An Evaluation of Exogenous Oxytocin in Contrast to Alternative Methods of Labor Induction in Uncomplicated Pregnancies

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An Evaluation of Exogenous Oxytocin in Contrast to Alternative Methods of Labor Induction and Augmentation

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Abstract

Labor induction rates in the United States (U.S.) are more than two-fold higher than the rate recommended by the Centers for Disease Control & Prevention (CDC). Maternity health care in the U.S. would benefit from a reevaluation of the interventions performed, and a reconsideration of the risks and indications for intervention. Will there be a difference in complications in low-risk pregnancies if labor was induced using exogenous oxytocin as compared to the use of non-invasive strategies? This literature review evaluated 17 studies that investigated the risks and indications associated with each labor induction method. It was noted that there were no complications associated with non-invasive strategies. Complications associated with non-pharmacologic, mechanical methods of labor induction were bleeding and pain. Complications associated with pharmacologic methods of labor induction (mifepristone, misoprostol, and oxytocin) were uterine hyperstimulation, painful contractions, need for epidural analgesia, abnormal fetal heart rate patterns, need for cesarean section, and postpartum hemorrhage. Through this research project, it was found that there is a direct relationship between the degree of invasiveness and the risk of the complications. The more systemically invasive the induction method, the higher the risk of serious complications becomes. The wide-spread use of a labor induction protocol would increase standardization of labor induction, decrease the likelihood of advancing to more invasive methods prematurely, and possibly reduce the incidence of adverse outcomes.

Keywords: labor induction, oxytocin, Pitocin, membrane sweeping, misoprostol, mifepristone, Foley bulb
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INTRODUCTION

Natural childbirth is a term used to describe the labor and delivery of a child using little-to-no analgesia. Labor is a process that begins and progresses naturally in most cases. The normal process of labor involves uterine contractions that cause the cervix to efface and dilate to allow the fetus to be expelled vaginally. There are four dynamic stages of labor. The first stage of labor encompasses natural changes in hormone levels such as oxytocin, prostaglandins, and relaxin, that prepare the body for the initiation of labor. There are three phases that occur in the first stage of labor. The first phase is referred to as early labor and begins with uterine contractions that cause cervical effacement and dilatation and ends with the cervix being four centimeters dilated. In the second phase of the first stage of labor, the cervix dilates from five centimeters to seven centimeters. The third phase of the first stage of labor, also referred to as transitional labor, begins with cervical dilatation of eight centimeters and ends with complete cervical dilatation at ten centimeters. The second stage of labor begins with cervical dilatation of ten centimeters and ends with the birth of the newborn. The third stage of labor begins with the birth of the newborn and ends with the delivery of the placenta. The fourth stage of labor begins after the delivery of the placenta and ends with the resumption of fertility (Irani & Foster, 2015).

The healthcare delivery model in the United States (U.S.) tends to follow an algorithm of least invasive to most invasive when recommending treatment options. Non-medical care during labor should always be offered prior to medical intervention (Kozhimmanel, Johnson, Attanasio, Gjerdingen, & McGovern, 2013). For some women, labor fails to begin or to progress naturally. When this occurs, interventions become necessary to ensure optimal safety for the mother and baby. There are interventions that include administering medications and there are interventions that involve mechanically inducing and advancing labor. Both types of interventions are
currently used in practice both independently and often concurrently. Factors to consider when selecting interventions include the stage of labor the mother is in, and the risk of complications to the mother and fetus if an intervention is not performed. This project will compare the risks associated with common interventions in the first stage of labor.

**Background of the Problem**

A systematic review completed by Amis (2014) states that cesarean births account for almost one-third of births in the United States annually. Cesarean sections are linked with increased length of hospital stay, uterine scarring, increased blood loss, and higher risk for complications in future pregnancies (Wijepala, Jagath, & Najimudeen, 2013). The review attributes this alarmingly high rate of cesarean births to the overloading of oxytocin receptors with exogenous oxytocin. Exogenous oxytocin does not provide the same neuroprotection that natural, endogenous oxytocin provides. Endogenous oxytocin provides fetal neuroprotection by allowing the fetus to withstand lower oxygen levels during uterine contractions (Amis, 2014). Amis (2014) recommends a reduction of intervention in labor and delivery care to support the natural process of labor. Allowing labor to begin and progress on its own allows birth hormones to regulate labor and birth, breastfeeding, and bonding as it was naturally intended to occur. However, there are cases where this is not a viable option, and the health care provider must intervene to ensure patient safety.

The rates of labor induction in the U.S. are alarming. Of all U.S. births in 2005, 22.3 percent were induced. Seven years later, 23.3 percent of all U.S. births were induced (Centers for Disease Control & Prevention, 2014). Currently, rates of elective labor induction range from 12 to 55 percent in U.S. hospitals. The World Health Organization (WHO) recommends that the rate of labor induction should not exceed ten percent in any given geographical location (Declerq
Sakala, Corry, Applebaum, & Herrlich, 2014). Though the Centers for Disease Control & Prevention (2014) find that the rates of labor induction have begun to gradually decline starting in 2010, labor induction rates are still more than two-fold higher than the recommended rate. Labor induction rates in the U.S. on average are much higher than the WHO recommendation. This calls for review of the current methods in use for labor induction, and more careful consideration of risk versus benefit for each method.

When labor fails to begin on its own, there can be complications and risk of harm to the mother and fetus. Pregnancy that lasts beyond 42 weeks’ gestation is considered post-term pregnancy. The risks associated with post-term pregnancy include fetal macrosomia, placental insufficiency, meconium aspiration, uterine rupture, and an increased need for a cesarean section surgery (“Post-term pregnancy,” 2014). Once a pregnancy is post-term, the health care provider will consider the risk of continuing pregnancy through electronic fetal monitoring, kick counts, a non-stress test, contraction stress test, and/or biophysical profile. It becomes a deliberation of balancing the probability of harm of continuing pregnancy or inducing labor. Interventions for labor induction are typically used between 37 and 42 weeks’ gestation, depending on fetal development and maternal and fetal health status.

Members of the care team, including the patients and families, have various beliefs as to which interventions are preferred and at what time intervention is required throughout the pregnancy and labor process. There are several treatment options to artificially inducing labor. There are nonpharmacologic methods such as membrane sweeping and Foley catheter bulb insertion. There are pharmacologic measures such as the use of exogenous intravenous oxytocin, vaginal or intracervical prostaglandins, and mifepristone. Though it may be against medical advice in most cases, women do always have the option of continuing the natural birth process
and refusing intervention. Expectant mothers may not always be aware of this right. Every patient case is unique, but there are guidelines and recommendations for labor and delivery interventions from the World Health Organization, national organizations such as the National Guideline Clearinghouse, and policies and procedures held by individual healthcare facilities (“Induction of Labor,” 2014). The risks associated with each intervention will be examined throughout this project, with emphasis on the widespread and frequent use of exogenous intravenous oxytocin.

**Statement of the Problem**

In the U.S., interventions in labor and delivery nursing care are at an all-time high. In general, the length of the labor process is different for every woman, and every pregnancy. There is not a consistent time in labor when it is deemed that labor is failing to progress. It varies from patient to patient. It all boils down to more time versus more interventions. Interventions can essentially be used to plan the time of birth and length of labor for convenience (Lothian, 2014). As described previously, there are many health risks for mom and baby if labor or birth is postponed. However, there are also many health risks associated with interventions such as uterine rupture, placental abruption, fetal hypoxia, and the need for cesarean section. In the U.S., the maternal mortality rate (MMR) was 12 deaths per 100,000 live births in 2013 (“Country Comparison: Maternal Mortality Rate,” 2013). There were 48 other countries with a lesser MMR. In the U.S., the infant mortality rate (IMR) was 5.8 deaths per 1,000 live births in 2016. There were 55 other countries with a lesser IMR than the U.S. such as Canada (4.6), United Kingdom (4.3), Israel (3.5), Germany (3.4), and Japan (2.0) (“Country Comparison: Infant Mortality Rate,” 2016). The rate of labor induction in the U.S. is decreasing each year, but is still much greater than the WHO recommendation of less than ten percent in any given location (see
Appendix B). The rate of cesarean deliveries in the U.S. is increasing each year (See Appendix B). In 2014, there were 1,284,551 cesarean deliveries out of 4,014,221 deliveries in the United States (Hamilton, Martin, Osterman, Curtin, & Matthews, 2015). Obstetricians and bedside nurses must carefully assess mom and baby via fetal heart monitors and contraction tracings to determine risk versus harm throughout the labor process to achieve optimal safety.

As compared to the other avenues of labor induction, exogenous oxytocin appears to be the most frequently implemented. If labor induction or augmentation is the only viable option, the cascade of interventions should progress from least invasive to increasingly invasive interventions. For the purpose of this project, it will be assumed that all other interventions have been exhausted and that inducing labor is the only viable option. This project will seek to discover which method should be attempted first, deemed least invasive. This project will compare the likelihood of complications with exogenous intravenous oxytocin induction to other induction methods.

Maternity nursing uses a family-centered approach when selecting interventions; therefore, patients and their families are an equal part of the healthcare team. They must be educated on the reasons for intervening and the possible risks that may be associated with any intervention chosen to be implemented. Then, a collaborative decision should be made. It is largely the responsibility of clinical nurses to educate patients on these subjects.

The report entitled, “Major Survey Findings of Listening to Mothers III: Pregnancy and Birth,” is an analysis of the results of a survey sent to 2,400 postpartum women who gave birth in a hospital in the U.S. between 2011-2012. The purpose of this study was to gain perspective related to the way patients view their labor experience in a healthcare facility. One section of the survey asked women to select the indication for which medical intervention was implemented.
Many women cited that the indications for intervention were for reasons of convenience, such as the date of birth or the timing of birth (11%). The most common indications were post-term pregnancy (18%) or maternal health problems warranting quick delivery (18%). A common theme among the results was that mothers reported feeling pressured by the health care team to have interventions implemented (Declerq et al., 2014). This either indicates that patient education is inadequate, or providers are intervening beyond what is deemed appropriate. In either case, patient advocacy is being neglected. In order to advocate for patients, providers must be able to present patients with clear and accurate rationales for their actions, allow patients to ask questions, and discuss the potential risks associated with interventions.

**Purpose of the Project**

First, do no harm. This is the Hippocratic oath taken by physicians, and all clinicians should practice by this premise. Patient safety is always the highest priority. In order to do no harm, providers must be aware of the harm patients are facing and do everything in their power to prevent the harm. Furthermore, providers must do everything in their power to avoid causing harm to their patients by way of intervention. This requires clinicians to have knowledge of the potential risks posed by any intervention they are considering implementing. Providers intend to do no harm, and they must have knowledge of potential risks to ensure patient safety.

The purpose of this project is to review existing literature and compare the relative likelihood of complications for various induction methods. The PICO question for this literature review is the following: Will there be a difference in complications in low-risk pregnancies if labor was induced using exogenous oxytocin as compared to the use of non-invasive strategies, membrane sweeping, Foley bulb, vaginal prostaglandins, and cervical ripening agents? Guidelines do exist that outline national recommendations for maternity care (“Induction of
These guidelines are typically reviewed every five years. Between these intervals, new research evidence becomes available, and is not included in the recommended guidelines until the scheduled revision period, or until new research evidence is gathered and submitted to the National Guideline Clearinghouse. Therefore, providers must remain current in their knowledge of existing research evidence. Critical thinking is a vital process in medicine. An important component of critical thinking involves clinical inquiry. Clinical inquiry involves asking questions and questioning answers. This is parallel to the purpose of this project. When a patient has arrived at the need for intervention, clinicians select actions based on current research and protocols. This is the answer to their inquiry. However, clinicians must then question their answer. Clinicians must remain vigilant in monitoring for complications and advancing the sequence of their interventions from least invasive and hazardous, to the most invasive and hazardous. The interventions in this project will be reviewed in sequence of increasing invasiveness.

This project will aid in addressing the ambiguity of selecting an induction method by exploring the indications for each induction method and the consequences that may follow the induction. With analysis, it will be possible to recommend which labor induction method is associated with a lower likelihood of complications. This will add to the body of knowledge regarding safe, effective maternity care.

**Review and Summary of Relevant Literature**

To compare the likelihood and severity of risks associated with each intervention, it is necessary to review current literature and evaluate patient outcomes. Most of the studies reviewed in this project address the likelihood of one or two complications in relation to the intervention being evaluated. In summation, the complications included in this research were
bleeding, pain, prolonged labor, abnormal fetal heart rate patterns, incidence of cesarean sections, need for epidural analgesia, maternal and fetal infection, tachysystole, and hypertonus. Multiple studies for each intervention will be compiled for analysis. This section will provide an explanation of interventions and the associated risks and complications.

**Labor Induction Recommendations from the National Guideline Clearinghouse**

The National Guideline Clearinghouse has recommendations for labor induction based on the favorability of the cervix. For expectant mothers with a favorable cervix and ruptured membranes, it is recommended that exogenous oxytocin be considered over expectant management. It is also recommended that the administration of oxytocin follow a hospital administration protocol. For expectant mothers with an unfavorable cervix, the recommendation is to first use an intracervical Foley catheter bulb both inpatient and outpatient. If this fails, a double lumen catheter should be considered. The recommended pharmacological option for expectant mothers with an unfavorable cervix is intravaginal or intracervical prostaglandins. Intravaginal prostaglandins are preferred due to increased incidence of vaginal deliveries. Misoprostol is considered safe and effective if the expectant mothers’ membranes are intact and the patient is in a hospital setting. If misoprostol is used, it is recommended that oxytocin not be started any earlier than four hours after the last dose of misoprostol (“Induction of Labor,” 2014). These guidelines do not address the risks associated with these interventions. The risks associated with these interventions will be discussed in this literature review.

**Non-invasive Strategies to Induce Labor**

Following the sequence of least invasive to most invasive interventions, labor induction should begin with the least invasive strategies that pose the least likelihood of risk to the patient. Interventions that pose no risk to the patient and are minimally invasive include ambulation and
breast stimulation. Lothian (2014) proposed that breast stimulation and ambulation may help progress labor as a non-medical option. Non-invasive strategies should always be the starting point for patient education and the first choice for intervention as long as the expectant mother and baby are stable.

Emotional support strategies are another non-invasive technique. In a grounded theory study, Gilliland (2011) described nine emotional support strategies used to encourage women prior to and throughout labor. Strategies used by both nurses and doulas included reassurance, encouragement, praise, and explanation. Strategies used exclusively by doulas included mirroring, acceptance, reinforcing, reframing, and debriefing. Using these strategies increased women’s ability to cope with the stress of labor.

A study by Rooks (2009) compared a group of women laboring without assistance from a doula to a group of women laboring with assistance from a doula. The results showed that the need for cesarean section was 12.5% in the group of women being assisted by a doula, compared to 59% of the women in the group with no assistance from a doula. There were no health risks associated with doula-assisted births in a healthcare facility. This is significant because it represents the correlation of emotional support strategies with positive labor and delivery outcomes.

Membrane Sweeping to Induce Labor

When non-invasive measures have been exhausted without success, providers must consider alternative interventions. Membrane sweeping involves a physician or midwife mechanically separating the amniotic sac from the cervix. The cervix must be thinning and dilating, referred to as a favorable cervix. A randomized controlled trial of membrane sweeping in low-risk patients, completed by Yildirim, Gungoduk, Karada, Aslan, Turhan, and Ceylan
(2010), showed that labor began spontaneously within 7 days for 72% of patients who received membrane sweeping. Spontaneous labor began within 7 days for only 48% of women in the study who did not receive membrane sweeping. However, membrane sweeping was most effective at 40 weeks’ gestation. No significant difference was seen in women at 38-39 weeks’ gestation (Yildirim et al., 2010). This induction method was effective and associated with minimal risks of complications, but criteria for inclusion of effectiveness were quite narrow.

A randomized trial by De Miranda, Van Der Bom, Bonsel, Bleker, and Rosendaal (2006), was performed and included 742 women between 40 and 42 weeks’ gestation. Vaginal examinations were not completed during this period of time in order to prevent release of prostaglandins. The women in the sweeping group received membrane sweeping at 41 weeks’ gestation, and two more times subsequently. In the sweeping group, 30 out of 242 women (12%) experienced post-term pregnancy. Moderate pain was reported by 179 women (51%) and bleeding was reported by 111 women (30.5%) in the sweeping group. Of the 239 women who reported pain, 210 women (88%) stated they would elect to have membrane sweeping in future pregnancies (De Miranda, et al., 2006). Membrane sweeping was very effective in preventing post-term pregnancy, and was associated with minor complications including bleeding and pain.

**Foley Catheter Bulb to Induce Labor**

Using a Foley catheter bulb to induce labor is a prevalent method among patients with an unfavorable cervix. This method ripens the cervix without causing the uterus to overly contract. The Foley bulb stays inflated in place for a maximum of 24 hours. A randomized clinical study by Wijepala, Jagath, and Namjimudeen (2013) included 88 women and was conducted to determine the efficacy of using a 30 mL Foley bulb as compared to a 60 mL Foley bulb. Inclusion criteria for intervention was 40 weeks and 2 days’ gestation and a Bishop’s score of 5
or less. In the 60 mL group, 93.2% had a vaginal delivery following Foley bulb induction and 97.7% achieved cervical favorability (Bishop’s score of 8 or greater). In the 30 mL group, 72.7% had a vaginal delivery and 56.8% achieved cervical favorability. The most common complications reported were pain and bleeding (Wijepala et al., 2013). The 60 mL Foley bulb resulted in more cervical favorability and greater odds of vaginal delivery.

**Prostaglandins and Anti-Progesterone Agents to Induce Labor**

Prostaglandins are hormones that are naturally produced in the body. When applied locally in the vagina, they cause uterine contractions. An analysis by Thomas, Fairclough, Kavanagh, and Kelly (2014) of 70 studies involving 11,000 women compared the outcomes of labor induced by different forms (gels, tablets, and vaginal inserts) and doses of vaginal prostaglandins. There was no significant difference in medication form, and lower-dose regimens were equally as effective as higher-dose regimens. The main concern was excessive stimulation of the uterus that caused the fetal heart rate to decline. Uterine hyperstimulation occurred in 4.8% of women who received vaginal prostaglandins, compared to 1% in the placebo group (Thomas et al., 2014). More research is needed to determine the effect of vaginal prostaglandins on maternal and fetal outcomes and risk of complications.

Misoprostol (Cytotec) is a prostaglandin analogue administered vaginally and used off-label to ripen the cervix. A major concern with using misoprostol is hyperstimulation of the uterus. Hyperstimulation of the uterus can cause extremely painful, tetanic contractions that may result in fetal instability, uterine rupture, and emergency hysterectomy (Oden, 2009). A study by Santo, Lourenco, Centeno, Pargana, Clode, Ferreira and da Graca (2009) included 250 singleton term pregnancies, that evaluated the safety and effectiveness of inducing labor with 25 micrograms of vaginal misoprostol. The reported rate of successful labor induction was 97.6%.
There were 15 reported cases of tachysystole, 3 cases of hypertonus, and 1 case of uterine hyperstimulation. There were no adverse fetal or neonatal outcomes reported (Santo et al., 2009).

A systematic review by Hofmeyr, Gulmezoglu, and Alfırevic (1999) evaluated the efficacy and risks associated with induction by vaginal misoprostol in four clinical trials from the Cochrane Pregnancy and Childbirth Group. The relative risk of failure to achieve vaginal delivery within 24 hours of misoprostol administration was 0.48 (95% Confidence Interval [CI] 0.35 to 0.66). Failure to achieve vaginal delivery within 24 hours occurred less often with misoprostol when compared with other prostaglandins (Relative Risk [RR] 0.71, 96% CI 0.62 to 0.81). The relative risk for uterine hyperstimulation with fetal heart rate abnormalities were 2.54 (95% CI 1.12 to 5.77) and without fetal heart rate abnormalities was 2.96 (95% CI 2.11 to 4.14). Vaginal misoprostol was associated with an increase in meconium stained amniotic fluid (RR 1.38, 95% CI 1.06 to 1.79) (Hofmeyr et al., 1999). Using vaginal misoprostol for labor induction was associated with risks of uterine hyperstimulation and meconium aspiration, but does show significant achievement of successful vaginal delivery.

Mifepristone is an anti-progesterone agent administered vaginally to induce labor. A study by Hapangama and Neilson (2009) reviewed 10 trials including 1,108 women where the effectiveness of mifepristone was compared to a placebo. Women who received mifepristone were more likely to have a favorable cervix and more likely to be in labor by 48 hours’ post-administration. The women who received mifepristone were also less likely to require exogenous oxytocin for augmentation. A common complication associated with administration of mifepristone was abnormal fetal heart rate patterns. The study does not state if this was a dose-related complication. The results stated that women who received mifepristone were less likely to require cesarean section due to failure to induce labor (Hapangama, & Neilson, 2009). The
study did not state if there was an increased need for cesarean section in response to unstable fetal heart rate patterns. Mifepristone was effective in cervical dilatation and initiation of labor. However, the risk of uterine overstimulation and fetal intolerance as evidenced by abnormal fetal heart rate tracings was a serious concern.

**Exogenous Intravenous Oxytocin to Induce Labor**

The Institute for Safe Medication Practices (ISMP) listed oxytocin as one of the thirteen medications that were known to cause potentially serious harm when used in error. This list was used by The Joint Commission and other regulatory agencies that monitor patient safety in hospitals. Exogenous oxytocin is a synthetic form of oxytocin given intravenously to induce labor. Adverse effects of exogenous oxytocin are dose dependent. Rooks (2009) stated that women who were exposed to increasing levels of exogenous oxytocin during labor were at increased risk for postpartum hemorrhage due to desensitization of uterine muscle cells to endogenous oxytocin. One factor affecting oxytocin dosage was epidural analgesia. The use of epidural analgesia decreased the endogenous oxytocin levels, thus increasing the need for exogenous oxytocin administration. A review by Rooks (2009) suggested that the dosage of oxytocin should be considered effective when 200-220 Montevideo Units (MVUs) are achieved consistently, or contractions follow a consistent pattern of 1 contraction every 2-3 minutes lasting 80-90 seconds and an experienced labor nurse deems the contractions strong by palpation. Rooks (2009) recommends that the dose should not be titrated up once this is achieved in order to avoid uterine hyperstimulation. If labor does not progress despite achievement of these evaluation measures, a cesarean section is a safer option compared to increasing the exogenous oxytocin dosage. Continuing to increase the oxytocin dosage could increase uterine contractility to potentially dangerous levels (Rooks, 2009).
A systematic review by Alfirevic, Kelly, and Dowsell (2009) of 61 studies including 12,819 women researched the use of oxytocin for induction of labor with most of the women having ruptured membranes. When oxytocin induction was compared to expectant management, more women delivered vaginally within 24 hours (91.6% compared to 46.2%). More women failed to have a vaginal delivery within 24 hours when oxytocin induction (70%) was compared to the use of vaginal prostaglandins (21%). The same conclusion was drawn when comparing oxytocin to intracervical prostaglandins (50.4% versus 34.6%). With oxytocin induction, there was an increase in the need for epidural analgesia (95% confidence interval). There was an increase in cesarean sections for women who were induced with oxytocin (19.1%) when compared with intracervical prostaglandins (13.7%). It was noted that the use of vaginal prostaglandins to induce labor in women with ruptured membranes tended to result in increased incidence of maternal and fetal infection (Alfirevic, Kelly, & Dowsell, 2009). Exogenous intravenous oxytocin for labor induction achieved shorter duration of labor when compared with expectant management; however, there was an increase in the need for epidural pain management and an increase in cesarean sections.

In a retrospective pre-post study by Wojnar, Cowgill, Hoffman, and Carlson (2014), it was found that the use of an exogenous oxytocin protocol and administration checklist resulted in improved maternal and fetal outcomes as evidenced by decreased length of hospital stay, decreased incidence of cesarean delivery, improved APGAR scores, decreased incidence of meconium presence at birth, and decreased instrumented deliveries. Due to the nature of a retrospective study, it was not reasonable to assume that other factors besides the oxytocin checklist did not influence the positive trend in maternal and fetal outcomes (Wojnar et al., 2014).
In Colorado, a system-wide quality improvement project implemented a standardized evidence-based protocol and administration checklist for administration of exogenous intravenous oxytocin to women in labor. The use of this protocol and checklist resulted in decreased durations of labor, decreased occurrences of tachysystole, and decreased incidence of primary cesarean deliveries (Krening, Rehling-Anthony, & Garko, 2012).

**Major Findings**

The purpose of this project was to compare the relative likelihood of risks associated with selected labor induction methods. There were no significant risks associated with non-invasive methods of labor induction. Doula-assisted births were shown to reduce the need for invasive labor inductions methods (Rooks, 2009). Bedside care providers can easily use the same emotional support strategies to encourage the natural labor process, and initiate the journey of labor and delivery on an optimistic path.

The nonpharmacologic labor induction options evaluated were membrane sweeping and Foley bulb inflation. Membrane sweeping was effective and minimally invasive for inducing labor. This method was most effective at 40 weeks’ gestation; therefore, it may not be appropriate for post-term pregnancies (Yildirim et al., 2010). Complications of membrane sweeping were indicated to be bleeding and moderate pain. Most of the women in the study stated they would elect to be induced with membrane sweeping in future pregnancies (De Miranda, et al., 2006). Foley bulbs inflated with 60 mL of fluid were significantly successful in achieving vaginal delivery and cervical favorability. Complications associated with Foley bulb induction were bleeding and pain (Wijepala, Jagath, & Najimudeen, 2013).

Of the pharmacologic labor induction methods, prostaglandins, anti-progesterone agents, and exogenous oxytocin were evaluated. The use of vaginal prostaglandins frequently resulted in
vaginal delivery within 24 hours. This is ideal if there is a need to deliver sooner rather than later. An increase in the incidence of uterine hyperstimulation in women who received vaginal prostaglandins was detected (Hofmeyr et al., 1999). Uterine hyperstimulation has the potential to cause fetal instability, uterine rupture, and emergency hysterectomy. Fetal instability and uterine rupture can be potentially life-threatening, and a hysterectomy would render a woman permanently sterile (Oden, 2009). Mifepristone, an anti-progesterone agent, reduced the need for exogenous oxytocin augmentation and cesarean delivery. Increased infection was shown in women with ruptured membranes who were induced with cervical ripening agents such as mifepristone and misoprostol (Alfirevic et al., 2009). However, abnormal fetal heart rate and uterine hyperstimulation were common findings following mifepristone induction (Hapangama, & Neilson, 2009). Exogenous oxytocin, another pharmacologic option, increased the need for epidural analgesia, risk of postpartum hemorrhage, uterine hyperstimulation (Rooks, 2009), and meconium-stained amniotic fluid (Wojnar et al., 2014). When compared with prostaglandins, oxytocin resulted in less vaginal deliveries within 24 hours and more women requiring cesarean delivery (“Induction of Labor,” 2014). Cesarean section was preferred instead of increasing intravenous oxytocin dosages (Rooks, 2009).

These findings do provide an answer to the PICO question of the project. There was a difference in complications when using oxytocin to induce labor as opposed to non-invasive strategies, membrane sweeping, Foley bulb, vaginal prostaglandins, and antiprogesterone agents. The risks associated with nonpharmacologic methods included bleeding and pain. These complications are not immediately life-threatening. The risks associated with prostaglandins and anti-progesterone agents included uterine hyperstimulation, abnormal fetal heart rate patterns, meconium aspiration, and uterine rupture (Thomas et al., 2014). These complications are more
emergent than the complications associated with nonpharmacologic options. Exogenous oxytocin used for labor induction was associated with the risks of increased need for epidural analgesia, risk of postpartum hemorrhage, uterine hyperstimulation, and meconium-stained amniotic fluid (Rooks, 2009). These complications are potentially as life-threatening as the complications associated with prostaglandins and anti-progesterone agents, but the research revealed there is an increased incidence of these problems occurring with oxytocin administration. Prostaglandins and anti-progesterone agents are administered locally, therefore the side effects are typically less severe than an agent administered systemically, such as oxytocin. The amount and severity of complications is increased with exogenous oxytocin as compared to other induction methods.

**Implications for Nursing Practice**

In the U.S., maternal and neonatal mortality rates are relatively high. To avoid unnecessary intervention and complications, labor and delivery care should follow a clinical pathway. Non-invasive methods are associated with minimal risk of complications. This should always be the first intervention in labor induction. If labor fails to begin this way, all non-pharmacologic measures should be exhausted if there is not an indication for immediate delivery. If non-pharmacologic measures fail to induce labor, there are several pharmacologic options. There is a direct relationship between the degree of invasiveness and the risk of the complications. The more systemically invasive the induction method, the higher the risk of serious complications becomes.

A systematic review by Clark, Simpson, Knox, and Garite (2009) suggested the need for an oxytocin protocol due to the ambiguity of current literature regarding dosing, titration, and evaluation of effectiveness when using exogenous oxytocin to induce labor. Implementing a protocol would decrease conflict between members of the obstetric care team and increase
patient safety with specific directions guiding implementation of this labor induction method (Clark, Simpson, Knox, & Garite, 2009).

Nursing leaders should implement guidelines in maternity care units to ensure patient safety throughout labor and delivery. Induction methods with increased risk of serious adverse outcomes should be used minimally and as a last resort. Bedside labor and delivery care providers should be aware of the potential for adverse outcomes and remain attentive throughout the labor process. Patients should be adequately educated of the risks of adverse outcomes following intervention, but also the risks that may accompany not intervening. Adverse outcomes were shown to be significantly reduced with the implementation of exogenous oxytocin administration guidelines. This result may be reproducible if administration guidelines are created and used nationally for each pharmacologic labor induction method, since these methods are associated with more dangerous complications.

**Recommendations**

Labor and delivery care needs to shift toward limiting interventions, using less invasive techniques to improve the birthing experience, and supporting the natural process of labor. Specific protocols and guidelines regarding monitoring of mom and baby and choice of inductions methods should be implemented to improve patient outcomes and reduce conflict between members of the obstetric care team. Nursing professionals should be encouraged to educate patients on the need for intervention and the potential adverse outcomes to be aware of. Nursing leaders and policy makers should work to create a clinical pathway for bedside nurses and obstetricians to refer to when caring for patients. Based on the initial assessment of the patient, providers should have a pathway that suggests the succession of interventions if induction is indicated. The use of a labor induction pathway protocol would increase
standardization of labor induction, decrease the likelihood of advancing to more invasive methods prematurely, and possibly reduce the incidence of adverse patient outcomes.

Future research should seek to explore the incidence of specific adverse outcomes in relation to dosage regarding pharmacologic labor induction. Adverse outcomes are interpreted to be dose dependent. If the threshold dosage for each adverse outcome can be identified, the pharmacologic intervention could be used in a safer and more effective manner in practice. Specific dosages and protocols for titration of dosages should be evaluated for efficacy and safety. It would be beneficial for future research to evaluate each induction method for each adverse outcome individually. This would provide more dependable results to be applied to the clinical labor induction pathway. It would also be beneficial to explore Foley bulb induction and membrane sweeping comparatively in future studies to determine which method results in vaginal delivery more often and more rapidly.

Conclusions and Contributions to the Profession of Nursing

This project was successful in identifying gaps and inconsistencies in current literature regarding labor induction methods. This project made it possible to recommend the order of general succession of labor induction methods. Labor induction methods should initiate with non-invasive strategies, followed by nonpharmacological methods, and ending with pharmacologic intervention. This suggested succession is rationalized by the increased incidence of critical adverse outcomes related to pharmacologic intervention. Labor induction methods should be evaluated based on consistent expected outcomes across multiple studies. If each study evaluated effectiveness of induction by successful vaginal delivery within 24 hours, it would be possible to rank each specific method by efficacy. This project identifies what is known in existing literature regarding the indications and risks associated with labor induction methods,
but is not conclusive in developing a detailed hierarchy of intervention due to the inconsistency of evaluation measures across all the studies.
References


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Appendix A: Definitions

The terms associated with this thesis project that require further clarification include the following:

APGAR scores: APGAR scores assess neonatal activity, pulse, grimace, appearance, and respiratory effort and each area is scored as 0, 1, or 2 based on assessment. Neonates will be assigned an APGAR score of 0-10 at 1 and 5 minutes after birth, and 10 minutes following birth if neither of the first 2 scores are above 8 (“Apgar score,” 2014).

Augmentation: This term refers to the progression of labor through to eventual delivery (Labor induction and augmentation,” 2015).

Biophysical profile: A biophysical profile (BPP) is a combination of a non-stress test, electronic fetal heart monitoring, and a fetal ultrasound. The results will show the baby’s heart rate, muscle tone, movement, breathing, and amount of amniotic fluid within the amniotic sac (“Biophysical profile (BPP),” 2015).

Bishop’s score: This refers to a cervical scoring system that analyzes a patient’s readiness for labor by assessing cervical dilatation in centimeters, effacement percentage, fetal station, cervical consistency, and fetal position. A lower Bishop’s score is associated with prolonged labor and failed labor induction. If the Bishop’s score exceeds 8, the likelihood of successful vaginal delivery in increased (Harman & Kim, 1999).

Cesarean section: This is a surgical procedure done under regional anesthesia, where an incision is made through the abdomen and the uterus, and the neonate is removed from the uterus by the obstetrician (“C-section,” 2015).

Contraction stress test: This test is performed to assess the fetal heart rate response before, during, and after natural contractions or contractions produced by oxytocin. Two external
monitors are placed on the mother’s abdomen and contraction strength and fetal heart rate are evaluated for a ten-minute period. If the fetal heart rate declines significantly at the peak of at least half of the contractions, the result is positive and further evaluation is required (“Oxytocin challenge/contraction stress test,” 2007).

*Dilatation:* Dilatation refers to the increasing diameter of the cervix during labor. At the onset of labor, the cervix is typically closed at zero centimeters. The cervix is fully dilated at ten centimeters, and this is when the patient will begin to push (“Cervical effacement and dilatation,” 2017).

*Doula:* This term describes a non-medical professional trained to assist mothers through the labor process (Gilliland, 2011).

*Effacement:* Effacement refers to the thinning and shortening of the cervix during labor, and is expressed as a percentage (“Effacement”, 2017).

*Endogenous oxytocin:* This term refers to natural oxytocin hormone produced within the body (Harman & Kim, 1999).

*Exogenous oxytocin:* Synthetic form of oxytocin, administered intravenously to stimulate uterine contractions (Harman & Kim, 1999).

*Expectant Management:* This is also referred to as “watchful waiting” or “watch and wait.” It is a medical approach to treatment when more time is allowed before medical intervention takes place (“Watchful waiting,” 2012).

*Favorable cervix:* A favorable cervix is associated with increased likelihood of successful vaginal delivery, and a Bishop’s score of 8 or greater (Harman & Kim, 1999).

*Fetal hypoxia:* This occurs when the oxygen supply to the fetus via the placenta is inadequate (“Fetal hypoxia,” 2009).
**Fetal macrosomia:** When a fetus is much larger than average and is greater than 8 pounds 13 ounces at birth, this is referred to as fetal macrosomia. This can complicate vaginal delivery and potentially lead to cesarean section delivery (“Fetal macrosomia,” 2015).

**Fetal monitoring:** Electronic fetal heart rate monitoring can be done externally, or internally. It constantly traces fetal heart rate and bedside labor nurses and obstetricians review the tracings periodically to ensure that the fetus is tolerating labor and that placental insufficiency is not occurring (“Fetal heart rate monitoring during labor,” 2011).

**Hypertonus:** This term is defined as a single contraction lasting longer than two minutes (“Hypertonic labor,” 2012).

**Infant mortality rate (IMR):** This statistic measures the number of deaths of infants less than one year of age out of 1,000 live births in the same year (“Country Comparison: Infant Mortality Rate,” 2013).

**Instrumented deliveries:** Instrumented deliveries include the use of instruments such as forceps or vacuum devices to assist the baby through the birth canal (“Operative vaginal delivery,” 2017).

**Kick counts:** Pregnant women are encouraged to count how many times their babies move around because a lack of movement may indicate a problem. The American Congress of Obstetricians and Gynecologists (ACOG) recommends that the fetus should kick, flutter, swish, or roll at least ten times within two hours (“Kick counts,” 2017).

**Low-risk pregnancy:** Low-risk pregnancy exists in the absence of high blood pressure, polycystic ovary syndrome, diabetes and other metabolic diseases, advanced maternal age, alcohol and cigarette use, and multiple gestation (“What are the factors that put a pregnancy at risk,” 2012).
**Maternal mortality rate (MMR):** This measurement represents the annual number of maternal deaths per 100,000 live births related to or aggravated by pregnancy or the care provided during pregnancy. This measure does not include accidental or incidental maternal deaths ("Country Comparison: Maternal Mortality Rate,” 2013).

**Meconium aspiration:** If a fetus has a bowel movement in utero, the stool, or meconium, is expelled into the amniotic fluid. If the fetus inhales the amniotic fluid containing meconium, respiratory complications may follow ("Meconium aspiration syndrome,” 2015).

**Meconium presence at birth:** This refers to the fluid in the amniotic membranous sac being stained with meconium from a fetal bowel movement. This is an abnormal finding ("Meconium aspiration syndrome,” 2015).

**Montevideo Units (MVUs):** MVUs are a unit of measure for contraction strength and is calculated by deducting the resting uterine tone from the peak uterine activity for each contraction within a ten-minute period ("Uterine Activity,” 2014).

**Non-stress test:** A non-stress test assesses fetal well-being and is completed any time after 28 weeks’ gestation. A belt is wrapped around the mother’s abdomen, and monitors fetal heart rate and movement for 20-30 minutes. A reactive non-stress test indicates that fetal oxygen and blood supply is adequate. A non-reactive result requires further evaluation ("Fetal non-stress test,” 2016).

**Placental abruption:** This occurs when the placenta either partially or completely tears away from the uterine lining, depriving the fetus of sufficient blood supply and potentially resulting in maternal hemorrhage ("Placental abruption,” 2014).
Placental insufficiency: The placenta is considered insufficient when it is unable to supply an adequate amount of nutrients and oxygen to the fetus, potentially affecting the development of the fetus (“Placental insufficiency,” 2016).

Ruptured membranes: This refers to rupture of the amniotic sac. This may occur within the uterus naturally or may be done artificially by an obstetrician prior to or during delivery. In some rare cases, the baby is delivered with the amniotic sac intact (“Rupture of the membranes,” 2015).

Tachysystole: This term refers to a condition in which the uterus is contracting too frequently. Uterine tachysystole is defined as six or more contractions within ten minutes (“Tachysystole,” 2009).

Unfavorable cervix: An unfavorable cervix is associated with a decreased likelihood of successful vaginal delivery, and a Bishop’s score equal to or less than five (Harman & Kim, 1999).
Appendix B: Figures

Figure 1. Cesarean delivery rates: United States, 1991–2007

![Graph showing annual cesarean delivery rates from 1991 to 2007 with data points for each year between 22 and 32 per 100 births.]


Figure 2. Induction of labor at each gestational week 34–38: United States, 2006–2012

![Graph showing the percentage of births by gestational age from 34 to 38 weeks, with data for each year from 2006 to 2012.]

NOTES: Singletons only. Thirty-four, 35, and 36 weeks are late preterm; 37 and 38 weeks are early term. Access data table for Figure 2 at: http://www.cdc.gov/nchs/data/databriefs/db155_table.pdf#2.