

**Mother's Own Milk Expression: A Quality Improvement Initiative to Increase the
Provision of Maternal Milk in Very Low Birth Weight Infants**

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Abstract

Breastmilk or maternal milk is widely recognized as the recommended primary source of nutrition for very-low-birth-weight (VLBW) infants. Many of these infants are unable to feed at the breast, leaving mothers with the task of manual breastmilk expression. Providing breastmilk has been proven to decrease morbidity and mortality in VLBW infants. Literature suggests that early breastmilk expression, within six hours of delivery, is key to the long-term success of providing breastmilk and breastfeeding. Many studies have shown a positive correlation between early breastmilk expression and maternal education provided by lactation specialists and neonatal intensive care nurses. However, little is known about the direct impact a maternal nurse has on early breastmilk expression. This paper will discuss the implementation of a quality improvement project aimed to increase knowledge on the benefits of maternal breastmilk in VLBW infants and the importance of early breastmilk expression among nurses in a labor and delivery and postpartum unit. Education provided to maternal nurses and visible reminders to initiate breastmilk expression proved to decrease the time to initiate breastmilk expression among mothers with VLBW infants in the Neonatal Intensive Care Unit.

Keywords: breastmilk, mother's own milk, early expression of breastmilk, VLBW infant, maternal education

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Section I. Introduction

Background

Globally, breastfeeding and providing maternal breastmilk is recognized as the best source of nutrition for term and preterm infants. Both the American Academy of Pediatrics (2012) and The World Health Organization (n.d.) recommend exclusively breastfeeding for at least six months, and even up to a year or longer if desired by both mother and infant. Breastmilk comprises many macronutrients and micronutrients imperative to the growth and development of neonates (Parker et al., 2021). Providing breastmilk or mother's own milk has shown significant short and long-term benefits in neonates.

Alternative nutrition choices for infants in the Neonatal Intensive Care Unit (NICU) include pasteurized human milk and formula. However, the literature suggests that maternal breastmilk should be the number one choice of nutrition for infants admitted to the NICU due to its positive impact on infant mortality and morbidity rates. Preterm infants are born before 37 weeks gestation (Centers for Disease Control and Prevention [CDC], 2021b). Very-low-birth-weight infants are born weighing less than 1500g (Parker et al., 2021). Infants born prematurely have a weakened immune system compared to term infants (Huang et al., 2020). Breastmilk expressed from the mother is rich in immunoglobulins, cytokines, growth factors, hormones, antimicrobials, immune cells, and stem cells, which aid neonates' immunity, growth, and development (Parker et al., 2021). Additionally, many studies have shown that maternal breastmilk lowers the incidence of necrotizing enterocolitis, sepsis, chronic lung disease, and retinopathy of prematurity in preterm and very-low-birth-weight (VLBW) infants (Parker et al., 2021).

Organizational Needs Statement

Data suggests that the optimal time to initiate breastmilk expression is within six hours of birth (Parker et al., 2021). Internal data collected from maternal electronic health records by a quality improvement committee at the DNP project's organization found that the average time to initiate breastmilk expression was 23 hours in August 2020 (██████████ et al., 2021).

Establishing milk supply through early initiation of breastmilk expression can increase long-term breastfeeding rates in both term and preterm infants (Perrella et al., 2021). A prospective observational study of maternal-infant couplets in a NICU in Australia found that insufficient milk supply was the principal reason for the cessation of breastfeeding by 12 weeks of corrected gestational age (Perrella et al., 2021).

An overarching goal for Healthy People 2030 is to improve the health and safety of infants. They proposed two breastfeeding objectives to help meet their goal. These include increasing the proportion of exclusively breastfed infants at six months from 24.9% in 2015 to 42.4% by the year 2030 (US Department of Health and Human Services [USDHHS], 2020a). The Centers for Disease Control and Prevention [CDC] (2022) identifies exclusive breastfeeding as only providing an infant with breastmilk as the only source of nutrition, with the exception of fortification with medication, vitamins, and minerals. Moreover, Healthy People 2030 proposed an increase in the proportion of breastfed infants at one year from 35.9% in 2015 to 54.1% by the year 2030 (USDHHS, 2020b). The CDC recognizes several breastfeeding key indicators that align with the Healthy People 2030 objectives. According to *Breastfeeding Report Card 2020*, published by the CDC (2020), the national percentage of infants that have ever breastfed and continued to breastfeed exclusively at 3 and 6 months is 84.1%, 46.9%, and 25.6% respectively. At the state level, infants in North Carolina that have ever breastfed and continued to exclusively

breastfeed at 3 and 6 months fall below the national average at 80.3%, 42.2%, and 23.3% (CDC, 2020).

Furthermore, infants breastfed at 12 months was 35.3% nationally and 29.2% in North Carolina (CDC, 2021a). According to data collected from birth certificates of infants born in the project organization's county, infants receiving colostrum or breastmilk from birth until discharge was 93.4% in 2018-2019 (CDC, 2021a). County data for exclusive breastfeeding at 3 and 6 months with continued breastfeeding at 12 months could not be retrieved due to the differences in data collection methods at the national, state, and local levels.

Providing breastmilk to preterm and VLBW infants in the NICU meets the dimensions of the Triple Aim in a multitude of ways. The Triple Aim was established by the Institute for Healthcare Improvement to enhance health system performance (Institute for Healthcare Improvement [IHI], n.d.). The three dimensions of the Triple Aim include improving the patient care experience, improving population health, and reducing the cost of healthcare (IHI, n.d.). Bedside nurses can provide mothers with the proper education needed to start breastmilk expression within hours of birth. By promoting the early initiation of breastmilk expression, mothers are more likely to establish and maintain an ongoing milk supply for their infants even after discharge (Parker et al., 2021).

Breastfeeding not only provides benefits for preterm infants, but it also has short-term and long-term maternal benefits. Short-term maternal benefits include reduced postpartum bleeding and increased uterine involution. In the long term, breastfeeding can decrease the rates of breast and ovarian cancer (Heller et al., 2021). The benefits for both mother and infant can reduce adverse outcomes, improve the patient care experience, and improve population health.

Additionally, providing breastmilk meets the third domain of the Triple Aim: cost-effectiveness. A cost analysis performed at a Level 1 perinatal center in Germany found that providing mothers' own milk to infants in the neonatal intensive care unit costs significantly less than providing donor milk (Fengler et al., 2019). Level 1 perinatal centers provide basic care to low- to moderate-risk pregnant women (American College of Obstetrics and Gynecologists [ACOG], 2019).

Problem Statement

Providing maternal milk to preterm infants comes with many obstacles. These infants are admitted to the NICU almost immediately after birth. Maternal-infant separation, an immature suck-swallow reflex, and potentially compromised pulmonary function make it difficult for mothers to feed their infant directly at the breast (Huang et al., 2020). Maternal separation and infant immaturity leave mothers with the task of extracting their breastmilk by electric pump or hand expression. Studies found that waiting until 48 hours postpartum to initiate breastmilk expression is directly linked to infants receiving nutrition other than breastmilk. The early expression of breastmilk also increases the chances that an infant will receive mother's own milk after discharge (Heller et al., 2021). Therefore, prompt breastmilk expression after delivery will help establish and maintain an adequate milk supply. Prior to project implementation, the project site had no workflow process for nurses to follow to support early breastmilk expression for mothers that are separated from their infants.

Purpose Statement

This DNP project aimed to develop nursing education for nurses to follow to promote the initiation of breastmilk expression within six hours after birth.

Section II. Evidence

Literature Review

A literature search was conducted to support the chosen project intervention of decreasing the time to initiation of breastmilk expression using PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Ovid, and ProQuest databases. Keywords and MeSH terms were established early in the process and were applied to the databases. These included: *mother's own milk, breastmilk, maternal milk, breastmilk expression NICU, nursing education, breast pumping, early initiation of breast pumping, preterm infant, breastfeeding, and lactogenesis*. The search yielded a total of 2,792 articles, twenty-five of which were kept for review. All articles were read thoroughly to determine their relevance to the project problem and purpose. Inclusion criteria included articles with full text available, published within the past five years, and English language. Exclusion criteria included redundancy in information, clinical relevance, and failure to look at the target population. Once inclusion and exclusion criteria were applied, 12 articles remained. These were further reviewed and added to the literature matrix (See Appendix A). The remaining articles included Levels of Evidence I-V with the exception of a cost-benefit analysis and policy statement. In addition, two quality improvement studies, one randomized controlled trial, two prospective studies, two longitudinal studies, a retrospective study, and a cross-sectional study were among the articles that remained.

Current State of Knowledge

The literature search revealed a strong recommendation for the use of maternal milk as the most beneficial form of nutrition for preterm and VLBW infants in the NICU (Hirpha et al., 2021; Hoban et al., 2018; Huang et al., 2020; Kulkarni et al., 2020; Parker et al., 2020; Perrella et al., 2021; Ru et al., 2020; Yu et al., 2019). Amongst the articles examined, providing breastmilk

to VLBW infants poses a unique challenge as many mothers have difficulty establishing and maintaining an adequate milk supply (Kulkarni et al., 2020; Parker et al., 2020; Yu et al., 2019). The early initiation of breastmilk expression in mothers of VLBW infants to establish milk supply was a common theme recognized throughout the literature (Hirpha et al., 2021; Hoban et al., 2018; Kulkarni et al., 2020; Parker et al., 2020; Ru et al., 2020; Yu et al., 2019). Ru et al. (2020) also attributed the achievement of maternal milk supply to frequent pumping sessions. The prospective observational study found that mothers who pump at least six times daily produced significantly more maternal milk than their counterparts (Ru et al., 2020). While much of the literature discusses the importance of lactation education amongst multidisciplinary team members, it fails to recognize the specific role that the mother's primary nurse plays in the early initiation of breastmilk expression. Many authors focus on the role of the NICU nurse and lactation support within the neonatal intensive care unit.

Current Approaches to Solving Population Problem(s)

Providing maternal breastmilk to VLBW infants is thought to have dose-dependent benefits (Kulkarni et al., 2020; Parker et al., 2020; Perrella et al., 2021; Ru et al., 2020). Kulkarni et al. (2020) suggested that even a 10ml/kg/day maternal milk dose can positively affect neonatal morbidities. Therefore, several strategies were presented to improve the provision of maternal breastmilk to preterm and VLBW infants. These include early initiation of breastmilk expression, use of lactation specialists, and maternal education.

Early initiation of breastmilk expression by either an electric pump or hand expression is a widely attributed factor in providing breastmilk in preterm and VLBW infants (Hirpha et al., 2021; Hoban et al., 2018; Kulkarni et al., 2020; Parker et al., 2020; Ru et al., 2020; Yu et al., 2019). However, the literature varies in opinions on the optimal time to start initiating breastmilk

expression. There is thought that initiating breastmilk expression within one hour of delivery is more beneficial than initiating expression within six hours (Yu et al., 2019). A randomized controlled trial (RTC) was conducted by Parker et al (2020) to examine the relationship between the time to initiation of breastmilk expression and breastmilk production. In contrast, the RTC found that mothers who initiated breastmilk expression within 181-360 minutes of delivery produced more maternal milk during the first three days postpartum compared to those who initiated expression within 60 minutes. The study also found that the 181-360 minute expression group produced more breastmilk over the first six weeks and were more likely to continue lactating at 40 weeks corrected gestational age (Parker et al., 2020). The RTC suggested that mothers who initiate breastmilk expression within 60 minutes of delivery may engage in less frequent pumping sessions, which can negatively impact breastmilk production (Parker et al., 2020). In addition, a retrospective study found that breastmilk expression within six hours of delivery significantly improved the rate of maternal milk feedings at discharge (Heller et al., 2021).

The use of lactation specialists plays an integral role in providing mother's own milk to preterm and VLBW infants (Huang et al., 2020; Kulkarni et al., 2020). A lactation specialist is a healthcare professional that is certified in breastfeeding support. They can assist mothers with inadequate milk supply, latch issues, and breastfeeding positions (Cleveland Clinic, 2021). In a quality improvement study conducted in a NICU at a high-risk perinatal center in India, a lactation specialist was explicitly hired to educate NICU mothers, assist them with breastmilk expression within six hours of delivery, and promote pumping at least eight times a day (Kulkarni et al., 2020). Employing lactation specialists and increasing access to breast pumps led

to a 60% improvement in maternal milk use in VLBW infants from admission to hospital discharge (Kulkarni et al., 2020).

Maternal education is also central to improving the provision of maternal milk in VLBW infants. All interdisciplinary team members should provide education (Hoban et al., 2018; Huang et al., 2020; Kulkarni et al., 2021). This team includes NICU staff, postpartum staff, lactation specialists, and physicians. Evidence found throughout the literature strongly suggested that maternal education provided by multidisciplinary team members correlates to an increase in the provision of mothers' own milk for VLBW infants (Kulkarni et al., 2021). A QI study implemented to increase enteral feedings with mothers' own milk, provided education to healthcare providers on the benefits of maternal milk and methods of expression (Kulkarni et al., 2021). These providers disseminated their new knowledge to mothers of VLBW infants and increased awareness amongst this population. Parker et al. (2021) further suggested that while support from lactation specialists is essential, bedside nurses can significantly impact and reinforce maternal lactation education. Additionally, Hirpha et al. (2021) found that mothers who received instruction on their expression method of choice were more likely to initiate breastmilk expression earlier than those who did not receive instruction.

Literature highlights the importance of education on early breastmilk expression amongst mothers and the care team. Yet, there is little knowledge on the impact of education amongst nurses caring only for the mother. The project site organization developed an infant feeding policy that recommends breastmilk expression within six hours of delivery if the mother and infant are separated. However, the organization lacks ongoing education on the policy and importance of early breastmilk expression, which caused significant delays in the initiation of breastmilk expression. Through collaboration with the project site champion and unit managers,

education was developed to bring awareness to the organization's feeding policy and increase knowledge on the importance of early breastmilk expression in mothers who are separated from their infants.

Evidence to Support the Intervention

Preterm and VLBW infants are often separated from their mothers immediately after birth. This separation can cause mothers to experience increased anxiety and feelings of helplessness (Ru et al., 2020). Many of these mothers report that providing breastmilk as a source of nutrition is the only helpful contribution they can make to the well-being of their child (Ru et al., 2020). Initiating the early expression of breastmilk bolsters overwhelming support across the literature. For these reasons, nursing education was chosen as the intervention for the DNP project to encourage the early initiation of breastmilk expression.

Encouraging early breastmilk expression decreases the chances of delayed lactogenesis II (Ru et al., 2020; Yu et al., 2019). Lactogenesis II refers to the onset of ample milk production after birth (Yu et al., 2019). In term infants, this usually occurs within 30-48 hours after delivery and is marked by feelings of breast fullness (Yu et al., 2019). Premature delivery and delay in breastfeeding are correlated with delayed onset of lactogenesis II (Yu et al., 2019). Moreover, Parker et al. (2020) proposed that the genes responsible for mammary gland secretory activation and prevention of secretory gland cell death are most active in the first hours and days following delivery. Activating these genes is pivotal in the long-term production of maternal milk. Furthermore, mothers who established an adequate milk supply by the time of infant discharge are more likely to transition to predominant breastfeeding (Perrella et al., 2021). Therefore, developing strategies to increase the rate of early breastmilk expression is critical in the long-term provision of mothers' own milk to VLBW and preterm infants.

Evidence-Based Practice Framework

The framework chosen to implement this project was the Plan-Do-Study-Act (PDSA) framework. This framework effectively tests changes implemented throughout several cycles (Agency for Healthcare Research and Quality [AHRQ], 2020). Four steps are involved in the PDSA cycle (AHRQ, 2020). The initial step, Plan, consists of identifying the intended goal, stating the desired outcome, and formulating the plan for the cycle. The second step, Do, includes executing the plan outlined in the first step to reach the desired goal or outcome. The third is the Study phase. During the Study phase, the results will be studied to determine if the selected outcome measures were met. Lastly, during the Act phase, the entire process will be examined to determine if the change was successful and can be adopted on a broader scale or if the intervention needs to be adjusted and the cycle restarted (The W. Edwards Deming Institute, n.d.). Benefits of the PDSA cycle include a short duration cycle and a small sample size requirement (AHRQ, 2020).

Using the PDSA framework for the DNP project allowed for ongoing changes throughout the project implementation process. Project data was analyzed on an ongoing basis to determine if changes to the intervention were needed; if necessary, these changes were made promptly at the start of the next PDSA cycle. Additionally, this helped identify which aspect of the intervention had the greatest impact on accomplishing the project goal of decreasing the time to initiation of breastmilk expression in mothers with VLBW infants.

Ethical Consideration and Protection of Human Subjects

The Collaborative Institutional Training Initiative (CITI) modules were completed by the project leader to help determine ethical considerations for this project. The proposed intervention poses minimal to no ethical violations and is equitable to those in the target population. The

project upheld the ethical principle of beneficence, which is maximizing possible benefits and minimizing potential risks to participants (CITI Program, 2018). There was no potential harm to the mothers of VLBW infants expressing breastmilk for their infants. Furthermore, the benefits of breastfeeding were well-studied throughout the literature. Additionally, educating nurses on the importance of breastmilk in VLBW infants and early initiation of breastmilk expression does not carry any potential harm. Participants' privacy and confidentiality were upheld throughout project implementation and evaluation. All questionnaires and surveys remained anonymous, and information gathered from electronic health records (EHR) remained free of patient identifiers.

A multi-step process was required for the approval of this project. First, a project site and project site champion were obtained. Once these were secured, a formal project proposal was submitted to the organization's Clinical Research Institute for review. Once reviewed, it was determined that the intended project was considered a quality improvement project. Therefore, the project site did not require an official Institutional Board Review (IRB). An official project approval letter was provided by the organization's Clinical Research Institute chairperson. Qualtrics Self-Certification was completed and submitted to East Carolina University, and the project was considered a Quality Improvement Project by the university's standards.

Section III. Project Design

Project Site and Population

This quality improvement project was implemented at the organization’s main campus. The project site’s organization was a private, not-for-profit healthcare organization founded in 1961 (██████████, n.d.-a). It is the largest health system in the county, with three acute care hospitals and three stand-alone 24/7 emergency departments. The organization’s main campus is home to 567 acute care beds and a 98-bed rehabilitation hospital.

The DNP project partnered with a quality improvement committee at the organization. The quality improvement committee was formed in collaboration with the Vermont Oxford Network (VON) and Newborn Improvement Quality Collaborative (NICQ) to address the perceived opportunity to improve the provision of mother’s own milk to preterm and VLBW infants as well as increase overall breastfeeding rates in the NICU. The quality improvement committee developed several goals to increase the provision of breastmilk. These included reducing the time to initiation of breastmilk expression, increasing the percentage of eligible mothers to provide any colostrum, decreasing the time to first administration of mother’s own milk, and increasing the rate of mother’s own milk at discharge (Project Site Champion, personal communication, February 4, 2022).

Description of the Setting

In 2021, the organization’s main campus had 4,529 deliveries (██████████, n.d.-c). The organization’s Women’s and Children’s Pavilion included a 48-bed Level IV NICU, 24-bed Labor and Delivery unit, an 8-bed Obstetrics Emergency Department, and a 38-bed postpartum unit (██████████, n.d.-b; ██████████, n.d.-c). A Level IV NICU is considered a regional NICU,

which provides the highest level of care for very sick babies that require special care and equipment (March of Dimes, 2020).

The organization specializes in high-risk obstetrics. Once delivered, mothers deemed stable were transferred to the postpartum unit until discharge from the facility. This transfer usually occurred within two hours of delivery. Upon transfer to the postpartum unit, the patient's care was reassigned from the labor and delivery nurse to the postpartum nurse.

Description of the Population

The labor and delivery unit and postpartum units are staffed by registered nurses, certified nurse aides, certified lactation consultants, social workers, and neonatal providers. The project population was nurses that cared for postpartum mothers at the project site. There were 203- Registered Nurses employed on the postpartum and labor and delivery units, 164 nurses with a Bachelor of Science in Nursing (BSN) degree, and 104 nurses with national certifications (Postpartum Unit Manager, personal communication, July 7, 2022; Labor & Delivery Unit Manager, personal communication, March 8, 2023). There were limited lactation consultants on staff, which decreased the chance that mothers of VLBW infants were seen within six hours of delivery. Therefore, the nursing staff was responsible for educating new mothers about breastfeeding benefits, techniques, and breastmilk expression. The organization required nursing staff to participate in a "shadow" day with a lactation specialist and attend a breastfeeding essentials class within six months of employment.

Project Team

The project team included the project leader, project site champion, and unit managers. The project site champion provided guidance and insight for project implementation. The project

leader implemented the quality improvement project at the project site with approval from the labor and delivery and postpartum managers.

Project Goals and Outcome Measures

The overall goal of this project was to increase the provision of maternal milk to eligible VLBW infants in the NICU. The primary outcome measure was to decrease the time to initiation of breastmilk expression to the target goal of within six hours of delivery. Other outcome measures included increasing the knowledge of the benefits of early breastmilk expression in maternal nurses, improving nurse adherence to the organization's feeding policy, and decreasing the time to provide maternal milk to VLBW infants. The organization's infant feeding policy stated:

“Mothers of infants who are medically unstable following delivery may need to delay breastfeeding initiation. In such cases, begin hand expression as soon as possible after delivery, pumping within 6 hours after birth, and initiate breastfeeding as soon as possible.” (██████████, 2021, p. 3).

Description of the Methods and Measurement

Several methods of measurement were used to assess intended outcomes. The nursing staff was instructed to chart the time of breastmilk expression initiation with a simple “Yes” or “No” in the mother's EHR. Answering “Yes” triggered additional charting needed for education reviewed with patients and chosen method of expression. Conversely, answering “No” triggered additional charting for why the expression was not initiated. The timestamp of this action was used to determine the time to initial expression of breastmilk and nurse adherence to the infant feeding policy. In addition, data collected from the infant HER was used to determine the first

maternal milk administration time. All data collected from mother and infant EHRs was de-identified.

To measure knowledge among nurses, the project leader developed an educational PowerPoint with a pre-and post-survey. Key objectives addressed in the PowerPoint included the definition of a VLBW infant, the benefits of breastmilk in VLBW infants, breastmilk expression recommendations, the facility's policy on breastmilk expression, and identifying nurse-driven interventions to meet the overall goal of the project. The surveys were kept anonymous.

Discussion of the Data Collection Process

Before the start of project implementation, a retrospective chart audit was performed from May 2022 to August 2022. The retrospective chart audit helped determine the average time to initiation of breastmilk expression and the average time to first administration of maternal milk to VLBW infants four months before project implementation. This provided the most current average times. In addition, the retrospective chart audit helped gauge the success of the quality improvement project during implementation by allowing a comparison of average breastmilk expression initiation time and first administration time during each PDSA cycle to ensure times decreased.

A voluntary pre-and post-education survey (See Appendix B & Appendix C) was developed and included six questions with Likert-scale responses. The surveys asked nurses to rate their confidence in educating patients about breastmilk and breastmilk expression, as well as rate their current practice regarding initiating breastmilk expression.

The post-education survey also included two multiple-choice questions about the key objectives. Data collected from the surveys were reviewed and used to measure the success of the educational sessions. An Excel spreadsheet tool developed by the project site champion and

adapted for the DNP project's needs by the project leader was used to collect data from mother and infant EHR.

Implementation Plan

The implementation of the project began by collaborating with the project site champion to develop a program to decrease the amount of time to breastmilk expression initiation amongst VLBW infant mothers. From there, a pilot program was developed and titled "Project Pumping for Preemies". This program included educational material for nurses and pre- and post-educational surveys.

To capitalize on nurse participation, the project leader obtained permission to introduce "Project Pumping for Preemies" during two mandatory staff meetings conducted by unit management. Several days before the meetings, a link to the educational PowerPoint and anonymous pre- and post-survey was sent to the nursing staff on the postpartum unit. A reminder email was sent ten days after the original to bolster participation. During the staff meetings, the project leader introduced the "Pumping for Preemies" pilot program to the staff. Prior to the project start date flyers were posted around the unit (See Appendix D). At the conclusion of PDSA cycle #1, the project leader made the decision to introduce the project to labor and delivery staff in collaboration with the project site champion and labor and delivery manager. Throughout project implementation, data was collected weekly. A PDSA cycle was performed every three weeks. This allowed for changes in project implementation when warranted. At the conclusion of the project, results were reviewed and compared to pre-implementation data. An additional post-implementation survey was distributed to staff in order to gauge their participation during project implementation (See Appendix E).

Timeline

Project planning began in January 2022, and implementation began at the project site from August 2022 to December 2022. In June 2022, “Project Pumping for Preemies” was developed by the project leader. The project was introduced to postpartum nursing staff during mandatory staff meetings on August 17, 2022, and August 24, 2022. The PowerPoint and pre- and post-surveys were sent via email on August 15, 2022, with a reminder sent on August 25, 2022. The “go-live” date for “Project Pumping for Preemies” was August 31, 2022. The project site champion introduced “Project Pumping for Preemies” to labor and delivery staff on September 21, 2022. At the conclusion of PDSA Cycle #3, the project leader placed reminder badges on workstation computers throughout labor and delivery and postpartum units (See Appendix F). Data collected from the project implementation period was analyzed and presented to nursing staff on December 8, 2022. The project was presented to faculty and students at East Carolina University on April 11, 2022. See Appendix G for a visualization of the project timeline.

Section IV. Results and Findings

Results

The DNP project aimed to decrease the time to initiate breastmilk expression in mothers with VLBW infants. It also aimed to increase the knowledge of the benefits of early breastmilk expression among nurses caring for mothers with VLBW infants. A pre-and post-education survey was distributed via e-mail. There were 27 respondents to the pre-education survey and 24 to the post-education survey. At the conclusion of the project, an additional survey was distributed with eight respondents.

Outcome Data

In August 2021, a quality improvement committee at the project site's organizations found that the average time to initiate breastmilk expression was 23 hours. Before implementing the DNP Project, data was collected and analyzed to help strengthen the need for the project. The project lead collected and analyzed data from the 3-months before project implementation to help determine if project goals were being met before implementation. This time frame was chosen because the project was implemented over roughly three months, from August 2022 to November 2022. In May 2022, the average time to initiate breastmilk expression in mothers with VLBW infants was 21 hours and 51 minutes. June 2022 was 18 hours and 43 minutes, and July was 11 hours and 43 minutes. Collectively over the three months before project implementation, the average time to initiate breastmilk expression was 17 hours and 53 minutes. This was still well above the recommended time frame of initiating breastmilk expression within six hours of delivery.

Respondents of the pre-education survey included 21 postpartum nurses, five labor & delivery nurses, and one lactation specialist employed on the postpartum unit. The lactation

specialists' response was excluded because the project population only included postpartum nurses and labor & delivery nurses. Most participants strongly agreed (48%) or agreed (37%) they were aware of the organization's infant feeding policy. However, only 26% of the participants responded "Always" when asked if they initiate breastmilk expression within six hours of delivery if their patient had an infant in the NICU. Additionally, participants were asked how often they rely on lactation consultants to initiate breastmilk expression for mothers with infants in the NICU. Most respondents indicated they never (11%) or rarely (48%) relied on lactation consultants to initiate breastmilk expression.

Respondents to the post-education survey included 21 postpartum nurses, five labor & delivery nurses, and two lactation specialists. As with the pre-education survey, the lactation specialists' responses were discarded because they were not included in the project population. After viewing the educational PowerPoint, 78% of respondents strongly agreed they were aware of the organization's Infant Feeding Policy and that they knew where to find it. After viewing the educational PowerPoint, participants were asked about their confidence in providing education on the benefits of breastmilk in VLBW infants to their mothers and their confidence in providing education about the early expression of breastmilk to mothers with VLBW infants. Respondents strongly agreed (81%) they were confident in providing education on the benefits of breastmilk, and 85% strongly agreed they were confident in providing education on the initiation of breastmilk expression. When asked about their motivation to initiate breastmilk expression within six hours of birth, 90% strongly agreed, and 10% agreed they felt motivated after viewing the PowerPoint. All respondents (100%) correctly identified a VLBW infant as those weighing less than 1500g. Question #9 asked respondents to identify the benefits of breastmilk in VLBW infants, and all respondents (100%) answered correctly (See Appendix C).

Lastly, a project conclusion survey was distributed to postpartum and labor & delivery nurses to gain additional data on project implementation (See Appendix E). The survey asked questions about the nurse's actions and feelings during project implementation. Respondents indicated that during project implementation, they either always (37.5%) or often (62.5%) initiated breastmilk expression within six hours of delivery for mothers with infants in the NICU. In addition, four respondents (50%) indicated they never relied on lactation to initiate breastmilk expression, while four (50%) indicated rarely. All respondents indicated they understood the importance of early breast milk expression. Nurses participating were able to provide comments about project implementation. One respondent commented, "I thought the project was very important and timely. I thought the reminders were helpful". Another respondent commented, "There are times when mom is too emotionally exhausted within the six-hour window to cooperate with pumping, but this is not the norm."

During project implementation, 25 VLBW infants were born. Data from four infants were excluded for various reasons. Two infants' mothers declined to provide breastmilk, one infant was transferred from an outside facility whose mother was never admitted to the project site, and one infant's mother was transferred to the intensive care unit immediately after delivery. During the PDSA cycles, the average and median times to initiate breastmilk expression in mothers with VLBW infants were analyzed. Analyzing the median was chosen to discard potential outliers that may skew data. During PDSA Cycle #1, from August 31, 2022, to September 20, 2022, the average time to initiate breastmilk expression was 13 hours and 13 minutes, while the median time was 10 hours and 20 minutes. PDSA Cycle #2 from September 21, 2022, to October 11, 2022, the average time was 16 hours and 29 minutes; the median was 8 hours and 57 minutes. PDSA Cycle #3, from October 12, 2022, to November 1, 2022, the average time was 10 hours

and 56 minutes; the median was 3 hours and 55 minutes. PDSA Cycle #4, the average time was 6 hours and 18 minutes the median was 4 hours and 43 minutes.

Discussion of Major Findings

Literature supported maternal education as a key component to the early initiation of breastmilk expression and improving the provision of maternal breastmilk to VLBW infants (Hoban et al., 2018; Huang et al., 2020; Kulkarni et al., 2021). Education comes from many sources, including the maternal nurse, lactation consultants, and maternal and newborn providers. The mother's bedside nurse has the opportunity to provide influential knowledge on the benefits of breastmilk in VLBW infants and the importance of early breastmilk expression. This is partly due to the amount of one-on-one time maternal nurses spend with the mother in the labor & delivery and postpartum units. Providing the educational PowerPoint to the project population allowed the nurses to disseminate the knowledge gained to their patients. This is evidenced by all post-education survey respondents answering Question #8 and Question #9 correctly (See Appendix C). In addition, most respondents felt confident in providing the PowerPoint education to their patients and felt motivated to share.

Little information was found in the literature that looks at the impact of the mother's nurse on the early initiation of breastmilk expression. Most studies focus on the role of the NICU nurse and lactation specialist. Data from project implementation suggested a positive correlation between knowledge of early initiation of breastmilk expression amongst maternal bedside nurses and decreasing time to initiate breastmilk expression. This is evidenced by the significant decline in the average and median times to initiate expression once the project was introduced to labor and delivery staff in PDSA cycle #2. Furthermore, a need for education beyond the NICU nurses and lactation consultants was strengthened once badges with a reminder to initiate pumping

within six hours of delivery were placed on computer workstations throughout the postpartum and labor & delivery units at the beginning of PDSA Cycle #4. This reminder for nurses to share their knowledge gained from the PowerPoint education resulted in a 42% decrease in the average time to initiate breastmilk expression.

Section V. Interpretation and Implications

Costs and Resource Management

In 2019, 51,716 VLBW infants were born throughout the United States (Johnson et al., 2022). VLBW infants account for 36% of the costs spent on newborn care due to their lengthy hospitalizations and risk for severe and potentially preventable complications (Johnson et al., 2022). The average cost of hospitalization for VLBW infants is \$219,669 based on a mean length of stay of 56.5 days (Johnson et al., 2022). The costliest of complications include sepsis, necrotizing enterocolitis, and bronchopulmonary dysplasia. Infants who receive high doses of maternal milk in the early postnatal period are less likely to develop severe complications and are less likely to have an extended length of stay (Johnson et al., 2022).

The total cost for the project leader to implement the DNP Project was \$41.30 (See Appendix H). The only costs incurred came from materials for the flyers and reminder badges for workstation computers. This included \$33.33 to print and laminate the badges and \$4.00 for the double-sided tape to adhere the badges to the workstations. An additional \$7.40 was spent on color-printed flyers to distribute throughout the units. The project team leader distributed the pre- and post-education survey via Microsoft Forms through a free subscription provided by the project leader's university. A contributing factor to the low cost of implementing this DNP Project included the ease of access to electric breast pumps in the postpartum and labor & delivery units. The project site provided an electric breast pump in every postpartum room. If a mother remains in the labor and delivery unit due to pre-eclampsia and postpartum magnesium, two pumps are located in the L&D unit for use.

Other costs must be considered if duplication without the project leader is desired. These include personnel costs, hospital-grade pumps, breastmilk collection kits, refrigerators for

maternal milk, and milk warmers. To implement this project, a staff member must provide periodic education to nurses in the postpartum and labor & delivery units. Once all staff is given project education, there are no additional personnel costs as it is a part of the registered nurse's responsibility to provide breastfeeding education to their patients. Breastmilk as a means of nutrition comes at no cost to the mother. Collecting breastmilk can be done via hand expression or an electric pump. Hand expression incurs no cost from equipment; the only cost comes from collection containers to store the breastmilk. It simply requires teaching from the mother's bedside nurse. Compared to the average cost of VLBW infant hospitalization, implementing this DNP project with or without the project team leader is a cost-saving option for organizations.

Implications of the Findings

The implications of the project findings are multifaceted and can be broken down into three subcategories. These include implications for the patients, implications for nursing practice, and implications for the healthcare system.

Implications for Patients

Project implications for patients are two-fold because two separate patient populations are involved. These include implications for the mothers of VLBW infants and the VLBW infants themselves. Mothers are more likely to initiate expression within six hours of delivery by providing timely education to mothers on the benefits of breastmilk in VLBW infants and the importance of early breastmilk expression. Helping mothers provide breastmilk to their VLBW infants can improve maternal mental health. It can make them feel they contribute to their newborn's care and overall health. Which, in turn, can help increase maternal-infant bonding. Implications for VLBW infants include decreased risk for complications, decreased length of

hospitalization, decreased time to administration of oral care, and increased rate of breastmilk as a form of nutrition at discharge.

Implications for nursing practice.

The DNP Project uncovered several implications for nursing practice. First, it improved the perception of who is responsible for initiating breastmilk expression, the bedside nurse or the lactation consultant. Second, it increased knowledge of VLBW infants and the benefits of breastmilk in this fragile population. This, in turn, helped improve confidence and motivation to disseminate knowledge about the benefits of breastmilk amongst mothers with VLBW infants. These factors can help strengthen the relationship between nursing staff and their VLBW infant mothers.

Impact for Healthcare System(s)

Implementing this DNP Project improved adherence to the organization's Infant Feeding Policy, as seen by the decreased time to initiate breastmilk expression. In addition, the VLBW infants reviewed during project implementation received their first dose of breastmilk in a timelier manner than the three months preceding the project implementation. The early introduction and continued use of maternal milk as the primary source of nutrition can decrease the incidence of neonatal complications such as neonatal sepsis, necrotizing enterocolitis, chronic lung disease, and retinopathy of prematurity (Parker et al., 2021). These complications can lead to increased length of stay and healthcare costs.

Sustainability

The project site champion intends to continue collecting data relevant to the DNP project. This will be done as part of the organization's quality improvement committee for increasing the provision of maternal breastmilk to VLBW infants. Without a project lead, the sustainability of

this DNP project can be challenging. Increased turnover in nursing staff can cause a fallout in the number of nurses familiar with the project and the organization's feeding policy. Additionally, nurses may become complacent in their practice if they do not have regular reminders to initiate breastmilk expression within six hours of delivery. To help remedy these challenges, periodic educational sessions and “check-ins” may be required.

Dissemination Plan

The project was presented at East Carolina University’s College of Nursing on April 11, 2023. The college’s faculty and students were in attendance for the presentation of this DNP project. The DNP project paper was uploaded to East Carolina University’s ScholarShip database.

Section VI. Conclusion

Limitations and Facilitators

Several limitations and facilitators were identified during project planning and implementation. In the initial stages of project planning, low provider buy-in resulted in a change in the project implementation plan. Originally the DNP project leader intended to include a nursing communication order in the mother's chart stating, "If infant admitted to NICU, initiate breastmilk expression within six hours of delivery unless contraindicated or mother declines". However, this was not accomplished due to low provider buy-in and organizational policies against differing postpartum order sets across the organization's multiple locations. Early into the implementation process, another limitation was identified. During the first two PDSA cycles, the project was only introduced to the postpartum staff. However, nine out of eleven mothers with VLBW infants remained in the labor & delivery unit due to needing 24 hours of postpartum magnesium. This oversight caused a significant delay in the initiation of breastmilk expression. Other limitations included low survey participation and staff reluctance to initiate early breastmilk expression.

A key facilitator for the project was excellent buy-in from the project site champion, who also serves as chair of the organization's quality improvement committee that aims to increase the provision of maternal milk to VLBW infants. In addition, managers of the postpartum and labor & delivery units supported the project's goals and subsequent project implementation within their units. Another primary facilitator of the project was the baseline knowledge of breastfeeding and breastmilk expression among nurses on both units. This knowledge was acquired from a mandatory "Breastfeeding Essentials" class all postpartum and labor & delivery attend.

Recommendations for Others

This project could have long-term impacts on VLBW infants and their mothers. Recommendations for others who wish to carry on this project include considering nurse buy-in as the main driver for project success. Project success is only possible if the nurses are dedicated to the project goals and outcomes. Provider buy-in is also essential for project success. A provider-driven order within the mother's chart can bolster adherence to project implementation and the organization's infant feeding policy. Consideration should also be made to introducing maternal education before delivery. Identifying mothers at high risk for preterm delivery and educating them on the benefits of breastmilk in VLBW infants and early initiation of breastmilk expression can change their feeding plans from formula to breastmilk and prepare them for what lies ahead.

The scalability of this project is low within this organization because all high-risk VLBW infants are cared for at the organization's Level 1 NICU on the main campus. Other campuses do not have the capabilities to provide care for these infants. However, others may consider implementing this project within organizations that frequently care for VLBW infants.

Recommendations Further Study

Recommendations for further study include examining the longevity of breastfeeding after discharge. A project that examines the effect of early breastmilk expression on breastfeeding rates at six months old and one year can help meet the goals of Healthy People 20230. In addition, studies on the impact of early breastmilk expression and infant readmission to the hospital may help decrease healthcare costs.

Several parts of the project can be applied in different settings. The project can be adapted into a two-part project that looks at the effects of breastfeeding education and early

initiation of breastmilk expression in patients at high risk for delivering VLBW infants. Pre-delivery education can be given to expecting mothers in the high-risk obstetrics clinic within the organization. Studies can be done to examine the maternal perception towards providing breastmilk versus other forms of nutrition. As well as the impact pre-delivery education can have on a mother's willingness to initiate breastmilk expression early and frequently.

Final Thoughts

The overall purpose of this project was to decrease the time to initiate breastmilk expression. Pre-implementation average initiation time was well above the recommended time of within six hours of birth. However, throughout the implementation process, the time to initiation of expression decreased significantly. While the literature neglects to examine the role of education from a mother's bedside nurse and its effects on early breastmilk initiation, this project sheds light on its importance. Using nursing education and empowerment is essential to project success. Providing baseline education about VLBW infants and the benefits of breastmilk among nursing staff motivated them to provide nurse-led education to patients with VLBW infants.

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Appendix A Literature Matrix

Authors	Year Pub	Article Title	Theory	Journal	Purpose and take home message	Design/Analysis/Level of Evidence	IV DV or Themes concepts and categories	Instr. Used	Sample Size	Sample method	Subject Charac.	Comments/critique of the article/methods GAPS
Parker M.G, Stollwagen, L. M, Lawrence, N, Kim, J.H, Poindexter, B. B, Puopolo, K. M.	2021	Promoting human milk and breastfeeding for the very low birth weight infant	N/A	<i>Pediatrics</i>	Provide clinicians with information about NICU lactation support for mothers of infants that are VLBW.	Clinical Report Level V	Themes: • Mother's own milk is the nutrition of choice for VLBW infants. • NICU staff and other providers play major role in supporting lactation in mother's of babies in the NICU	N/A	N/A	N/A	N/A	Limitations: • Report only addresses how NICU staff and providers can support lactation. Staff in other departments (L&D/Postpartum) play a large role in supporting lactation as well. • Article only discusses VLBW infants. There is more than just VLBW infants in the NICU that benefit from MoM.
Huang, X, Junping, Z, Zhou, F, Diploma, Y. Y, Lizarondo, L, McArthur, A.	2020	Promotion of early breast milk expression among mothers of preterm infants in the neonatal ICU in a obstetrics and gynaecology hospital: a best practice implementation project	N/A	<i>JBI Evidence Implementation</i>	Describe the QI initiative for promoting the early expression of breastmilk and share findings of the project.	Quality Improvement Initiative Level V	Independent: QI Project Dependent: Actions of healthcare workers to promote early expression of breastmilk.	• JBI Practical Application of Clinical Evidence System and Getting Research into Practice audit and feedback tool • Questionnaires • Interviews	177	Convenience	• 1 project protocol • 146 healthcare workers on unit where project was completed (90 nurses, 42 midwives, and 14 doctors) • 30 mothers who have infants in the NICU	Overall there was an increase of early initiation of breastmilk expression after QI implemented. Usefulness: Barriers to project uptake identified: inadequate knowledge of healthcare professionals and mothers, mother's lack of access to breast pumps, and lack of support for mothers. Limitations: Lack of access to pump will not be issue at project facility because every room is equipped with a pump and mother's are given loaner pumps when they are discharged if baby is still in NICU.
Heller, N, Rudiger, M, Hofmeister, V, Maase, L.	2021	Mother's own milk feeding in the neonatal intensive care unit or special-care nursery: obstacles, interventions, risk calculation	N/A	<i>Environmental Research and Public Health</i>	Assign risk scores to for maternal-infants dyads within the institution and assess risk for non-mother's own milk feeding based on score. Identify modifiable risk and non-modifiable risks for non-maternal milk feedings.	Retrospective Cohort Study Descriptive Statistics Qualitative and Quantitative Level IV	Themes: • Modifiable and nonmodifiable risk factors for non-maternal milk feedings at discharge Independent: mother's own milk, donor milk, formula, fixed costs, and variable costs Dependent: overall cost to provide certain type of nutrition	• Calculation of risk scores for non-maternal milk feeding based on if infant <28weeks GA, no skin-to-skin done until end of first week of life, and maternal use of ETOR or illicit drugs • Comparing cohort scores to risk score	368	Convenience	Preterm infants born <34 weeks gestation from 4/1/13 to 3/31/15 at a level III neonatal center in Germany.	• Modifiable risk factors: skin-to-skin contact in delivery room and NICU, strategies for feeding infant and milk expression, & type of delivery • Non-modifiable risk factors: demographics of infant (≥ or < 28 weeks GA), demographics of mother (age, profession, education, parity, neonatal comorbidities, and maternal comorbidities). Modifiable risk factors are easy target for institutional policies.
Fengler, J, Heckmann, M, Lange, A, Kramer, A, Flossa, A.	2019	Cost analysis showed that feeding preterm infants with donor human milk was significantly more expensive than mother's milk or formula	N/A	<i>Acta Paediatrica</i>	Compare the cost of feeding preterm infants donor milk, maternal milk, and formula.	Cost Benefit Analysis Level VII	Independent: mother's own milk, donor milk, formula, fixed costs, and variable costs Dependent: overall cost to provide certain type of nutrition	N/A	N/A	N/A	N/A	• It is less costly to provide maternal milk over donor milk. However, processing maternal milk is more expensive than formula. Limitations: Investment costs not analyzed
American Academy of Pediatrics.	2012	Breastfeeding and the use of human milk.	N/A	<i>Pediatrics</i>	Provide for breastfeeding.	Policy Statement Level VII	N/A	N/A	N/A	N/A	N/A	• Breastfeeding beneficial for infant and mother in the long and short-term. AAP recommends exclusive breastfeeding for 1st 6 months of life.
Porella, S.L., Nancarrow, K, Rea, A, Murray, K, Stimmer, K, N, Geddes, D. T.	2021	Longitudinal follow-up of preterm breastfeeding to 12 weeks corrected gestational age	N/A	<i>Advances in Neonatal Care</i>	Analyze and describe breastfeeding characteristics between mother and infant at up to 12 weeks of corrected gestational age	Longitudinal Observational Study Descriptive Statistics Qualitative and Quantitative Level IV	Independent: time to initiation of milk expression Dependent: time of onset of lactogenesis II, milk volume	• Maternal collection checklists • Maternal questionnaires on perceived importance of breastfeeding.	49	Randomized	Mothers and infants previously enrolled in a RTC to examine milk transfer from 2 different bottle nipples. Inclusion: Mother's >18 years or older who breastfed and had milk expression of >300ml/24hr	• Low milk supply is most common reason for cessation of maternal milk feedings. • Early and consistent/sustained milk removal important to long term breastfeeding success. Limitations: • nonmodifiable factors can impact cessation of breastfeeding (socioeconomic status & comorbidities). • Possible selection bias due to mothers rating breastfeeding of high importance
Yu, X, Li, J, Lin, X, Luan, D.	2019	Association between delayed lactogenesis II and early milk volume among mothers of preterm infants	N/A	<i>Asian Nursing Research</i>	Mother's separated from their infants if preterm birth have a delay in lactogenesis II (milk production)	Longitudinal Cohort Study Qualitative & Quantitative Level IV	Independent: time to initiation of milk expression Dependent: time of onset of lactogenesis II, milk volume	Wilcoxon's rank sum test	142	Convenience	>20 years old, married, delivers in hospital, <37 weeks gestation Intention to breastfeed w/ no contraindication	• Clear results that mothers of preterm infants have delayed onset of lactogenesis II. • Other factors that cause delayed lactogenesis II- PHBS and shorter duration of sleep
Huban, R, Bigger, H, Schoeny, M, Engstrom, J, Meier, P, Patel, A.L.	2018	Milk volume at 2 weeks predicts mother's own milk feeding at neonatal intensive care unit discharge for very low birthweight infants.	N/A	<i>Breastfeeding Medicine</i>	Purpose: determine the maternal risk factors that can predict "coming to volume" and continuation of MoM through discharge in VLBW infants.	Prospective Cohort Study Descriptive Statistics Level IV	Independent: Maternal risk factors Dependent: provision of MoM at discharge, time until "coming to volume" achieved	N/A	402	Convenience	Age, marital status, race/ethnicity, low income status, formal education attained, previous breastfeeding experience	• Having a cesarean is strong predictor for not achieving CTW by day 14 postpartum Strengths: diverse sample (racially, ethnically, socioeconomically), use of documented pumped volumes. Limitations: potential bias to enter with milk measurement due to self reporting from mothers, feedings at discharge measured by infant records rather than daily pumped milk volume, low incidence of diabetes in cohort (made it difficult to determine if diabetes is a risk factor).
Ru, X, Huang, X, Feng, Q.	2020	Successful full lactation achieved by mothers of preterm infants using exclusive pumping	N/A	<i>Frontiers in Pediatrics</i>	Studied milk production and milk nutritional content of preterm mother who are dependent on electric pump.	Observational Prospective Study Descriptive Statistics Level IV	Independent: Mothers of preterm infants <28weeks GA, electric breast pumps, time to initiation of expression Dependent: time to achievement of lactogenesis, pump milk nutrient content.	Pumping diary	30	Convenience	Mean age: 32.9 years 19 cesarean deliveries 9 multiparous 7 multiple births Mean GA=29.7 weeks Mean BW= 1235.7g	• Benefits of maternal milk are dose-dependent. • In 2 weeks after birth are critical to lactogenesis. • Providing maternal milk eases mother anxiety, they feel they are able to make a positive contribution. • pumping frequency can have a significant effect on lactogenesis. Limitations: small study group, specific nutrition habits of mothers were not documented.
Hipha, M, Makonnen, H, Feita, F. A.	2021	Initiation of breastmilk expression and associated factors among mothers of preterm and low birth weight neonates admitted to neonatal intensive care units of government hospitals in Addis Ababa, Ethiopia, 2020	N/A	<i>Pediatric Health, Medicine, and Therapeutics</i>	Examine the initiation of breastmilk expression and factors associated with timing of expression	Cross-Sectional Descriptive Statistics Level IV	Independent: Mother's of infants in the NICU Dependent: initiation time of breastmilk expression	N/A	130	Systematic Random Sampling	Mean Age= 29.13 years	• None of the participants in the study expressed before 6hrs postpartum. • Lack of education about chosen expression method and GA >32weeks were major factors in late breastmilk expression. Strengths: Random sampling used Limitations: difficult to determine direction of the association between study variables, risk for social desirability bias; may cause over or under reporting of initiation of breastmilk expression
Parker, L. A, Sullivan, S, Kruger, C, Mueller, M.	2020	Timing of milk expression following delivery in mothers delivering preterm very low birth weight infants: a randomized trial	N/A	<i>Journal of Perinatology</i>	Examine the effect of timing of breastmilk expression on mother's own milk production and lactogenesis in mothers of preterm infants. Compare timing of early initiation (w/in 6 minutes, 61-180min, and 181-360 min).	Randomized Controlled Trial Descriptive Statistics Level I	Independent: Mother's of VLBW infants in the NICU Dependent: initiation time of breastmilk expression	N/A	180	Randomized	Mothers of infants <32weeks GA and estimated weight of <1500g. 58 early initiation (within 60 minutes), 62 intermediate initiation (61-180min), 90 late initiation (181-360min).	Early initiation group experience earlier secondary activation, however late group had more sessions and more likely to sustain MoM at 6 weeks. Limitations: lack of follow-up after discharge, maternal self-reporting.
Kulkarni, D.V, Murki, S, Purohit, D, Kim, S, Sharma, D, Verdheli, V, Oleti, T, Ruggala, Y.	2020	Quality improvement initiative to improve mother's own milk despite till hospital discharge in very low birth weight infants from a tertiary care NICU	N/A	<i>Journal of Perinatology</i>	The purpose of this QI project was to implement interventions to improve to provision of maternal milk to VLBW infants	Quality Improvement Initiative Level V	Independent: QI Project interventions Dependent: VLBW infants that were able to receive maternal milk.	N/A	282	Convenience	Mother infant dyads Maternal Characteristics Mean maternal age: 29 years old 209 w/ graduate or post graduate degree 148 w/ pregnancy induced HTN 64 w/ diabetes Infant Characteristics Mean GA 30.3 weeks Mean infant weight 1176g 170 males, 78 females	• Benefits of maternal milk are dose-dependent Strengths: large population of infants studied, development of standard operating procedure for sustenance, creation of a tool to assess measures of maternal milk intake Limitations: study did not include infants transferred from other facilities, unable to document time to reach full milk capacity by mothers, high proportion of graduate and post graduate mothers, and use of weight to estimate daily dose of maternal milk.

Appendix B

Pre-Education Survey

PROJECT PUMPING FOR PREEMIES

Pre-Education Survey

1. I am aware of [REDACTED] Infant Feeding policy, and I know how to find it.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree

2. I feel confident in providing education on the benefits of breastmilk to my patients that have infants in the NICU.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree

3. I feel confident in providing breastmilk expression education to my patients that have infants in the NICU.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree

4. I typically rely on the lactation consultant to initiate breastmilk expression for mothers with infants in the NICU.
 - a. Always
 - b. Often
 - c. Sometimes
 - d. Rarely
 - e. Never

5. I make sure to initiate breastmilk expression within 6 hours of delivery for mothers with infants in the NICU.
 - a. Always
 - b. Often
 - c. Sometimes
 - d. Rarely
 - e. Never

6. Throughout my shift, I encourage mothers with infants in the NICU to express breastmilk 8+ times in 24 hours.
 - a. Always
 - b. Often
 - c. Sometimes
 - d. Rarely
 - e. Never

Appendix C

Post-Education Survey

PROJECT PUMPING FOR PREEMIES

Post-Education Survey

7. I am aware of [REDACTED] Infant Feeding policy and I know how to find it.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree

8. After this education session, I feel confident in providing education on the benefits of breastmilk to my patients that have infants in the NICU.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree

9. After this education session, I feel confident in providing breastmilk expression education to my patients that have infants in the NICU.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree

10. After this education session, I believe that it is the responsibility of the lactation consultant to begin breastmilk expression with my patient that has an infant in the NICU.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree






11. After this education session, I feel motivated to initiate breastmilk expression within 6 hours of delivery for my patients that have infants in the NICU.
 - a. Strongly Agree
 - b. Agree
 - c. Neither agree or disagree
 - d. Disagree
 - e. Strongly disagree

12. After this education session, I feel motivated to encourage mothers with infants in the NICU to express breastmilk 8+ times per day.
- Strongly Agree
 - Agree
 - Neither agree or disagree
 - Disagree
 - Strongly disagree
13. What are the benefits of breastmilk for very-low-birth-weight (VLBW) infants?
- Supports neonatal immunity
 - Decreases risk for necrotizing enterocolitis
 - Decreases risk for retinopathy of maturity
 - Decreases risk for neonatal sepsis
 - All of the above
14. What is a very-low-birth-weight infant?
- Infant weighing <1500g at birth
 - Infant weighing <2500g at birth
 - Infant weighing >3000g at birth
 - None of the above

Appendix D

Project Pumping for Premies Flyer

PROJECT PUMPING FOR PREMIES

<p>ON ADMISSION, VERIFY DESIRED FEEDING METHOD.</p> 	<p>EDUCATE MOTHERS ON THE BENEFITS OF BREASTMILK FOR THEIR INFANT.</p> 
<p>ENSURE BREASTMILK EXPRESSION IS STARTED WITHIN 6 HOURS OF DELIVERY</p> 	<p>ENCOURAGE FREQUENT BREASTMILK EXPRESSION (8+ TIMES IN 24HOURS)</p> 
<p>DON'T FORGET TO CHART IN EPIC!</p> <p>GIVE YOURSELF CREDIT FOR ALL YOUR HARD WORK!</p>  <p>For questions please contact Carter Gitlin</p>	

Appendix E

Post Implementation Survey

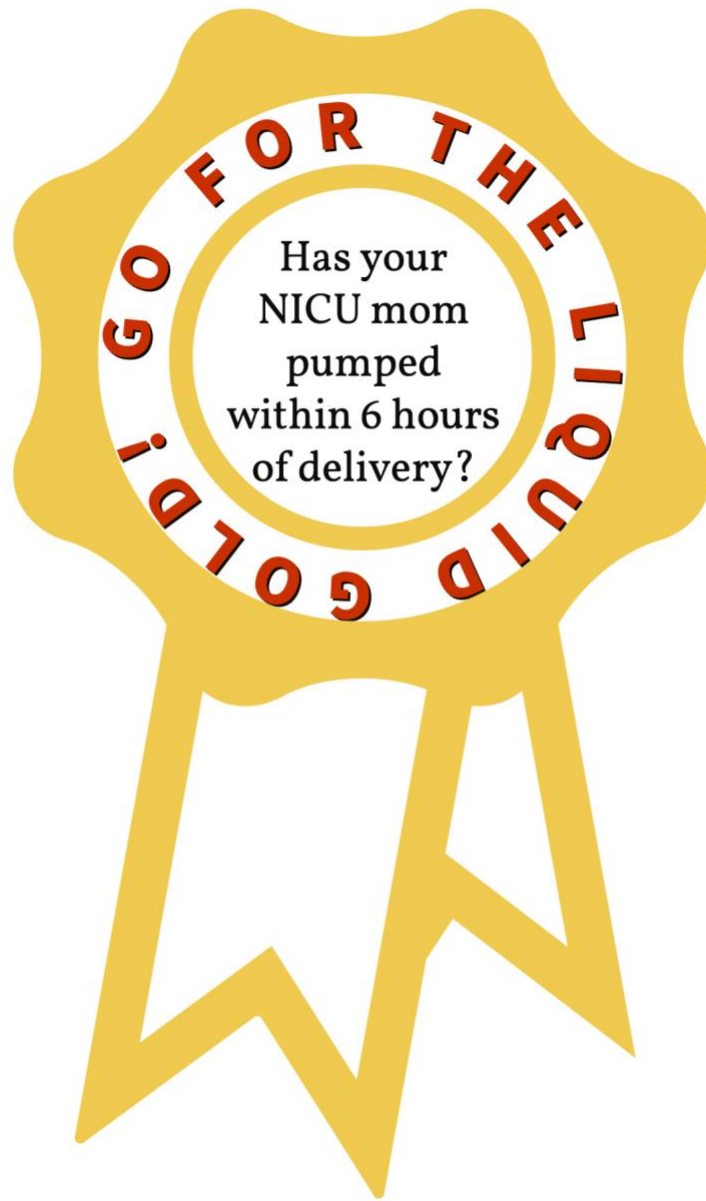
PROJECT PUMPING FOR PREEMIES

Post-Implementation Survey

1. In the past 3 months, I have initiated breastmilk expression with my patients that have infants in the NICU within 6 hours of delivery.
 - a. Always
2. Moving forward, I plan to initiate breastmilk expression within 6 hours of delivery.
 - a. Strongly Agree
 - b. Agree
3. In the past 3 months, I have relied on the Lactation Consultant to initiate breastmilk expression if my patient has a baby in the NICU.
 - a. Always
 - b. Often
4. I found the reminder badges on the workstation computers helpful in reminding me to initiate breastmilk expression within 6 hours of delivery
 - a. True
 - b. False
5. I understand the importance of initiating breastmilk expression within 6 hours of delivery.
 - a. True
 - b. False

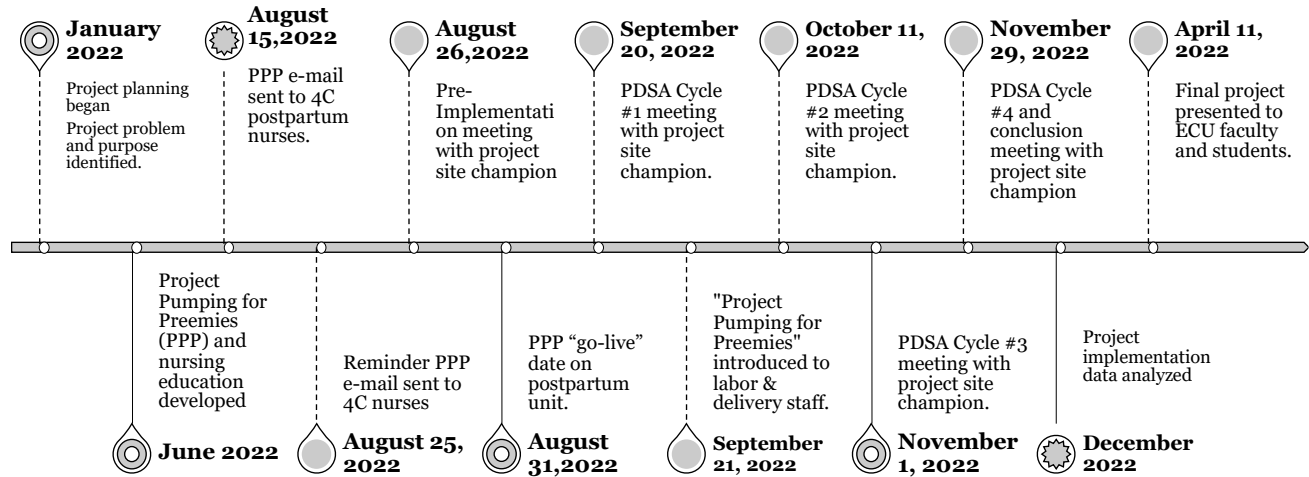
Please provide any comments or feedback on “Project Pumping for Premies”.

Appendix F
Reminder “Badges”



Appendix G

Project Timeline



Appendix H
Project Budget

Figure 1

EXPENSE	AMOUNT	NOTES
Microsoft Forms Subscription	\$0.00	Subscription provided by project leader's university.
Medela Hospital-Grade Electric Breast Pump	\$0.00	Supplied by organization
Project Flyers	\$7.40	
Reminder Badges	\$33.33	Cost to print and laminate
Double Sided Tape	\$4.00	Used to affix badges to nurse workstations
Total	\$44.73	