% of women induced compared to 7.1% of those who laboured spontaneously without augmentation (figures 12 and 13).

Figure 12 - Method of delivery by type of labour 2004 to 2009

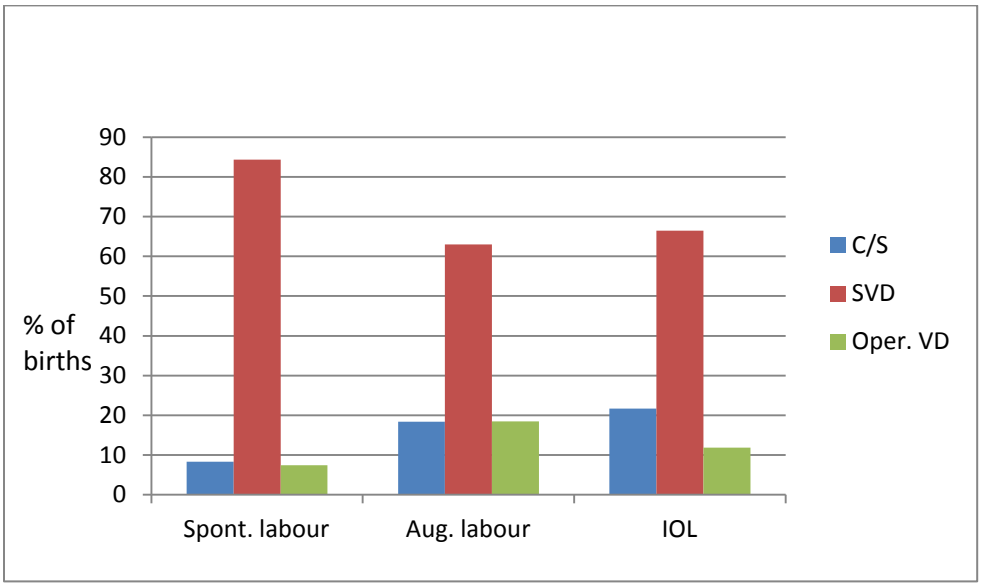
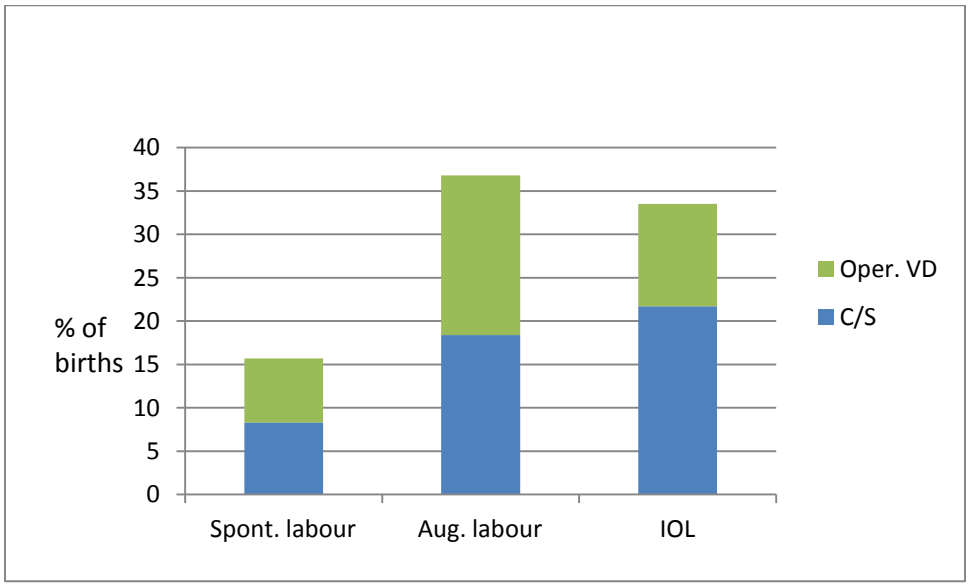


Figure 13 - Rate of cesarean section and operative vaginal delivery by type of labour 2004 to 2009

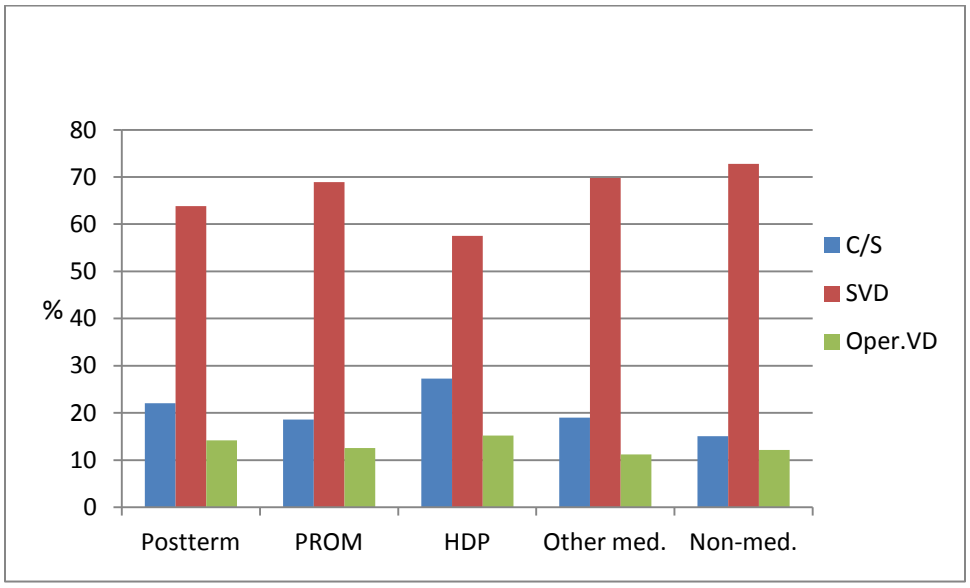


The rate of cesarean section was highest among women induced for hypertensive disorders of pregnancy (HDP) compared to the rates among

women induced for other reasons (figure 14). For example, of those induced for HDP, 27.3% were delivered by cesarean section, compared to 15.1% among women induced for non-medical reasons.

Figure 14 - Type of delivery by documented indication for IOL

1990 to 2009



Inductions for HDP continued to have the highest associated cesarean section rate even after adjusting the data to add postterm inductions < 41+0 weeks to the category of non-medical inductions. Interestingly the cesarean section rate for both postterm and non-medical inductions increased following those adjustments. The cesarean section rate among women induced for postterm pregnancy increased from 22% to 24 % while the rate associated with non-medical inductions increased from 15.1% to 19.5%.

From 2004 to 2009, dystocia was the indication for 52.6% of cesarean sections carried out following induction of labour. Further, dystocia following induction was the indication for 25.1% of all cesarean sections undertaken during labour. Abnormal FHR during induction of labour was the second most common indication for cesarean section, accounting for 33.4% of all cesarean sections

among women induced and 15.9% of all cesarean sections during labour (figures 15 and 16).

Figure 15 - Indication for C/S - % of all C/S following IOL
2004 to 2009

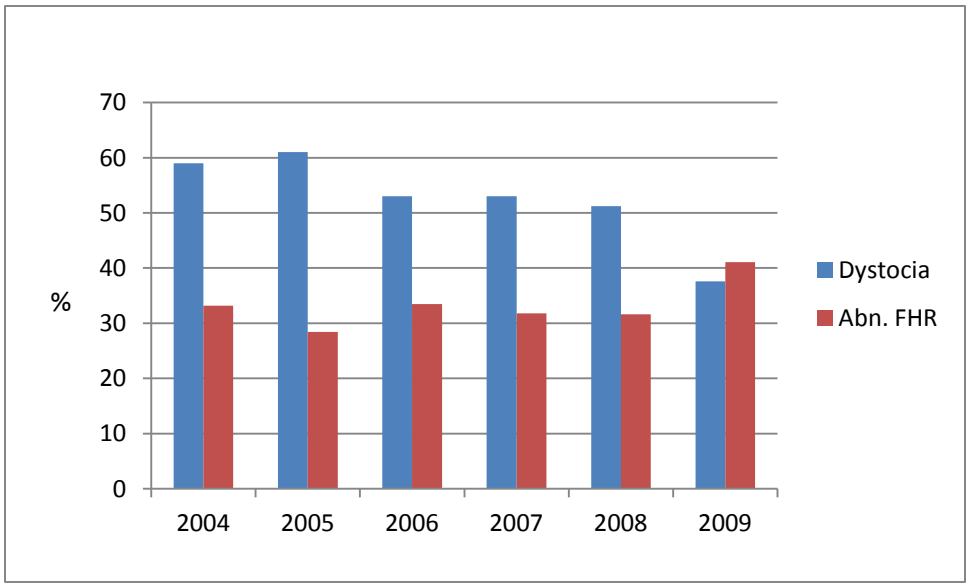
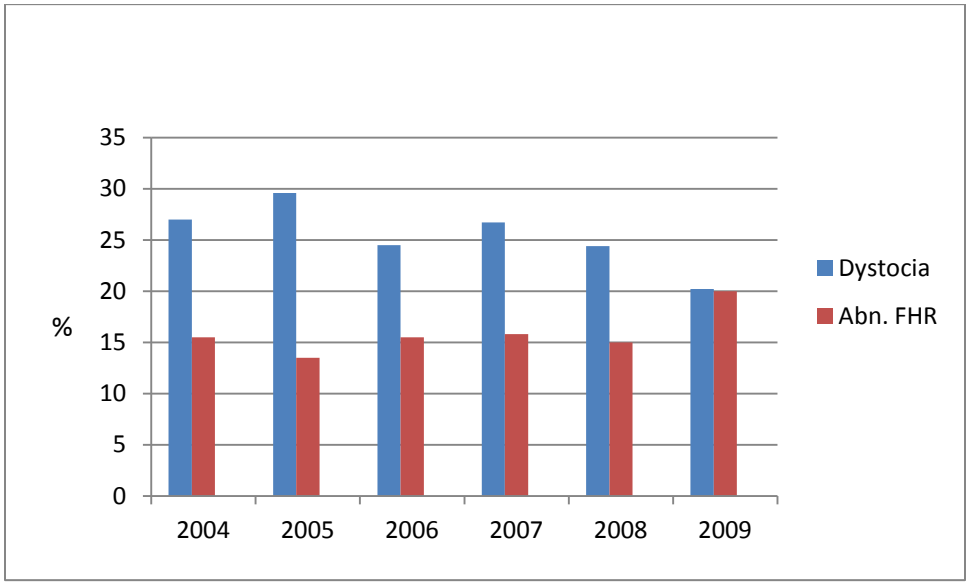
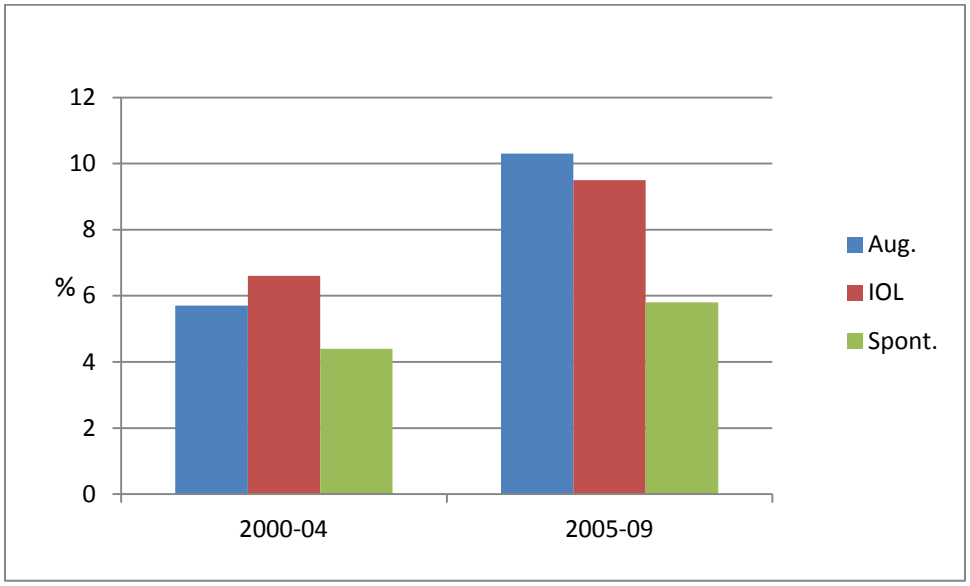


Figure 16 - Indication for C/S following IOL - % of all C/S during labour
2004 to 2009



An increase in the incidence of postpartum hemorrhage has been reported worldwide. In Nova Scotia this trend has been noted particularly since 2000 to 2004. The rate among women with labour rose from 5.4% in 2000 to 2004 to 8.4% in 2005 to 2009. Although the reasons have not been identified with certainty, the increase cannot be attributed solely to changing demographics.[106] What is also noteworthy is a significantly higher rate of postpartum hemorrhage among women undergoing induction or augmentation[3] (figure 17). In Nova Scotia, the rates of postpartum hemorrhage following induction or augmentation over the 10 year period from 2000 to 2009 were 7.8% and 8.3% respectively compared to 5% following spontaneous labour.

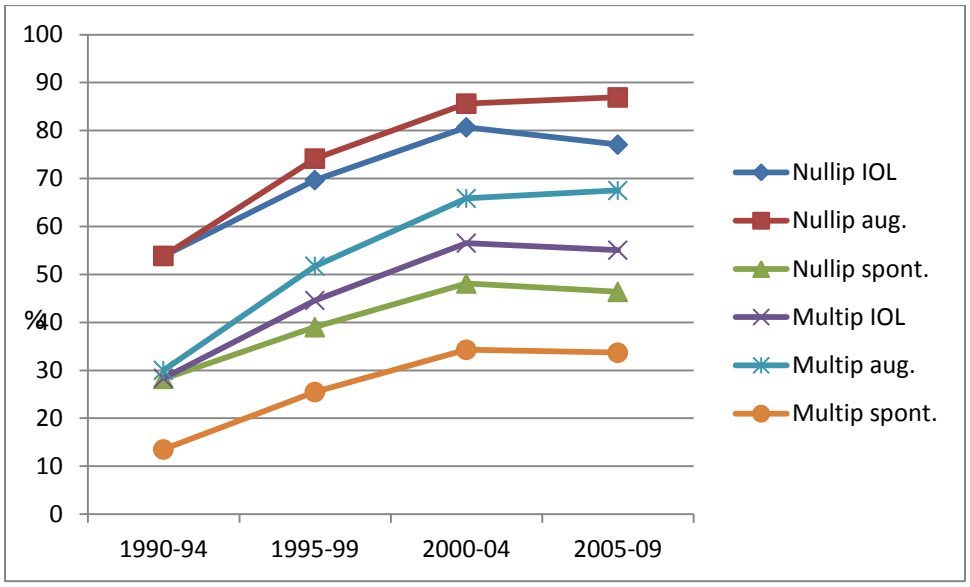
Figure 17 - Postpartum hemorrhage by type of labour
2000 to 2009



Epidural analgesia has become more common in Nova Scotia since 1990 (figure 18). The increase in use of epidural analgesia is noticeable among all women with labour regardless of parity or type of labour, particularly from 1990 to 1994 (28.6%) and 2000 to 2004 (56.6%), with the rate virtually unchanged (56.9%) in 2005 to 2009. There has consistently been a greater usage of epidural analgesia

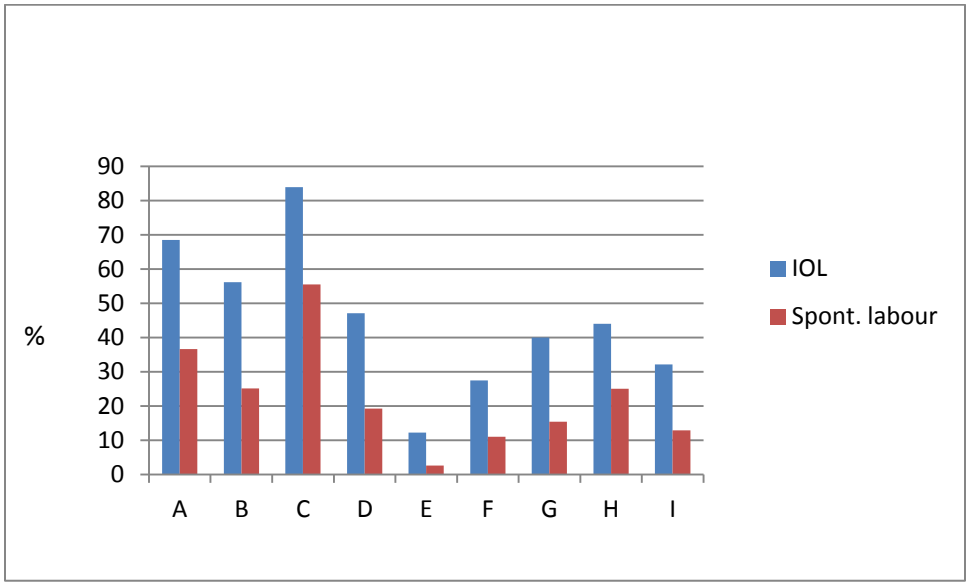
among both nulliparous and multiparous women during induced or augmented labour when compared to spontaneous labour. In 1990 to 1994, 42.2% of women undergoing induction and 49.2% of women whose labour was augmented received epidural analgesia compared to 19.2% of women who laboured spontaneously without augmentation. In 2005 to 2009, 67.6% of women induced, 81% of women whose labour was augmented and 38.3% of women who laboured spontaneously received epidural analgesia.

Figure 18 - Epidural analgesia during labour by type of labour and parity 1990 to 2009



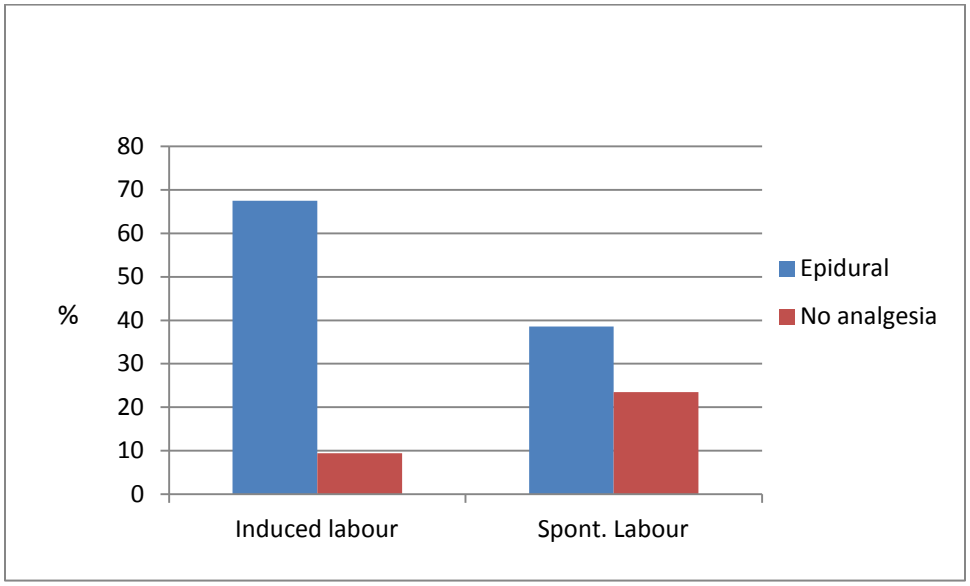
The overall increase in use of epidural analgesia in the province may be attributed in part to expanded anesthesia services in some facilities. Rates still vary widely among Districts. Regardless of the frequency that epidural analgesia was utilized in each District in 2004 to 2009, there was a marked increase in the rate of epidural analgesia among women induced when compared to those who experienced spontaneous labour (figure 19).

Figure 19 - Epidural analgesia in induced and spontaneous, not augmented labour by DHA 2004 to 2009



From 2004 to 2009 the proportion of women who experienced unmedicated labour differed noticeably as well (figure 20). Of women induced, 9.4% received no analgesia during labour whereas 23.6% of those who experienced spontaneous labour without augmentation received no analgesia.

Figure 20 - Analgesia during induced and spontaneous, non-augmented labour all NS 2004 to 2009

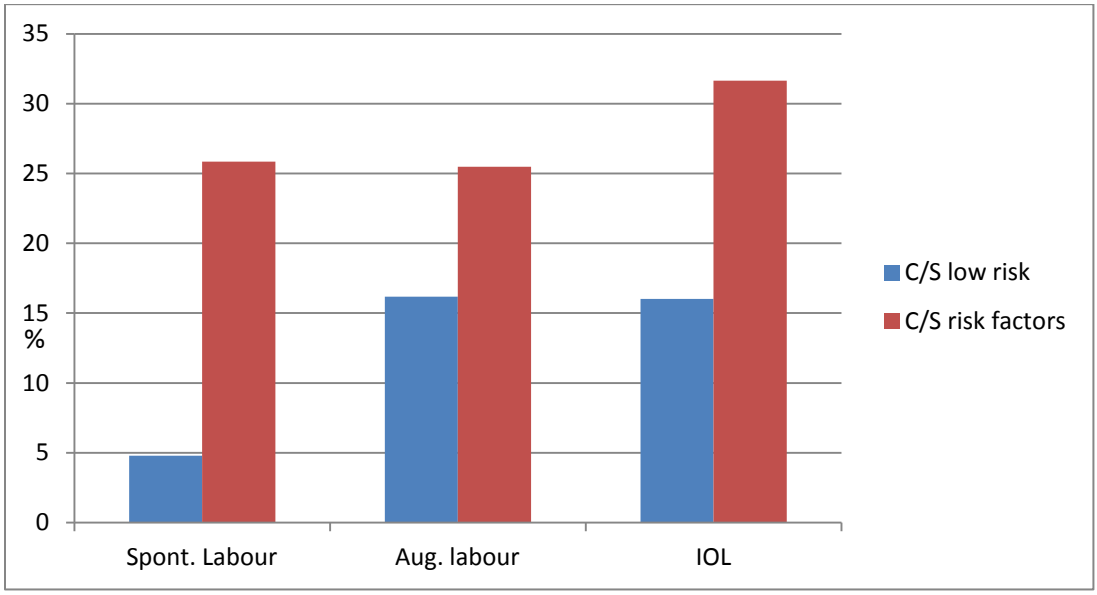


Nearly one-half (47.3%) of the pregnancies delivered in Nova Scotia from 1990 to 2009 were low risk, defined as singleton, cephalic presentation, 37+0 to 41+0 weeks gestation, and without medical, pregnancy or fetal complications. Among low risk women, 16.4% experienced induction such that 33.4% of all inductions were carried out in the population of low risk women.

Women with risk factors were more likely to undergo cesarean section during labour; however, there was a notable increase in the rate of cesarean section following induced labour for both those with risk factors and for low risk women (figure 21). The cesarean section rate among women with risk factors who laboured spontaneously without augmentation was 25.9%, increasing to 31.7%

following induction. The cesarean section rate for low risk women during spontaneous labour was 4.8% compared to 16 % among those induced.

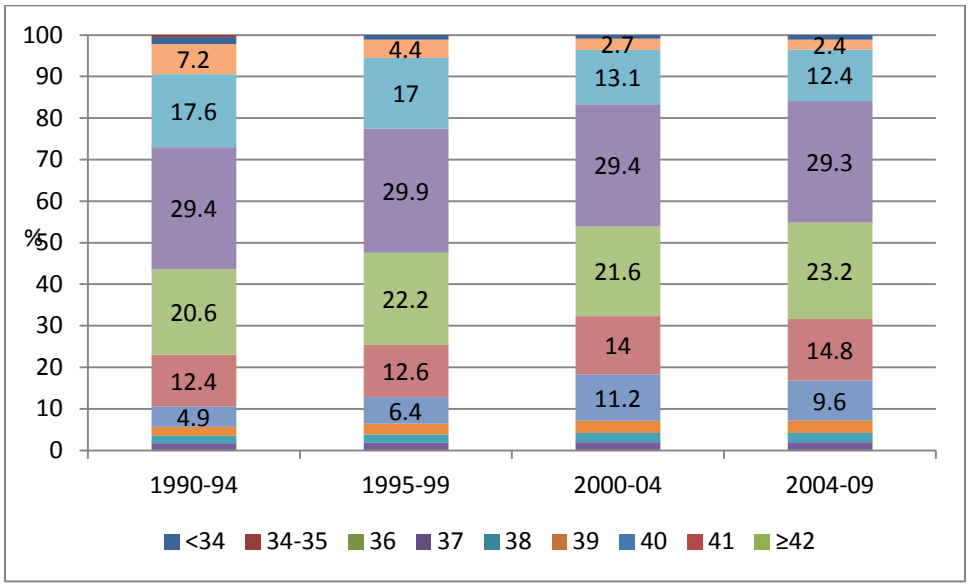
Figure 21 - C/S rate by type of labour for low risk women and women with risk factors 1990 to 2009



Neonatal Outcomes

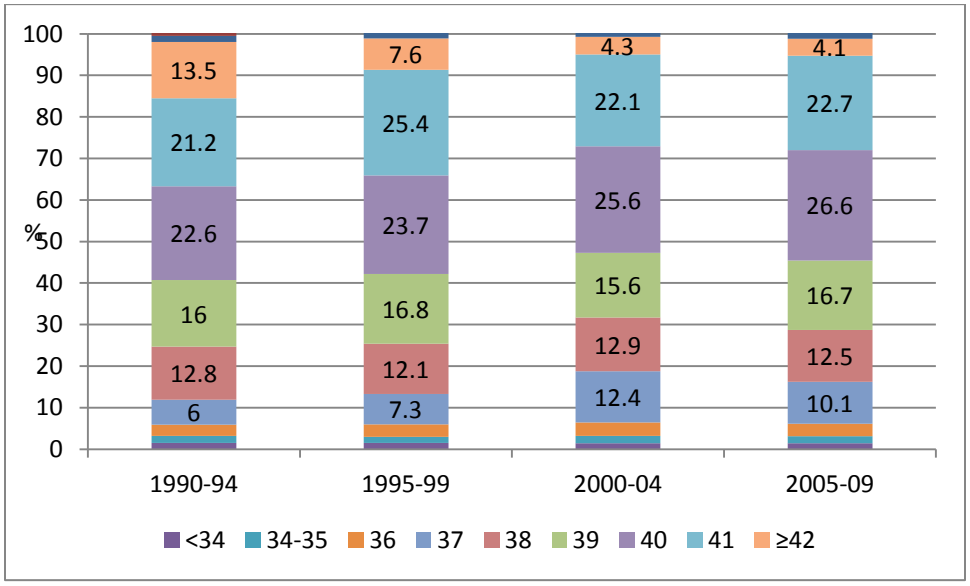
Another commonly cited risk of induction is inadvertent delivery before term. This is more likely to occur in the late preterm period i.e. 35+0 to 36+6 weeks gestation. The number of late preterm births is increasing globally and in Nova Scotia (figure 22). This can be attributed in part to a corresponding increase in multiple births.[1] Although babies at this gestation often are well and cared for as 'term', there is a significant increase in neonatal morbidity and mortality in this population.[6, 107, 108]

Figure 22 - Gestation at birth - all births all NS



It is important to carefully evaluate gestation to consider potential risks to the newborn prior to induction. Examining the data from 2000 to 2009, 43% of inductions were carried out at 36+0 to 39+6 weeks gestation (figure 23).

Figure 23 - Gestation at birth - induced labour all NS



Neonatal outcomes in the Nova Scotia postterm population (41+0 weeks gestation or greater) were reviewed, comparing outcomes following induction to those following spontaneous labour or cesarean section without labour. From 1990 to 2009 there was no significant difference in the rate of moderate to severe respiratory distress syndrome (RDS), need for resuscitation, cord artery pH value ≤ 7.0, or 5 minute Apgar score < 7. However, there was a significant difference in the proportion of babies admitted to NICU: 8.2% following induction for postterm pregnancy compared to 6.4% delivered without induction.

The Nova Scotia Experience: Qualitative Findings

Community Factors

During focus groups new mothers were asked about their understanding of induction and their choices for labour. A range of opinions was expressed. Several reported that they had asked to be induced as they reached term in order to 'get things over with' and end the discomforts of late pregnancy. These women were mostly pleased with the experience and indicated that they would likely seek induction again in a subsequent pregnancy. Many participants of the focus groups had experienced contractions and gone to the hospital thinking that labour had begun only to be sent home after it was determined that they were 'not in labour'. They remembered this as a source of disappointment and frustration. One woman who had gone to the hospital several times described a feeling of relief when her membranes ruptured because she understood that she would now be induced and not sent home again to await labour.

Distance from a woman's residence to the hospital for birth may be a factor in decisions to undergo induction. There is little or no public transportation in rural communities. Driving in the winter months may be hazardous and concern about impending bad weather often contributes to a woman's anxiety as she awaits

labour. For these reasons, induction may be offered in order to ensure a woman is able to safely reach the hospital for birth.

Some of the women who were still pregnant during the focus groups expressed the desire to avoid induction in order to experience a more natural, spontaneous labour and birth. Others were fearful of induction because it had been described to them as painful and invasive by friends or family members who had been induced. Several of the mothers who had undergone induction expressed a wish to avoid it in a subsequent pregnancy. They described feeling unprepared for the experience and restricted by the oxytocin infusion and continuous fetal monitoring.

Most women reported that they relied on family and friends for information about pregnancy, labour and birth and many accessed information through Internet searches. Several times the RCP review team heard from women that they focused on evidence-based web-sites, suggesting that women are using the Internet judiciously looking for reliable sources of information. In one case a woman described her reason for avoiding induction as a fear of initiating a 'cascade of interventions', a potential consequence that was described on an Internet site. When asked to elaborate about the interventions, this woman gave as examples having her membranes ruptured and electronic fetal monitoring. When questioned specifically, a number of women reported that they had had little discussion with care providers about induction even as a decision to induce labour was being made. They stated that they were given a broad description of the process but little detail about how induced labour might differ from spontaneous labour and what complications might occur.

A number of women described situations in which there was more than one health professional involved in their care, and a difference of opinion existed among those health professionals about whether and when an induction might be indicated. This was particularly concerning when an induction that had been

scheduled with one physician was postponed by another. Inconsistent information was identified as a source of frustration for women and families as well as for health professionals, and may undermine trust in the relationship between a woman and the health professionals involved in her care. Trust is an important component of quality maternity care.[109, 110] In addition to a woman's satisfaction with her birth experience, a relationship of trust has been linked to more favourable health behaviors such as smoking cessation, improved health outcomes, and physical and emotional well-being.[110, 112]

System Factors

In most Labour and Birth Units there is an induction 'list' that includes a woman's name, due date, indication for the induction and the date the induction is planned or requested. A specialized booking form may be used in addition to or in place of the induction list. These forms generally have more detailed patient information including Bishop score. A copy of the form developed and used at Children's and Women's Health Centre of British Columbia is shared, with permission, and appended to this report.

In some facilities, a consultation with an obstetrician is required for every induction request, while in others a consultation is not required prior to inductions for PROM. In parts of Canada, in addition to PROM family physicians are not required to consult an obstetrician prior to induction for postterm pregnancy.

In most cases the assigned or on-call obstetrician prioritizes the inductions requested and, depending on availability of nurses and unit workload, women are called for admission in order of priority. Not infrequently the planned induction is postponed when the unit census or acuity increases quickly or another induction is requested and is deemed to be of greater urgency. As expected this is a source of great concern and frustration for these women, particularly when it happens more than once.

There are other challenges associated with prioritizing inductions. First, information provided in the process of booking may be inadequate or incorrect. For example prenatal records are not always available making it difficult to decide which of two requests for induction for hypertension is more urgent without details of blood pressure throughout pregnancy and other evidence of morbidity. An induction that is prioritized inappropriately can result in the delay of another that might be more urgently required. Second, there was evidence during the review that often the EDD was changed over the course of the pregnancy, not infrequently more than once and for reasons that were not clear. This was occasionally further compounded by the fact that two or more EDD's were documented in different parts of a single record. The issue of pregnancy dating was raised during at least one meeting at every site that participated in the QA Review.

Having a reliable EDD that is used consistently by all members of the team is a key component of safe care. Traditionally the EDD has been established in two ways: using a pregnancy wheel with a known date of the LMP, or plotting fetal measurements taken by ultrasound. Reliance on the date of the LMP alone to establish gestation has been speculated to result in an overestimation of gestation in part because of a lack of 'accurate recall' of the date by the woman and variable ovulation within the menstrual cycle.[14] This overestimation could potentially result in inappropriate or unnecessary interventions such as induction for postterm pregnancy, or an unanticipated preterm birth.

Measurement of the fetal crown rump length at 10 to 14 weeks gestation is acknowledged to provide the most accurate assessment of gestation. The SOGC has recommended a first trimester dating ultrasound be offered to all pregnant women in order to decrease the incidence of postterm pregnancies and postterm inductions.[14] However, Diagnostic Imaging Departments throughout Nova Scotia have reported that *routine* first trimester ultrasound for pregnancy dating is not

currently an option because of insufficient resources. Second trimester ultrasound for anatomy review is offered to all women at 18 to 20 weeks during which fetal biometry that includes biparietal diameter, abdominal circumference and femur length is used to estimate gestation.

When known, the date of the first day of the LMP factors into the establishment of the EDD even when early ultrasound is used. It is important to discuss with a woman her level of certainty of her LMP as well as the characteristics of her usual menstrual cycle, and to determine if she was using oral contraceptives at the time of conception. Women who planned their pregnancies are more likely to be confident about their LMP and may be disappointed if the EDD is altered based on ultrasound results. Women in these situations have reported a perceived lack of acknowledgement from care providers that they know their own bodies and the details of the pregnancies. A point of discussion with women is that regardless of how it is established, the 'due date' is an estimation only, as it is impossible to predict with absolute certainty the optimal gestation for each pregnancy. This discussion could perhaps help women be more open to accepting that the pregnancy may extend beyond a specific calendar date.

As mentioned previously, postterm pregnancy is the most common indication for induction of labour in Nova Scotia and the timing of this intervention is variable. There has been a lack of consensus in the province about what constitutes postterm pregnancy, and in many cases this lack of consensus exists within a facility. It is not uncommon that an induction for postterm pregnancy is undertaken at any time after 40 weeks gestation. This practice has occurred in part because inductions are requested in advance, and then scheduled around others that are part of an often lengthy induction list. Decisions are then sometimes made to initiate a postterm induction before absolutely necessary when the physician, nurses and space are available.

Inductions for hypertensive disorders of pregnancy (HDP) are generally prioritized high on an induction 'list' and routinely take precedence over those requested for other indications. Thus a woman for whom induction for PROM is planned, for example, may have her induction postponed so that another requested because of HDP can be started. This may not be appropriate, particularly if a diagnosis of hypertension was made with incomplete information or on the basis of a single elevated BP.

Finally, decisions to induce labour have traditionally been influenced in most hospitals by the number and availability of health care professionals. There has been a dramatic decrease in the number of family physicians whose practices include labour and birth, from over 500 in 1991 to 82 in 2011. Although the complement of obstetricians has remained relatively constant in the province over the last 20 years, there are 3 or fewer obstetricians practicing in 4 of the District Health Authorities. There are pediatricians at most of the regional facilities; however, in some cases coverage is frequently interrupted, particularly on weekends. Professional midwives have only recently been introduced in 2 Districts and the IWK Health Centre, since completion of the QA Review.

In recent years nurses have been required to care for a larger proportion of preterm and late pre-term babies and for a population of women with more complex health care needs. Furthermore, the patient population on maternal newborn units in most of the regional hospitals includes 'off-service' patients, many of whom will be awaiting transfer to a medical or surgical unit or long-term care facility. Nursing care requirements for these patients are often extensive. The needs of all patients and the availability of nurses to meet these needs are regularly assessed over the course of each shift and may result in the postponement of an induction until the situation on the unit changes. This is not always an appropriate option as it may put the mother or fetus at additional risk.

Maintaining a complement of skilled and experienced labour and birth nurses is an ongoing challenge. The RCP review team heard concern expressed throughout the province that many of the most experienced nurses are retiring or leaving to work in other areas of the hospital or elsewhere. The vast majority of newly hired nurses will require education and ongoing support to develop competence and confidence in labour and birth care, including the assessment and management of induction of labour.

Conclusion

It became clear over the course of the QA Reviews that induction of labour as a component of maternal newborn care in our province presents opportunities and challenges for women and families, health care professionals and the healthcare system overall.

Health professionals who participated in the Review acknowledged the increase in the rate of induction of labour over the last 20 years. Reasons for the increase were speculated to be related to revisions in guidelines and standards of care and changes in the population of childbearing women. There was a perception also that more women are actively seeking induction for reasons related to their personal lives, or simply to end the common and aggravating discomforts of late pregnancy. Many care providers noted the constant need to prioritize inductions because the number of women who can be induced at any one time is affected by the availability of nurses and other health professionals required to care for them.

There is no question that induction is often an appropriate and appealing option. When delivery is indicated because of health or pregnancy complications, an induction may enable a woman to labour and achieve vaginal birth. However, Nova Scotia data as well as data reported in the literature support the argument that induction is more commonly associated with cesarean section when

compared to spontaneous labour. In addition to an added risk of morbidity, there are increased costs associated with cesarean birth and these healthcare costs are highest when cesarean section follows induction of labour.

These findings suggest that it is best to induce labour only when there are carefully evaluated and documented medical indications to do so. It is important that health professionals who counsel or care for pregnant women provide them with information about induction that includes the risks as well as the benefits of allowing spontaneous cervical ripening and spontaneous labour to occur whenever possible.

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HCA Perinatal Safety Initiative

Recommended

Oxytocin "In Use" Checklist for Women with Term Singleton- Babies

"This Oxytocin "In Use" Checklist represents a guideline for care: however, individualized medical care is directed by the physician."

Checklist will be completed every 30 minutes. Oxytocin should be stopped or decreased if the following checklist cannot be completed.

Date and time completed _____

☐ **Fetal Assessment indicates:**

☐ At least 1acceleration of 15 bpm x 15 seconds in 30 minutes or moderate variability for 10 of the previous 30 minutes.

☐ No more than 1 late deceleration occurred.

☐ No more than 2 Variable decelerations exceeding 60 seconds in duration and decreasing greater than 60 bpm from the baseline within the previous 30 minutes.

☐ **Uterine Contractions**

☐ No more than 5 uterine contractions in 10 minutes for any 20 minute interval

☐ No two contractions greater than 120 seconds duration

☐ Uterus palpates soft between contractions

☐ If IUPC is in place, MVU must calculate less than 300 mm Hg and the baseline resting tone must be less than 25 mm Hg.

***If Oxytocin is stopped the Pre-Oxytocin Checklist will be reviewed before Oxytocin is reinitiated.**

Updated 2009

HCA Perinatal Safety Initiative
Recommended
Pre-Oxytocin Checklist
For Women with Term-Singleton Babies

"This Pre-Oxytocin checklist represents a guideline for care: however, individualized medical care is directed by the physician"

If the following checklist cannot be completed, Oxytocin should not be initiated

Date and time completed _____

1. ☐ Physician or Midwife Order on chart
2. ☐ Current history and physical on the chart*
3. ☐ Prenatal Record on chart*
4. ☐ Indication for induction is documented
5. ☐ Pelvis is documented by physician to be clinically adequate (should be on prenatal record)*
6. ☐ Estimated fetal weight within past week (clinical or ultrasound) less than 4500 grams in a non-diabetic woman or less than 4250 grams in a diabetic woman*
7. ☐ Gestational age documented
8. ☐ Consent signed (General L&D consent)
9. ☐ Physician with C-section privileges is aware of the induction and readily available and this is documented in the medical record
10. ☐ Status of the cervix is assessed and documented
11. ☐ Presentation is assessed and documented (physician required to come in if nurse unable to determine)
12. ☐ Fetal Assessment completed and indicates: (complete all below)
    - ☐ A minimum of 30 minutes of fetal monitoring is required prior to starting Oxytocin
    - ☐ At least 2 accelerations (15 bpm x 15 sec) in 30 minutes are present, or a biophysical profile of 8 of 10 is present within the past 4 hours or moderate variability.**
    - ☐ No late decelerations in the last 30 minutes
    - ☐ No more than 2 Variable deceleration exceeding 60 seconds and decreasing greater than 60 bpm from baseline within the previous 30 minutes prior to starting Oxytocin infusion.

*May be delayed for non-elective admissions.

** This document does not apply to a formal Oxytocin challenge test without the intent to induce or augment labor.

**There will be some situations in which alterations in management from that descried in the protocol are clinically appropriate. If, after reviewing the fetal heart rate strip and course of labor the responsible physician feels that in his or her judgment, continued use of Oxytocin is in the best interest of the mother and baby, the physician should write or dictate a note to that effect and order the Oxytocin to continue. The RN will continue to provide safe, high quality nursing care.

Updated 2009

CHILDREN'S & WOMEN'S HEALTH CENTRE OF BRITISH COLUMBIA
AN AGENCY OF THE PROVINCIAL HEALTH SERVICES AUTHORITY

BC Women's Induction of Labour Booking Form

Fax: (604) 875-2742 Phone: (604) 875-2165

Date: _____ **Name:** _____ **Phone**: home _____cell _____

Date Induction Requested: _____ **Physician/Midwife:**_____

Physician Responsible for Induction: _____**Phone**: _____**Fax**:_____

PRIORITY by Booking Physician:

- ☐ **One**: < 8 hours
- ☐ **Two**: < 24 hours
- ☐ **Three:** < 72 hours

Approved: ☐ **YES**
☐ **NO**, **REASON Not Approved:**

_____

Features	Score 0	Score 1	Score 2	Score 3
Station in relation to spines centimetres (cm)	-3	-2	-1, 0	+1, +2
Cervix dilation (cm)	0	1 - 2	3 - 4	4
Length	3	2	1	0
Consistency	Firm	Medium	Soft	
Position	Posterior	Mid	Anterior	

Approving Physician/RN:_____ **Bishop Score:** _____ (< 7 is **UNFAVOURABLE**)

G____ T____ P____ A____ L____ EDD by LMP: _____ or EDD By U/S: _____

Gestational age at date of induction _____ weeks
If dating Ultrasound confirms dates by LMP, accept LMP dating. ☐
If U/S result discordant (> 7 days variation) re-date by U/S. Attach dating ultrasound.

Induction method requested: ☐ Prostin ☐ Cervidil ☐ Oxytocin ☐ ARM

Caution: Prostaglandin agents are contraindicated for women with a previous uterine scar

LOW RISK Inductions (not VBAC) (May be booked by Family Physician)

☐ **TERM PROM with CONFIRMATION** Date & Time of PROM: _____
☐ **Meconium present** **GBS status**: ☐ Positive ☐ Negative ☐ Unknown

☐ **POSTDATES** (≥ **41**[3] weeks) on: _____

Is this woman appropriate for an Outpatient Clinic Induction?
☐ **NO** ☐ **YES, include signed Physician's Orders for Induction**
Note: Any woman having induction of labour, who can be sent home after the induction is initiated, may have her induction in the Diagnostic Ambulatory Clinic.

HIGHER RISK Inductions (May only be booked by an Obstetrician)

- ❑ Abnormal/Atypical Nonstress Test
- ❑ APA Syndrome ≥ 39 weeks
- ❑ At Risk for Precipitous Delivery
- ❑ Diabetes ≥ 38 wks
  - ❑ Type 1 ❑ Type 2
- ❑ Diabetes (GDM) ≥ 39 wks
- ❑ Fetal anomaly
- ❑ Gestational hypertension
- ❑ Intrahepatic Cholestasis of Pregnancy ≥ 37 weeks
- ❑ Intrauterine Fetal Demise
- ❑ Severe IUGR (EFW and/or AC < 3rd %centile)
- ❑ Moderate IUGR (AC >3rd but < 5th %centile)
- ❑ Maternal Age ≥ 40 years
- ❑ Severe oligohydramnios (DVP < 20 mm)
- ❑ Moderate oligohydramnios (AFI < 50 mm but DVP ≥ 20 mm)
- ❑ Previous Shoulder Dystocia
- ❑ Previous Uterine Scar with term PROM and/or postdates
- ❑ Pre-eclampsia
- ❑ Pre-existing (essential) hypertension
- ❑ Twins ≥ 38 weeks
- ❑ Other (provide supporting documentation): _____

Other information:

This form is for the sole use of the intended recipient(s) and contains confidential and privileged information. Any unauthorized use, disclosure or distribution is prohibited. If you are not the intended recipient please contact the sender and destroy all copies.

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