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Using quality improvement to increase human milk use for preterm infants

Margaret G. Parker, MD, MPH^{a,*}, and Aloka L. Patel, MD^b

^aDepartment of Pediatrics, Boston Medical Center, Boston University School of Medicine, 88 E Newton St, Vose Hall, 3rd Floor, Boston, MA 02118

^bDepartment of Pediatrics, Rush University Medical Center, Chicago, IL

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ABSTRACT

This review will provide an overview of quality improvement methods that have been used to improve human milk use (mother's own milk and donor milk) for very low-birth-weight infants in the hospital setting in the last decade. We will review the following: (1) evidence-based practices known to increase mother's own milk for very low-birth-weight infants; (2) individual hospitals with exemplary lactation programs and past and current US-based statewide quality improvement collaboratives focused on increasing mother's own milk; and (3) existing quality metrics for human milk and gaps in metrics. Finally, we will provide practical examples of key driver diagrams and change concepts that may be used to inform quality improvement for mother's own milk for very low-birth-weight infants.

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Introduction: Human milk use for very preterm infants

Evidence for use

Exclusive human milk for all newborns, and in particular preterm infants, is recommended by numerous professional organizations, including the American Academy of Pediatrics and World Health Organization.^{1,2} "Human milk" refers to a combination of mother's own milk and pasteurized human donor milk. Among preterm infants, human milk is particularly important for very low-birth-weight (VLBW; ≤ 1500 g) infants. Benefits of mother's own milk for VLBW infants are numerous, and include reduced risk of late onset sepsis³⁻⁵ and necrotizing enterocolitis⁵⁻⁷ and improved feeding tolerance and long-term neurodevelopment.^{8,9} Use of donor milk is recommended when mother's own milk is unavailable^{1,2}; it has also been shown to reduce risk of necrotizing

enterocolitis.^{10,11} Several studies have shown that exclusive human milk use is cost-effective, as the costs associated with prolonged hospitalization which accompany treatment of necrotizing enterocolitis are reduced.^{12,13}

Barriers to mother's own milk and donor milk

Despite the known benefits, barriers to provision of mother's own milk for VLBW infants in the hospital setting are substantial. Mothers of preterm infants face biological difficulties that can lead to decreased production of mother's own milk. Early delivery may lead to inadequate mammary development and subsequent reduction in milk supply.¹⁴ Lactogenesis II, commonly called "milk let down," is the onset of milk production following removal of the placenta after delivery, and can be delayed following cesarean sections¹⁵ and among mothers with medical complications such as diabetes¹⁶ and hypertension,¹⁷ situations which are

*Corresponding author.

E-mail address: Margaret.Parker@bmc.org (M.G. Parker).

particularly common among mothers of VLBW infants. Delayed lactogenesis II tracks to reduced milk supply overtime.¹⁴ Additionally, mothers of VLBW infants face physical barriers which can hamper milk production. Mother-infant separation often begins immediately after birth and lasts weeks to months while VLBW infants are cared for in neonatal intensive care units (NICUs). Separation contributes to reduced time for skin-to-skin care (STS), in which the mother holds the infant naked (or with a diaper only) on her bare chest. Less frequent STS contact is associated with decreased mother's own milk production.¹⁸ Because many VLBW infants are too immature to directly suck at the breast for several weeks of their NICU hospitalization, mothers rely on breast pumping or hand expression to produce milk,¹⁹ rather than direct breastfeeding; this can also lead to reduction in mother's own milk supply, although manipulation of pumping frequency and patterns may improve volumes.²⁰⁻²²

Mothers of VLBW infants also face substantial psychosocial barriers that impact their ability to produce mother's own milk. These mothers have higher rates of stress, anxiety, and depression²³; conditions that have been shown to reduce mother's milk supply.²⁴⁻²⁶ To maintain adequate milk volumes that will sustain rapid growth of their VLBW infants, mothers are encouraged to pump 8 times per day or more, including during the night.²⁷⁻²⁹ This can be a substantial burden and mothers have reported that caring for other siblings, time spent commuting to the hospital, and lack of motivational support from others in the home hinder the ability to frequently pump.³⁰⁻³² Additionally, due to financial constraints, mothers may return to work while their VLBW infants are still hospitalized, in order to "save up" time designated for maternity leave until after their infant is discharge home. This further contributes to mother-infant separation, as mothers have less time to visit their infant(s) in the hospital when they are working. Additionally, many work environments are not conducive to frequent pumping, which is needed to maintain an adequate milk supply.^{33,34}

Barriers in supporting mothers in producing milk exist among hospital providers. Nurses may not be adequately trained in assisting mothers in pumping, hand expression, or performing STS. Alternatively, nurses who are trained in such skills may not have sufficient time to assist mothers with their competing demands.³⁵ Hospitals may have insufficient availability of lactation experts to help mothers at all hours of the day, and/or inadequate supplies of hospital-grade breast pumps.

Donor milk is also not universally used for VLBW infants. Recent surveys to medical directors have shown that donor milk is used in 42-59% of level 3 NICUs, and that criteria for use vary widely.^{36,37} Cost and perceived accessibility are factors that have been associated with not using donor milk.³⁶

Disparities in mother's own milk and donor milk

Disparities in mothers producing their own milk according to maternal age, socioeconomic status, and race/ethnicity are well-known. United States national surveillance data have shown that younger mothers, mothers of non-Hispanic black infants, less educated mothers, and mothers with lower household incomes are less likely to produce their own milk for their infants.³⁸⁻⁴⁰ These populations of women are also

more likely to experience stress, anxiety, and depression,⁴¹ conditions that have been associated with decreased mother's own milk production.²⁴ Disparities may also exist with use of donor milk; a recent study found that donor milk was used less often among safety-net hospitals, which serve $\geq 75\%$ of their population with Medicaid insurance, compared to non-safety-net hospitals.³⁶ Finally, some hospitals have reported that non-Hispanic black mothers are less likely to consent for donor milk, compared to non-Hispanic white mothers.⁴²

Evidence-based practices to improve human milk use in the hospital setting

Despite the multitude of barriers and disparities that exist in human milk use, hospital-based practices that facilitate greater human milk use for VLBW infants are well-known. Quality improvement (QI) methods can be used to adopt these practices in a sustained manner. Currently, evidence-based practices to support human milk for VLBW infants in the hospital setting have been summarized by Nyqvist et al.,²⁷ in 2012, "Expansion of the Baby Friendly Hospital Initiative 10 Steps for Successful Breastfeeding into Neonatal Intensive Care: Expert Group Recommendations," Meier et al.,²⁹ in 2010, "Improving the Use of Human Milk During and After the NICU Stay," and by Spatz²⁸ in 2004, "10 Steps for Promoting and Protecting Breastfeeding for Vulnerable Infants." The majority of evidence-based practices described by Nyqvist et al., Meier et al., and Spatz are focused on improving mother's own milk, and include education for families and staff, early mother's own milk initiation, continuation of mother's own milk production, and successful transition to direct breastfeeding. Donor milk is also included as an evidence-based practice to improve overall human milk use when mother's own milk is unavailable.

Education for staff and families

In order for staff to adequately support mothers in making milk, they require education both in mother's own milk benefits as well as hands on training in assisting mothers with hand expression, pumping, and assessment of latch.⁴³⁻⁴⁵ Families also require education regarding the importance of mother's own milk, early and frequent milk expression, and the role of donor milk. Family education from physicians, as well as nurses and lactation consultants, has been shown to impact sustainment of milk production for mothers of VLBW infants.⁴⁶⁻⁴⁹

Early initiation

Multiple studies have shown that early hand expression and/or breast pumping are associated with increased mother's own milk production overtime.^{19,50-52} While studies have described increases in milk production when initiation occurs <6 hours after delivery,⁵¹ a recent study showed that initiation by mothers <1 hour after delivery led to greater milk volumes compared to mothers who initiated between 1 and 6 hours after delivery.¹⁹ Thus, it is recommended that mothers

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