Increasing Use of Intermittent Auscultation of the Fetal Heart Among Low-Risk Laboring Patients: A Quality Improvement Project

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Abstract

Continuous electronic fetal monitoring has not been shown to improve long-term neonatal outcomes. It is instead linked to increased rates of cesarean sections and assisted vaginal deliveries. Increasing the rate of intermittent auscultation is one proposed solution to decrease the cesarean rate. Guidelines for fetal monitoring are not specific about which patients are considered low-risk for uteroplacental insufficiency and should be monitored with intermittent auscultation in labor. Monitoring decisions are often left up to the discretion of the admitting provider.

This project aimed to determine the baseline rate of intermittent auscultation (IA) being used among Oregon Health & Science University midwifery faculty practice patients, assessed attitudes and knowledge of intermittent auscultation by providers, and developed and implemented an evidence-based checklist to clarify patient risk status on admission. Measures included provider attitude and knowledge of IA, and rates of IA monitoring orders being placed on admission for appropriate patients.

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Problem Description

The twentieth century was a time for developments that advanced obstetrics, but as maternal mortality struggles to sustain improvements in the U.S., some of those advancements have come under scrutiny and are being reexamined. Protocols and medications to decrease postpartum hemorrhage, and recognition and preemptive treatment of preeclampsia and eclampsia are advancements which have significantly reduced maternal morbidity and mortality, and continue to be used and improved. Continuous electronic fetal heart rate monitoring (cEFM) was another development, however, it has come under scrutiny and been reconsidered for its near-universal use in labor. Continuous EFM is a procedure "in which instruments are used to continuously record the heartbeat of the fetus and the contractions of the woman's uterus during labor" (ACOG, 2018). Continuous EFM was first promoted in the 1960s as having the potential to decrease cerebral palsy by alerting nurses and providers to changes in the fetal heart rate during labor, allowing time for intervention as needed, or to deliver the fetus safely (Banta & Thacker, 2001). Following the implementation of cEFM, cerebral palsy rates have remained unchanged, and cesarean section rates increased (Banta & Thacker, 1978). Despite the lack of improved outcomes, cEFM has remained the standard in monitoring in most US institutions. As of 2014, it was used in 90% of labors in the United States (Declercq, Sakala, Corry, Applebaum, & Herrlich, 2014). In many institutions it is the only monitoring option for patients in labor. An additional important factor in this is the training, confidence, and competence of the nursing staff to correctly perform and interpret IA. If nurses do not have adequate training in IA, cEFM has come to be the default monitoring during labor.

As cesarean births have reached their highest rates in the U.S., experts are examining ways to decrease primary cesareans (Lombard & Archil, 2016). One possible solution is the use of intermittent auscultation (IA) as a preferred method to monitor the fetal heart rate in low risk labors. (American College of Nurse-Midwives, 2015). Intermittent auscultation is "the technique of listening to the fetal heart rate for short periods of time without a display of the resulting pattern" (Lewis & Downe, 2015). The American College of Obstetricians and Gynecologists (ACOG), recommends development of protocols for IA when low-risk patients desire less invasive monitoring (AGOC, 2017a). The Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN) recommend that monitoring be a decision made between patient and provider taking into account clinical factors and patient preference, but also that the least invasive form of monitoring is preferred to promote physiologic birth (AWHONN, 2015).

Advantages of IA over cEFM include allowing the laboring person more mobility, which has been shown to benefit the progress of labor. It also allows for frequent contact between nurses or providers and the patient, facilitating increased labor support, and assessment of labor progression (Lewis & Downe, 2015).

Despite the endorsement to use IA to monitor the fetal heart rate of low-risk patients by organizational guidelines including the American College of Obstetricians and Gynecologists (ACOG) and the American College of Nurse-Midwives (ACNM), the majority of patients are still being monitored with cEFM (ACOG, 2017a; ACNM, 2015). There are several perceived barriers to widespread use of IA. Intermittent auscultation can increase staffing demands because of the need to have one nurse for one patient to adequately monitor every thirty, fifteen, or five minutes per protocol. Providers may have trained in high-risk hospital settings where few patients qualified for IA and they are therefore less familiar with its appropriate application and

technique. There are no evidence-based parameters for standard IA technique; recommendations differ between organizations (ACNM, 2015). Discrepancies also exist between providers regarding which patients are defined as high- or low-risk and therefore are eligible for IA verses cEFM. When there is not a clear indication, shared decision making between provider and patient becomes all the more important.

Available Knowledge

An often-cited argument for cEFM is that without it changes in the fetal heart rate may be missed. Major changes in the fetal heart rate may result from lack of oxygenation to the fetus as a result of uteroplacental insufficiency, and fetal morbidity or mortality may ensue from asphyxia (Krishna & Bhalerao, 2011). In a Cochrane Review from 2017, Alfirevic, Devane, Gyte, & Cuthbert found no evidence that cEFM leads to improved long-term neonatal outcomes when compared with IA. Alfirevic et al.'s review (2017) included 13 trials, and over 37,000 patients. The review included studies of patients who were both low-risk and high-risk, which is significant. IA is usually thought of as only safe in patients who are low-risk, but this data showed safety of IA in both low- and high-risk populations. It was estimated that use of cEFM over IA resulted in increased maternal morbidity due to an increased cesarean section rate of 63% and operative vaginal delivery rate of 15% with no improvement in neonatal outcomes (Alfirevic et al., 2017). In 2019 Heelan-Fancher et al. confirmed Alfirevic's findings that cEFM in low-risk pregnancies increases cesarean section rates, as well as assisted vaginal birth rates with no decrease in neonatal morbidity. Heelan-Fancher et al's retrospective analysis (2019) looked at birth data in two states over two decades, including over 1,500,000 low-risk births. Both Heelan-Francher et al., and Alfirevic et al.'s reviews have large sample sizes, which decreases the likelihood that their findings were random.

Based on these studies, as well as others, the major worldwide obstetrics organizations including the International Federation of Gynecology and Obstetrics (FIGO), the American College of Nurse-Midwives (ACNM), the American College of Obstetricians and Gynecologists (ACOG), the Royal College of Obstetricians and Gynaecologists (RCOG), the Society of Obstetricians and Gynaecologists of Canada (SOGC), and the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN), have synthesized outcomes of international literature on fetal monitoring to publish guidelines as a clinical decision making aid regarding the type of monitoring that would be most appropriate for individual patients. These guidelines are summarized in Table 1.

Of the national and international guidelines reviewed on fetal monitoring in labor, many provide no examples of conditions requiring cEFM, and some provide a partial list and left other conditions to provider discretion. Advanced maternal age, gestational diabetes, hypertensive disorders of pregnancy, meconium stained amniotic fluid, obesity, post-term pregnancy, and previous cesarean section were selected for review in this project because one or more organizational guidelines consider them factors that make pregnancy high-risk (ACOG, 2017a; FIGO 2015). ACNM, however, allows for the discretion of the individual institutions to make a risk determination (ACNM, 2015). This is due to lack of clear evidence that these conditions are all high-risk specifically for uteroplacental insufficiency, which can affect how the fetal heart rate responds to labor.

The Grading of Recommendations, Assessment, Development and Evaluation (GRADE) criteria were utilized to evaluate evidence reviewed, and make recommendations based on the quality of evidence. Refer to Table 2 for an explanation of this criteria. The below recommendations are classified as strong or weak, depending on how strongly the desired effects

outweigh the undesired effects, and are qualified as high, moderate, low, and very-low evidence based on the number and type of sources found to review.

Advanced Maternal Age

No studies provided a clear recommendation that advanced maternal age (AMA) alone is a contraindication for IA. There is evidence of increased rates of uteroplacental insufficiency in AMA populations >35 years old (Lean, Heazell, Dilworth, Mills & Jones, 2017). However, the population of patients over 40 years old statistically demonstrate poor outcomes more than younger patients that are not all explained by uteroplacental insufficiency (Miller, 2005). Cavazos-Rehg et al. (2015) found that for all patients over 35 the odds ratio of developing hypertensive complications and superimposed preelclampsia was increased. That risk was only slight increased for patients between 35-40, and more significantly increased in patients over 40. Hypertensive complications and superimposed preeclampsia both cause uteroplacental insufficiency. It is therefore reasonable to recommend cEFM to those over age 40. The evidence is less robust to recommend that patients ages 35-40 have eCFM. This is a situation where shared decision making becomes important, and recommendations may be specific to the individual patient considering comorbidities and other relevant factors such as patient preference, or previous pregnancy and birth outcomes. *Weak Recommendation, Moderate Quality Evidence. Based on 4 retrospective cohort studies, 1 case-controlled study, 1 observational study, and 2 systemic reviews.*

Gestational Diabetes

The concern for uteroplacental insufficiency in gestational diabetes arises from placental vascular pathology that occurs in pregnancy in the setting of diabetes (Huynh et al., 2015). Very few studies differentiated A1 Gestational Diabetes Mellitus (A1GDM) from A2 Gestational

Diabetes Mellitus (A2GDM) or Type 1 Diabetes Mellitus (T1DM) when looking at placental function in pregnancy. Therefore, little is known about how A1GDM affects placental function. Generally, patients with A1GDM are managed similarly to the non-diabetic low-risk population due to there being no increased risk of stillbirth among those with A1GDM (Taricco et al., 2009). Because of established low-risk status in A1GDM, antepartum fetal well-being testing and induction of labor are not standard of care according to ACOG guidelines, but left to the discretion of providers (ACOG, 2017b). In practice, some hospital policies permit patients with A1GDM to qualify for IA if they have no other risk factors; others treat all patients with diabetes as high-risk (Sharma, & Goyal, 2016; Galipeau, Khangura, Grimshaw & Moher, 2010). Considering this evidence, A1GDM is not an indication for cEFM. Shared decision-making may be utilized and patient comorbidities should be considered. If all other aspects of pregnancy are normal, IA is the preferred monitoring method. *Weak Recommendation, Very Low Quality Evidence. Based on 1 retrospective cohort study, 1 prospective cohort study, and expert opinion.*

Hypertensive Disorders of Pregnancy

In all types of hypertensive disorders of pregnancy, placental development and vascularity is altered from normal physiology (Stanek, 2018; Suranyi, Altorjay, Kaiser, Nyari, & Nemeth, 2017; Salmani et al., 2014). Hypertension in pregnancy can result in placental pathology leading to fetal growth restrictions and oligohydramnios due to uteroplacental insufficiency (Salmani et al., 2014). Regardless of whether these conditions have developed, the risk of adverse perinatal outcomes is significantly increased enough to classify all patients with hypertension as high-risk. For this reason, ACOG recommends weekly antenatal testing for patients diagnosed with gestational hypertension or preeclampsia from time of diagnosis until induction of labor at 37 weeks (ACOG, 2019a). According to current recommendations, all

hypertensive disorders of pregnancy indicate risk for uteroplacental insufficiency and should be monitored using cEFM while in labor. *Strong Recommendation, Low Quality Evidence. Based on 2 retrospective cohort study, 1 prospective cohort study, 1 observational study, and expert opinion.*

Meconium Stained Amniotic Fluid

The presence of meconium stained amniotic fluid (MSAF) has been linked with fetal distress, NICU admissions, low Apgar scores, and other neonatal morbidities (Hiersch et al., 2016; Sheiner et al., 2002). However, MSAF alone is not an indication of uteroplacental insufficiency (Sheiner et al, 2002; Rodriguez Gernandez, Ramon Y Cajal, Ortiz & Naveira, 2018). As noted by Roy Mondal, Bandyopadhyay, Mukhopadhyay, and Ganguly (2019), passage of meconium may be considered normal in some cases, such as breech deliveries, and that it is a normal sign of physiologic maturity after delivery. While the passage of meconium before delivery may be a sign of fetal distress, it is not always the case.

Meconium stained amniotic fluid has been associated with abnormal fetal heart rate patterns (Sheiner et al., 2002). This association results in the recommendation by some for categorizing a labor with MSAF as high-risk, which may require continuous electronic fetal monitoring. Rodrigues Gernandez, Ramon Y Cajal, Ortiz and Naveria (2018) found that the risks to the baby associated with MSAF increase as the staining and consistency evolve from clear and thin fluid, to brown, green and thick meconium during labor. This evolution may indicate a need for cEFM more than fluid that is initially meconium stained, but light in color and thin, and remains that way.

There have been no randomized controlled trials directly comparing cEFM and IA with MSAF and neonatal outcomes. Based on limited evidence, MSAF is not an automatic indication

for cEFM and it is recommended that co-morbidities are taken into account. A preliminary fetal heart rate tracing via cEFM is recommended at admission or when MSAF is first noted. Conversion to IA may be considered if the tracing is within normal limits. A discussion using shared decision making with patient and provider is recommended. Fluid that is thicker and darker in color and fluid that evolves from clear to meconium-stained throughout labor should be an indication for cEFM. *Weak Recommendation, Low Quality Evidence. Based on 2 retrospective cohort studies, 1 observational study, 2 prospective cohort studies, and expert opinion.*

BMI >30.0

Maternal obesity is often considered to be a high-risk condition. It is associated with pregnancy complications including gestational diabetes, gestational hypertension and preeclampsia, all of which can be linked to uteroplacental insufficiency (Howell & Powell, 2017). Only one study has looked at outcomes of cord blood pH differentiated into obesity categories, and they found that as BMI increases, cord arterial pH decreased, and base deficit increased (Edwards et al., 2013). Brocato, Lewis, Mulekar, and Baker (2019) found that patients with higher BMIs spent more time in labor with the FHR not tracking on the monitor when using cEFM that patients with normal BMIs. This presents a risk of heart rate changes going undetected.

More research is needed to clarify specific labor risks related to obesity. It would seem reasonable that choice of monitoring should be a shared decision between patient and provider based on individual patient circumstances. In the absence of other comorbidities such as gestational hypertension or IUGR, intermittent auscultation may be appropriate for monitoring in

obese patients. *Weak Recommendation, Very Low Quality Evidence. Based on 1 retrospective observational study, 2 morphological analyses, 1 population cohort study, and expert opinion.*

Postterm Pregnancy (>42 0/7)

There are well-documented complications that increase after 42 weeks of gestation including risk for macrosomia, shoulder dystocia, dysmaturity syndrome, and stillbirth (Ayyawoo, Derraik, Hofman, & Cutfield, 2014). One often-cited reason for complications is uteroplacental insufficiency arising from the aging placenta (Maiti et al., 2017; Galal, Symonds, Murray, Petraglia, & Smith, 2012). Some postterm pregnancies may show signs of uteroplacental insufficiency, but others may have strong uteroplacental reserve. The choice of type of monitoring in labor for patients with postterm pregnancies should involve shared decision making between the patient and provider based on the fetal and pregnancy risk factors. *Weak Recommendation, Very Low-Quality Evidence. Based on 2 observational studies, 1 longitudinal study, and expert opinion.*

Previous Cesarean Section

Trial of labor after cesarean (TOLAC) or previous uterine scar is routinely included in the conditions that exclude patients from intermittent auscultation while in the hospital. The ACOG committee opinion, *Approaches to Limit Intervention in Labor and Birth* (ACOG, 2017a), explicitly recommends cEFM in the case of a TOLAC patient. In 70% of the cases of uterine rupture there are abnormal fetal heart rate patterns (ACOG, 2017a). At this time, standard of care mandates cEFM for patients with previous cesarean sections in labor. While the current AGOC recommendation is that patients who desire VBAC give birth in a hospital setting, there is an increasing number of patients seeking TOLACs in an out-of-hospital setting, where IA is the only monitoring option (ACOG, 2019b; MacDorman, Declercq, & Menacker, 2011). There is

limited evidence on outcomes of out-of-hospital VBACs, but the data that exists reflects the same increased risks with VBACs that are already known, including uterine rupture (Cox, Bovbjerg, Cheynet, & Leeman, 2015). *Weak Recommendation, Moderate Evidence. Based on 1 systemic review, 1 randomized control trial, and expert opinion.*

Summary

Shared decision making is central to any management decision in labor, including what type of fetal monitoring is appropriate. Current evidence indicates that patients over 40, those with hypertensive disorders of pregnancy, and previous cesarean section should have cEFM in labor. Patients under 40, A1GDM, meconium stained amniotic fluid, obesity, or postterm pregnancy may qualify as appropriate for IA if there are no other comorbidities or contraindications.

Framework

The framework for this project was Ajzen's Theory of Planned Behavior (TPB). Ajzen theorized that behavior develops from behavior intentions. Behavior intentions stem from three factors: attitude towards the behavior, subjective norm, and perceived behavioral control (Ajzen, 1991). This project aimed to change provider behavior in admission orders, addressed attitudes toward this behavior, and designed an intervention aimed at increasing perceived behavioral control.

Global and Specific Aims

This project had a global aim to increase use of IA in the Oregon Health & Science University (OHSU) midwifery faculty practice setting. As there have been no previous quality assessment or quality improvement projects on this topic in this group, this project began by assessing the current baseline use of IA in the practice. Specific aims included: 1. Determining a

current baseline for IA ordering on admission among the midwifery faculty practice 2. Collecting data on midwife attitudes and knowledge about IA use 3. Utilizing an intervention to increase faculty admission orders for IA in appropriate patients so that by March 30, 2020, 90% of IA eligible CNM patients at OHSU received IA orders on admission 4. Colleting post-intervention midwife attitudes and knowledge about IA use to compare to pre-intervention data.

Methods

Context

Oregon Health & Science University (OHSU) is an urban, academic, tertiary-care, Level 1 trauma center. There are three care teams on the labor and delivery unit: 1) Maternal-fetal medicine and the generalist obstetrician and resident practice, 2) Family medicine and their resident practice, and 3) Nurse-midwifery practice. Each team has a separate patient panel but share staff and resources in the hospital.

The OHSU Nurse-Midwife faculty practice is comprised of 14 Certified Nurse-Midwives (CNMs), and approximately 8 per diem CNMs. The CNMs work 12 or 24 hours shifts and are responsible for triage, admission, labor and birth, and postpartum care of all CNM patients during their shift. In Oregon CNMs have practice independence, are listed as the admitting provider in patient charts, and place all patient admission and hospital orders. In the electronic health record used at OHSU, a fetal heart rate monitoring order is placed upon admission. The order is placed for either continuous electronic fetal monitoring or intermittent auscultation. Once factor on which this is based is a nonstress test (NST) that all patients receive during evaluation for admission. If the NST is not reactive according to NICHD criteria, patients will be required to continue cEFM until it has been determined the fetal heart rate is reactive. The nursing staff then carry out the orders for type of monitoring. It should be noted that there is no

evidence that NST admission tests are beneficial to low-risk patients, but in the U.S. NSTs are standard of care in hospital labor admissions (Blix, Reinar, Kloving, & Øian, 2005).

There are many providers within the midwifery practice who admit and care for patients. It was anticipated that individual provider assessment and discretion may have led to differences in management for patients.

Measures

An initial baseline for number of patients receiving orders for IA on admission was obtained. Patient medical records were reviewed to extract type of monitoring ordered on admission, patient risk factors, and type of monitoring received in labor. A baseline rate was calculated of how many patients who qualified for IA received an IA monitoring order on admission.

A pre-test survey was given to evaluate CNM attitudes toward patient risk factors for uteroplacental insufficiency in labor, and knowledge of monitoring guidelines and current evidence. After the intervention and three PDSA cycles, a posttest survey was given to evaluate changes in attitudes and knowledge. A Likert Scale survey was used for the pre- and posttests. The Likert scale is widely used and is a validated measure (Joshi, Kale, Chandel, & Pal, 2015). An even-numbered "forced choice" Likert scale was used to elicit provider choice of either cEFM or IA in example patient situations.

After the interventions were implemented, patient medical charts were reviewed retrospectively to calculate a post-intervention rate of patients receiving orders for IA on admission. This was the measure of changed CNM behavior.

Intervention

The interventions were: 1. An educational module for the midwives reviewing current evidence on high-risk and low-risk conditions pertaining to the choice of fetal heart rate monitoring 2. An admission checklist to evaluate each patient for risk factors requiring cEFM. If patients were low-risk for uteroplacental insufficiency, or had no risk factors, it was recommended that they receive counseling and informed consent on the recommendation for IA use during labor. If, after counseling the patient agreed with the recommendation for IA, an admission order was placed. Beyond being recommended in the educational module, shared decision making was not tracked in this project. This would be a potential area of future study.

Based on the baseline assessment of knowledge of IA criteria, an educational module was designed to standardize the CNM's knowledge about current evidence on patient risk factors and fetal monitoring options. It was designed to be brief and with the ability to completed in 20 minutes. The education was provided to CNMs present at the December 17, 2019 midwife faculty meeting in-person using a Microsoft® PowerPoint®. Providers were allowed time for questions and clarifications.

A checklist served as a tool to make ordering of IA more consistent and less discretionary between providers. The checklist was based on most current evidence described above as to which conditions necessitate cEFM. The checklist was a paper form completed by the CNM or student nurse-midwife upon admission of all term patients in spontaneous labor. Three PDSA cycles were used to improve implementation of the checklist and add any additional educational pieces based on what is learned in each cycle. The checklist also included a space for providers to indicate if IA was ordered. If the patient had none of the listed risk factors, and cEFM was ordered, the provider was asked for the reason for cEFM. See Appendix A for the checklist used.

Analysis

During the chart audit, patient information was never matched with identifiable patient characteristics. This was intentional to protect personal health information, and did not compromise any project aims. The only information collected and recorded was patient risk factors for uteroplacental insufficiency, and if they received IA orders on admission.

The CNM pre-test and post-survey were conducted in Qualtrics. This created anonymous survey responses, which were recorded in Microsoft® Excel®. Basic computations in Excel® were used to calculate rates of patient admission orders on IA. The checklist was used to determine if the specific aim was reached of having of 90% of IA-eligible patients receive appropriate admission orders.

Run charts were created using Microsoft® PowerPoint® to show percent of IA-eligible patients who received admission orders for IA before and after implementation if the interventions.

Ethical Considerations

The proposed intervention addressed CNM behavior about a current standard of care from a systems and knowledge perspective. Using the theoretical framework, the project aimed to understand if knowledge of best practice, specifically IA in the appropriate setting, was selected when appropriate. The project, therefore, was for quality improvement, and did not constitute patient research. A request for determination was submitted to the OHSU Institutional Review Board (IRB) and was assigned a determination of Not Human Research. Patient medical records were reviewed retrospectively to extract data on the type of monitoring they received in labor and the information was de-identified as described above. CNM survey data were de-identified the proposed intervention did not change provider and patient shared decision making and evidence-based safe practice.

Results

Evolution of Project

This project had a number of small changes that were made during implementation. First, the educational module was given only to the midwives present in-person, or over the phone at the December 17, 2019 faculty meeting. Any midwives not present, including the per diem midwives, were emailed the PowerPoint® and condensed summary of the educational materials provided in the CNM office during the quality improvement project. The educational module was also intended to be given to the midwifery students, however, due to scheduling and coordination issues that was unable to happen. This may have hindered the project as the students are often involved with the admission process.

The PDSA cycles were originally scheduled to run January 1-28, February 1-28, and March 2-30. Due to time taken in-between each cycle to review results and make changes before the next cycle, and inform the faculty midwives of those changes, the actual dates of the PDSA cycles changed slightly. PDSA cycle 1 ran January 1-28, PDSA cycle 2 ran February 6-March 4 and PDSA cycle 3 ran March 16-April 12.

Between cycles 1 and 2 one edit was made to the checklist due to an error of one item being duplicated. Otherwise, a faculty midwife made a recommendation to attach the admission data checklists to an unrelated patient research data form that midwives fill out for each admitted patient on the unit to increase utilization by pairing the new project form with an established form habit. However, this led to another potential for missed forms if the established research data form was not present. This can happen if the midwives take care of a patient in labor who was not otherwise seen in prenatal clinic. It was also clarified that checklists should be filled out on all admitted patients, including those admitted for scheduled inductions. The checklist

included an option to indicate if patients were admitted for induction or augmentation, which usually disqualified them from IA based on the hospital policy requiring cEFM with most induction or augmentation methods.

Between PDSA cycles 2 and 3 data were reviewed to determine specific suggestions for improvement. Faculty were asked in an email to remind per diem midwives they were giving handoff report to about the project, as those were the midwives who did not receive the initial in-person educational intervention. The per diem midwives were noted to be the providers working several of the shifts during which admission checklists were not completed. Extra blank patient admission checklists were also provided in a convenient location in case the paired research data form was missing at the time of a patient's admission.

Unintended Consequences

During PDSA cycle 3 hospital staffing and protocols changed due to COVID-19 restrictions. Changes that may have affected the QI project included students no longer being present on the unit, and focus and priority being given to patient and staff safety, with research and other non-essential tasks given less attention. This may have affected the quality of improvement during PDSA cycle 3. PDSA cycle 3 had fewer admission checklists filled out than PDSA cycle 2; cycle 3 was missing 5 admission checklists, whereas cycle 2 was missing 2 data forms. However, because cycle 3 had more overall admissions than cycle 2 they both had checklist filled out for 86% of patients admitted, so the COVID-19 restrictions may not have had a significant effect.

Missing Data

Because a paper system was used, there was significant room for human error in data collection. Paper forms were filled out by the midwives for each admission and collected in a

folder that remained on the unit. This folder was picked up monthly between the PDSA cycles. These were then cross-referenced with a list of admissions by the CNM practice provided by the practice coding and billing specialist. There were some discrepancies between the two lists; during PDSA cycle 1 there were 10 patient admissions without data forms completed of 28 total admissions during the cycle (36%). There were also two data forms completed that could not be matched to a patient admitted to the practice based on the provided list of admissions. In PDSA cycle 2 there were 3 patient admissions without data forms completed of the 22 total admissions during that cycle (13%). There was also 1 data form completed that could not be matched to a patient admitted to the practice. In PDSA cycle 3 there were 5 patient admissions without data forms completed of 36 patient admissions during that cycle (14%). There were also 6 data forms completed that could not be matched to a patient admitted to the practice. During PDSA cycle 3 there was 1 antenatal intrauterine fetal demise admission for which no admission form was filled out. This patient admission was removed from the data because no monitoring was needed during the induction. The PDSA admission list sent from coding also included 2 OBGYN patients, and 3 patients whose baby MRN was listed instead of the birthing parent, which was traced back to the correct patient's chart. These discrepancies come with human error, but need to be taken into account with the results of the quality improvement project.

Discussion

Key Findings

Faculty Knowledge of Current Monitoring Recommendations

On the initial faculty survey of attitudes and knowledge on fetal monitoring showed multiple areas of discrepancy. The initial survey was sent to 16 providers, and 13 surveys were completed. Providers were in agreement on type of monitoring appropriate based on the

following patient factors: patient age <40, gestational age 37w 0d-41w 6d, NICHD Category 1 &3, TOLAC, diagnosed gHTN and PET, diagnosed IUGR, AFI <5, and Pitocin for IOL or augmentation. Areas of disagreement included patient age ≥40, gestational age ≤36w6d and ≥42w0d, NICHD category 2, A1GDM & A2GDM, BMI, elevated BP in triage; labs pending, ruptured membranes, meconium stained amniotic fluid, AFI >5, suspected IUGR, misoprostol, AROM, Foley balloon, and Cook balloon. An educational module was developed based on these factors to review current evidence, and presented to the midwives at the December 17, 2019 faculty meeting in a PowerPoint® format. A summary document of evidence and recommendations was also placed in the midwifery call room for reference for the duration of the project. After the third PDSA cycle was completed a post-survey was sent to 16 providers, 11 of which were completed and returned. For both the pre- and post- survey OHSU supported survey platform Qualtrics was used. This allowed for responses to be deidentified, however, because of this pre- and post- survey responses were not able to be compared between the same participant.

In the post-survey there was still a large amount of discrepancy between what the participants reported as to what they considered indication for cEFM verses IA. Providers were in agreement on how they would order monitoring for the following factors: gestational age 37w 0d-41w 6d, TOLAC, diagnosed PET, BMI 25.0-29.9, ruptured membranes <24 hours with clear fluid, thick meconium, AFI 6.1-7.0, and Pitocin for IOL or augmentation. There was disagreement in ordering on the following factors: patient age, gestational age ≤36w6d and ≥42w0d, NICHD category 2, A1GDM & A2GDM, BMI >30.0, elevated BP in triage; labs pending, ruptured membranes >24 hours with clear fluid, thin and moderate meconium stained

amniotic fluid, AFI >6.0, suspected IUGR, diagnosed IUGR misoprostol, AROM, Foley balloon, Cook balloon, and Cervidil for induction or augmentation.

There are several things to note between the two surveys. The post-survey was initially intended to be the same as the pre-survey, but based on feedback on the initial survey several questions were modified for clarity, or removed. For this reason, the pre- and post- survey cannot be compared directly, but potentially improved the ability to evaluate the responses of the participants. A question regarding the OHSU policy on Cervidil for indication or augmentation was also included in the post- survey and was not on the pre- survey. Overall the survey did not show a significant improvement toward consistency of ordering of monitoring type. This may have been due to differences in the questions asked on the surveys, or it may reflect a need for improvement in the educational module and information given during the project. Another possible reason for this discrepancy is the different comfort levels and experience of the faculty midwives in using IA in some moderate risk situations. From the initial survey data, one midwife had been using IA in their practice as short as 5 years, and another as long as 45 years.

Fetal Monitoring Admission Orders

For the initial audit of provider ordering habits from March and April 2019, fetal monitoring type was ordered appropriately based on patient risk factors 87.7% of the time. One of the specific aims was to increase appropriate ordering to over 90%.

During PDSA cycle 1 monitoring was ordered appropriately on 27 of 28 patients (96.4%). There were 2 patients who had meconium stained fluid with rupture of membranes, and did not specify thickness or color. In both of these cases the providers ordered cEFM, which was in accordance with OHSU policy, and were therefore considered appropriate ordering. For the one patient who was eligible for IA but did not receive an IA admission order, that patient had an

elevated blood pressure in triage, but it was not sustained and PET labs were normal. This was one of the situations that had been identified in the initial audit, and had been included in the educational module. In this QI project process, continuous monitoring is not recommended until there is an official diagnosis of PET unless other risk factors for utero-placental insufficiency are present. This patient had no other risk factors.

During PDSA cycle 2 monitoring was ordered according to the project recommendations in 21 of 22 admitted patients (95.4%). For the patient on which it was not ordered, there had been 1 variable deceleration during the admission NST, but then the tracing returned to Category 1. Continuous monitoring was ordered for this patient. Recommendations during the educational module had been that it is appropriate to return to IA after 20 minutes of a Category 1 tracing.

During PDSA cycle 3 monitoring was ordered according to the project recommendations on 32 of 36 admitted patients (88.9%). One patient did not seem to have any possible reason for the incorrect ordering. One patient had a Foley balloon during induction, but did not have misoprostol at the same time, which, in accordance to OHSU policy included in the educational module, would have qualified her for IA after an initial period of cEFM after placement of the balloon. The final two patients had no risk factors and had IA indicated on their checklist, however, during the chart review were found to have been ordered cEFM. This may have been a human or systems error based on pre-selected monitoring orders in some electronic order sets in the electronic health record.

Overall for the 86 patients admitted during the 3 PDSA cycles, 80 had monitoring ordered appropriately (93.0%). Chart 1 displays a run chart showing the data broken down by month, and the overall averages.

Interpretation

Comparison of Findings to Literatures

While this review found no literature evaluating this exact type of study, the results showed that utilizing a tool can increase appropriate ordering of intermittent auscultation in general, but also consistency across a practice. This is a newly developed tool and it has not been validated. However, on this small-scale the tool increased consistency between provider monitoring orders of monitoring of IA or cEFM based on patient risk factors. Future research projects could compare birth outcomes comparing patients who received IA in labor, and patients who received cEFM in order to build a larger base of evidence.

Expected verses Observed Results

One unexpected result was the focus and attention that was needed to increase utilization of the project tool, the admission checklist. Utilization of the admission checklist the first month was the lowest, with checklists being completed for just 64% of patients admitted to the unit. PDSA cycles 2 and 3 completion of the checklist increased to 86%. However, much of the focus between the PDSA cycles was making the checklists easier to complete for the midwives, for example, attaching the checklist to the already-established database form, rather than making changes to the recommendations or increasing education. It had been anticipated that more focus would be on improving the tool itself, rather than focusing on tool use at all.

This quality improvement project took place in an academic setting where there are often multiple quality improvement projects happening simultaneously in some form on the unit, and there may have been some project fatigue. Focusing on what is most needed and desired by the midwives when designing a project is essential to increase interest and buy-in to any project.

Impact of Project on System

This quality improvement project was a small project to start gathering baseline data in a single system. It identified some of the key areas to target, including admission order for patients on the unit, and specific inconsistencies in ordering between providers about what type of monitoring is appropriate for patients. This project used the measure of admission orders to look at improvement. This project had a global aim to increase use of IA in the Oregon Health & Science University (OHSU) midwifery faculty practice setting. The global aim was attained by developing a targeted education module reviewing current evidence-based practice in fetal monitoring, and developing an evidence-based tool to help build consistency across admission monitoring orders. An overarching reason for increasing IA use is to decrease cesarean section rates; the project was not designed to examine birth outcomes. This project was intended to be the first of many to improve utilization of intermittent auscultation, and it will likely take multiple quality improvement cycles targeting different areas of the system that could be improved to see significant reduction in cesarean section rates.

Limitations

Generalizability

This project was designed and implemented in a specific practice and context; however, many of the lessons and principles can easily be expanded and utilized by other practices in other systems. If a practice has interest in expanding their use of intermittent auscultation, and consistency of use between providers, they could facilitate a discussion about their practice and hospital policies on fetal monitoring and risk assessment, and create a similar admission checklist to be used in their practice. There are many resources for similar checklists available, including through ACNM discussion boards.

Internal Validity

Because of the high potential for human error, the internal validity of the project may have been easy to compromise. Several cases were noted of forms filled out differently from what was recorded in the patient chart, and there were higher than anticipated discrepancies between admission checklists completed and patients admitted by the midwifery service per the coding list. Because there were so many midwives involved with completing forms, and a number of them were per diem who were not present at any of the launching presentations and educational sessions, there was room for variation despite best intentions to increase consistency.

Adjustments

Adjustments were made between PDSA cycles 1 and 2 to try to increase usability of the admission checklist. The location of the checklist was moved to be associated with an existing paper form that was completed for each patient admission. Information was also made readily available for reference so that midwives and students had easy-access to be reminded to monitoring data and recommendations that had been made in the educational session. Adding a digital charting component connected to a dot phrase in the electronic health record for easier use was also discussed, but ultimately it was decided that was not the optimal process change. Therefore, despite the higher potential for human error, paper checklists were kept throughout the three cycles.

Conclusions

Usefulness

The American College of Nurse-Midwives has identified decreasing the primary cesarean section as one of their focus areas, and increasing use of intermittent auscultation is one way to achieve that goal. Reviewing the evidence available addressing fetal monitoring in labor, and compiling it into an easy-to-use tool that can be adopted by many different practices in different

labor settings is one way to work toward that larger goal. The versatility also makes it more useful to the larger community, than just to one population or group.

Sustainability

This project was not intended to be sustained long-term. It was intended to be implemented for three months to help shift and reinforce the ordering habits for fetal monitoring on admission. It also provided tools that could continue to be utilized for reference if needed. If the practice were interested in continuing the admission checklists, it would be feasible to provide a pocket, laminated copy of the admission checklist to be kept in the midwife call-room, or the charting area on labor and delivery—areas that are commonly used when placing admission orders. This way the checklist could be referenced when appropriate, without the need for an ongoing paper checklist to be filled out for each admission.

This could also be a useful tool to use while teaching the midwifery students about what factors to consider when admitted a new patient to the unit. Giving students clear guidance on IA eligibility will make them more likely to perform IA in their own practice when it has been an ingrained part of their practice from the beginning of their training.

Expansion of Settings

This project can be easily expanded into other settings. Whether it is a midwife practice, family practice, OBGYN, or combined, the principles remain the same. The same data will support monitoring in all hospital settings. Practices will need to individualize the checklist for their institution and agreed on levels for risk factors, but underlying implementation would not be much different.

Further Study

There are many areas for further study on this topic. This project looked at the initial orders placed regarding fetal monitoring in labor, but it is important to look at how those orders are implemented, how long intermittent auscultation is utilized when started, reasons for switching to cEFM, how to encourage reverting back to IA from cEFM when appropriate, and ultimately birth outcomes. There are also likely many barriers and areas of study with labor and delivery nurses who are most often the ones performing monitoring while in labor.

Next Steps

Next steps include a final report to the midwife faculty on the results of the quality improvement project. It would also be advantageous to involve them in a discussion of their priorities, based on the results, for future projects as they are key stakeholders. This type of tool could also be validated in the future for further expanded use in different types of practice settings.

Funding

This study was not funded, and with the exception of printing, did not have costs of implementation. There were no conflicts of interest in the recommendations made or the outcomes. Cost should not be a barrier in further study of this topic or implementation of a similar quality improvement project in other settings.

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APPENDIX A

Table 1. National and International Organization Guidelines around Fetal Heart Rate Monitoring

Organization	**Year Published**	**Who should get continuous electronic fetal monitoring**	**Who should get intermittent auscultation**	**Full citation**
FIGO Guidelines	2015	"most experts believe that continuous CTG monitoring should be considered in all situations where there is a high risk of fetal hypoxia/acidosis, whether due to maternal health conditions (such as vaginal hemorrhage and maternal pyrexia), abnormal fetal growth during pregnancy, epidural analgesia, meconium stained liquor, or the possibility of excessive uterine activity, as occurs with induced or augmented labor. Continuous CTG is also recommended when abnormalities are detected during intermittent fetal auscultation." (p 13)	No specifications	Ayres-de-Campose, D., Spong, C.Y., & Chandraharan, E. (2015). FIGO consensus guidelines on intrapartum fetal monitoring: Cardiotocography. *International Journal of Gynecology & Obstetrics, 131,*(1), 13-24.
ACNM	2015	Anyone who is not low risk: "For the purpose of this bulletin, low risk refers to women who have no medical or obstetric conditions that are associated with uteroplacental insufficiency or conditions that are associated with an increased incidence of umbilical artery pH of less than 7.1 at birth." (p 628)	"IA is the preferred method for monitoring the FHR during labor for women at term who at the onset of labor are at low risk for developing fetal academia." (p 631) "For the purpose of this bulletin, low risk refers to women who have no medical or obstetric conditions that are associated with uteroplacental insufficiency or conditions that are associated with an increased incidence of umbilical artery pH of less than 7.1 at birth." (p 628)	American College of Nurse-Midwives. (2015). Intermittent Auscultation for Intrapartum Fetal Heart Rate Surveillance: Clinical Bulletin Number 60. *Journal of Midwifery and Women's Health, 60*(5), p 626-632.
ACOG	2017	Anyone who is not low risk	"*Low risk* in this context has been variously defined, but generally includes women who have no meconium staining, intrapartum bleeding, or abnormal or undertermined fetal test results before birth or at initial admission; no increased risk of developing	The American College of Obstetricians and Gynecologists. (2017). Approaches to Limit Intervention During Labor and Birth. *Committee Opinion Number 687.*

			fetal academia during labor (eg, congenital anomalies, intrauterine growth restriction); no maternal condition that may affect fetal well-being (eg prior cesarean scar, diabetes, hypertensive disease); and no requirement for oxytocin or augmentation of labor." (p 4)	
RCOG	2015	"Women who are apparently at low risk should have a formal fetal risk assessment on admission in labour irrespective of the place of birth to determine the most appropriate fetal monitoring method."	Directed to refer to the guideline on intermittent auscultation from the Royal College of Midwives	Royal College of Obstetricians & Gynaecologists. (2015). Intermittent auscultation: Key recommendations. *Each Baby Counts 2015.*
RCM	2018	"CTG should only be used when there is a clear clinical reason. Women without clinical indication for continuous monitoring should not be offered a CTG on arrival at a birth unit as part of a standard admission process…Offering CEFM is currently only recommended for women where pregnancy or labour complications pose a risk to the baby" (p 19)	"Intermittent fetal heart rate auscultation through labour, using a Doppler or a pinard, is likely to be more suitable for women clinout clinical indication for CTG." (pg 19)	The Royal College of Midwives. (2018). Midwifery care in labour guidance for all women in all settings. *RCM Midwifery Blue Top Guidance, 1,* 1-28.
SOGC	2018	"Electronic fetal monitoring is recommened for pregnancies at risk of adverse outcome. When a normal tracing is identified, it may be appropriate to interrupt the electronic featl monitoring tracing for up to 30 minutes to facilitate periods of ambulation, bathing, or position change, providing that (1) the maternal-fetal condition is stable and (2) if oxytocin is being administered, the infusion rate is not increased."	"[Intermittent auscultation in labour is recommended for] Intrapartum fetal surveillance for healthy term women in spontaneous labour in the absence of risk factors for adverse perinatal outcomes. Intermittent auscultation following an established protocol of surveillance and response is the recommended method of fetal surveillance; compared to electronic fetal monitoring, it has lower intervention rates without evidence of compromising neonatal outcomes…Intermittent auscultation may be used to monitor the fetus when epidural analgesia is used	Liston, R., Sawchuck, D., & Young, D. (2018). No. 197b-Fetal Health Surveillance: Intrapartum Consensus Guideline. *Journal of Obstetrics and Gynaecology Canada, 40*(4), e298-322.

			during labour, provided that a protocol is in place for frequent intermittent auscultation assessment."	
AWOHNN	2015	"Because variation exists in the original research protocols used to compare intermittent auscultation with continuous EFM, clinicians should make decisions about the method and frequency of fetal assessment based on evaluation of factors, including the woman's preferences and response to labor, the phase and stage of labor, assessment of maternal-fetal condition and risk factors, and facility rules and procedures." (p 684)	"A women's preferences and clinical presentation should guide selection of FHM techniques with consideration given to use of the least invasive methods. In general, the least invasive method of monitoring is preferred in order to promote physiologic labor and birth." (p 683)	Association of Women's Health Obstetric Neonatal Nurses. (2015). Fetal Heart Monitoring. *Journal of Obstetric, Gynecologic & Neonatal Nursing, 44*(5), 683-686.

Table 2. GRADE (Grading of Recommendations, Assessment, Development and Evaluation) criteria used to evaluate the body and evidence and used to make clinical recommendations. This table defines how the quality of the evidence is rated and how a strong verses weak recommendation is made.

Recommendation	
STRONG	Desirable effects clearly outweigh undesirable effects of visa versa
WEAK	Desirable effects closely balanced with undesirable effects
Quality	**Type of Evidence**
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g. inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence from at least 1 critical outcome from observational studies, from RCTs with some serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

APPENDIX B

OPTIMIZING USE OF INTERMITTENT AUSCULTATION OF THE FETAL HEART RATE AMONG LOW-RISK LABORING PATEINTS: A QUALITY IMPROVEMENT PROJECT

Checklist adapted from University of Minnesota Medical Center

DATE OF ADMISSION: _____ **TIME OF ADMISSION: _____**

NAME OF CNM OR SNM COMPLETING CHECKLIST: _____

Please check any conditions that would indicate the need for continuous EFM (consult recommendation cheat-sheet as needed)

Maternal Factors:

- ☐ Admission for Induction or Augmentation requiring cEFM (see reference table)
- ☐ Previous Cesarean Section or Other Uterine Scar

Conditions at Risk for Utero-Placental Insufficiency:

- ☐ Diagnosis of Gestational Hypertension
- ☐ Diagnosis of Preeclampsia
- ☐ A2GDM
- ☐ Maternal age ≥ 40
- ☐ AFI ≤ 5

Fetal and Intrapartum Factors:

- ☐ < 36w6d or >42w0d
- ☐ Diagnosis of Fetal Growth Restriction
- ☐ Thick, or dark meconium stained amniotic fluid
- ☐ Blood in Amniotic Fluid Concerning for Abruption
- ☐ Known Cardio-Pulmonary Fetal Anomaly
- ☐ Other fetal anomaly concerning for uteroplacental insufficiency
- ☐ Maternal Fever
- ☐ Category 2 or 3 FHR, or Category 1 <20 minutes

Does the patient have any other risk factors that you have deemed disqualifies them from intermittent auscultation? If so, please list:

What type of monitoring was ordered for the patient at admission?

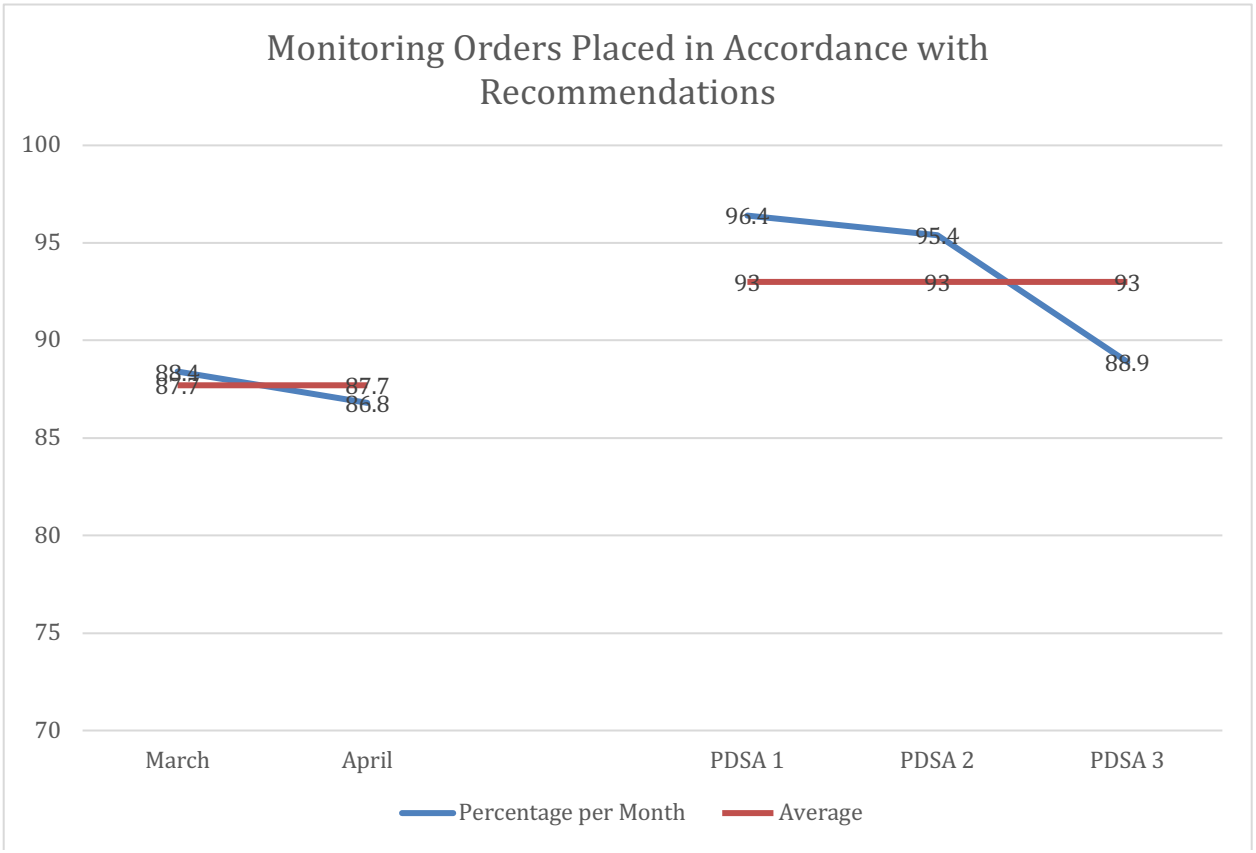
☐ Intermittent auscultation ☐ Continuous EFM

Please return this completed sheet to the purple folder on the CNM desk!

With questions please feel free to contact Carrie Miller at 503-548-8650 (text or call) or millcar@ohsu.edu

You are also welcome to add comments or feedback in the sheet in the folder! Thank you!

Chart 1.


Monitoring Orders Placed in Accordance with Recommendations
100
95
90
85
80
75
70
96.4
95.4
93
93
93
88.9
87.7
87.7
86.8
March
April
PDSA 1
PDSA 2
PDSA 3
Percentage per Month
Average