Recommendations to Improve Human Milk Feeding Rates for Preterm Infants in NICUs in North Carolina and the United States

By

Jessica Whelan

A Master’s Paper submitted to the faculty of the University of North Carolina at Chapel Hill
In partial fulfillment of the requirements for the degree of Master of Public Health in the Public Health Leadership Program.

Chapel Hill

2011

__________________________________________
William A. Sollecito, DrPH

__________________________________________
Miriam Labbok, MD, MPH

12 April 2011
Date
Abstract

Preterm birth rates remain high in North Carolina and throughout the United States (12.9% and 12.3% respectively), while human milk feeding rates are lower for preterm infants than for full term infants. Human milk is widely known to be the optimal form of nutrition for preterm infants, due to its multiple health, psychological, and economic benefits. Breastfeeding helps prevent many health problems to which preterm infants are susceptible; breastfeeding is therefore an important public health intervention. However, mothers of preterm infants face unique challenges to initiating and sustaining lactation. Mothers of preterm infants need to be supported in overcoming these challenges in order to improve human milk feeding rates. Hospitalization in the neonatal intensive care unit (NICU) presents an opportunity for mothers to receive specialized support from hospital personnel. The objectives of this paper are to review the literature on human milk feedings in the preterm population in order to explore barriers to lactation and recommend NICU interventions for addressing these barriers, thereby increasing lactation initiation and duration rates. This paper also discusses the use of donor human milk and makes recommendations on how to increase access to its use in the NICU and in the outpatient setting. More research is needed on human milk feeding and preterm infants, but the literature demonstrates that there have been successful interventions at improving human milk feeding rates. Successful interventions must be multi-tiered and focus on multiple levels of the social ecological model in order to be most effective. Recommendations in this paper span a range of interventions, from the inpatient setting to post-discharge, and include both general and specific (for North Carolina) recommendations for NICUs.
Introduction

Human milk is widely recognized as the optimal nutrition for infants and for its contribution to child survival and lifelong health. Human milk is especially important for the health and development of preterm and low birth weight infants, yet national human milk feeding or breastfeeding statistics do not exist for this subpopulation; furthermore, there is less evidence about successful interventions to increase human milk feeding rates for mothers of preterm infants. This paper will explore local (North Carolina), national, and international research to describe patterns and issues related to human milk consumption among preterm infants. Breastfeeding patterns and rates in North Carolina are comparable to other Southeastern U.S. states, as this region has the lowest breastfeeding rates than any other U.S. region. A review of the data and the literature will lead to a series of recommendations designed to improve human milk intake for preterm infants. This paper will:

1) Explore barriers to breastfeeding initiation and continuation for mothers of preterm infants.

2) Recommend interventions for hospital NICUs targeting different levels of the socio-ecological model to improve lactation initiation and duration in North Carolina.

3) Discuss the use of donor human milk and recommend actions to increase the use of donor milk in hospital NICUs and increase access to donor milk for mothers of preterm infants who are unable to initiate or sustain lactation.

The recommendations presented in this paper will be based on the current literature as well as my own recommendations derived from an analysis of the literature.
**Preterm Birth Rates and Associated Factors**

After a steady rate of increase since the 1980s, preterm birth (defined as a gestational age less than 37 weeks) rates declined in 2007 and 2008 in the U.S. However, the preterm birth rate in the U.S. in 2008 was still high at 12.3% (Martin, Osterman, & Sutton, 2010). The North Carolina preterm birth rate in 2008 was somewhat higher at 12.9% (Martin et al., 2010).

Although advanced medical technology and knowledge have improved health outcomes for preterm infants, prematurity is the leading cause of death for newborn infants and can cause serious health problems and long-term hospital stays in the neonatal intensive care unit, or NICU (CDC, 2010). Infants born at earlier gestational ages and lower birth weights are most at risk for death and disability (CDC, 2010). The high rate of preterm births is costly both at the personal and health economics levels. The Institute of Medicine reported in 2006 that premature births cost American society at least $26 billion a year, or $51,600 per infant; this amount reflects medical care during infancy, as well as the costs of early intervention services, maternal care, and lost labor productivity (Institute of Medicine, 2006). The costs today might be substantially higher due to increasing technologies that contribute to saving ever younger preterm infants.

Furthermore, preterm birth rates also reflect overall patterns of health disparities among ethnic groups. African American women have a higher proportion of preterm births than do white women (17.5% and 11%, respectively), which is a troubling health disparity (Martin et al., 2010). This health disparity is further compounded by national and state statistics on breastfeeding—African American mothers of full term infants have lower breastfeeding rates than do white mothers. According to the 2006-2008 North Carolina Pregnancy Assessment Monitoring Survey System [PRAMS], the breastfeeding initiation rate for African American women was 59.7% compared to 78.6% for white women (North Carolina PRAMS, 2010).
Breastfeeding among Preterm Infants

As reported in the literature, breastfeeding initiation rates for preterm infants are lower than that of full term infants. In addition, preterm infant rates vary widely, depending on a variety of factors, such as maternal race, age, socioeconomic status, hospital location, gestational age, birth weight, and infant medical complications. In North Carolina, there is no statewide data collected on breastfeeding among preterm infants, but the North Carolina PRAMS does include data on breastfeeding rates by birth weight, a factor that is correlated with prematurity, as preterm infants are often low birth weight. According to the 2006-2008 North Carolina PRAMS, breastfeeding was lower for low birth weight infants (defined as < 2500 grams) at initiation, 4 weeks after delivery, and 8 weeks after delivery, compared to infants weighing more than 2500 grams (NC PRAMS, 2010). Although breastfeeding initiation rates were comparable between low birth weight infants and infants of normal weight (71.9% compared to 73.9% for infants weighing 2500 grams or more), these rates diverge quickly over time; breastfeeding at 8 weeks after delivery was 43.3% compared to 51.8%, respectively (NC PRAMS, 2010). There is no distinction in PRAMS between low birth weight (LBW) and very low birth weight (VLBW), which is defined as less than 1500 grams.

The PRAMS does not distinguish between any or exclusive breastfeeding, nor between feeding expressed milk and direct breastfeeding; the survey question asks “For how many weeks or months did you breastfeed or pump milk to feed your baby?” (NC PRAMS, 2010). The distinction between exclusive and partial human milk feeding is important, as there is a “positive dose- response association between the volume of human milk intake” and better health outcomes (Zachariassen et al., 2010, p. 1000). Thus, the distinction between partial and exclusive human milk intake is especially important for preterm or LBW infants who may require long
hospitalizations in the NICU and are often fed mixed feedings of human milk and preterm formula due to either clinician decision or mothers’ inability to provide sufficient milk (Sullivan et al., 2010). In this paper, the terms breastfeeding and human milk feeding will both be used, as much of the literature does not distinguish between expressed milk feedings and feeding directly at the breast.

**Macro-social correlates of lactation**

It is widely documented that macro-social factors such as race, age, and socioeconomic status are indicators of breastfeeding for full term infants in North Carolina and across the U.S. The literature supports this finding for preterm infants as well. Race, age, and socioeconomic status are independently associated with breastfeeding across multiple studies. Two different studies conducted with mothers of VLBW infants by Furman, Minich, and Hack reported that mothers who continued breastfeeding or pumping for longer durations were white, married, older, and had more than a high school education (1998; 2002). Another study of 361 mothers of VLBW infants in the Northeast reports that mothers who initiated breastfeeding were significantly more likely to be white, married, older, with private insurance, and higher verbal IQs (Smith, Durkin, Hinton, Bellinger, & Kuhn, 2003). In a study of preterm infants younger than 34 weeks gestational age in rural Illinois, Espy and Senn found that age and insurance status were positively associated with breastfeeding (2003). Another study analyzing data of 3901 preterm births (ages 24-37 weeks GA) in 2001 in Massachusetts reported that Hispanic and black women born outside the U.S. had the highest breastfeeding initiation rates while white women born in the U.S. had the next highest breastfeeding rates (Merewood, Brooks, Bauchner, MacAuley, & Supriya, 2006).
Public Health and Health Care Issues

The low breastfeeding rate for preterm infants is a public health problem that requires attention in order to improve infant health, reduce health disparities, and provide cost-savings. Human milk has many known benefits for preterm infants. Necrotizing enterocolitis (NEC) is a serious gastrointestinal disorder that affects preterm infants with a mortality rate of 25% (Eisner, 2009). Multiple studies have demonstrated a higher incidence of NEC among preterm infants who are exclusively fed formula (Sullivan et al., 2010; Lucas & Cole, 1990). Preterm infants fed human milk also have lower incidence of sepsis and meningitis than infants fed exclusive formula (Nascimento & Issler, 2003). Hylander et al. report that VLBW infants who are exclusively fed formula have a higher incidence of retinopathy of prematurity (ROP), an eye disorder that can cause vision impairment or blindness (2001). In a meta-analysis assessing the relationship between breastfeeding and cognitive development, Anderson, Johnstone, and Remley found that full term and preterm infants who are breastfed have higher levels of cognitive function at 6 to 23 months of age than infants who are formula-fed; furthermore, low birth weight infants fed human milk had more gains than term infants, “suggesting that premature infants derive more benefits in cognitive development from breast milk than do full-term infants” (1999, p. 525). Yet another benefit of human milk for preterm infants is faster brainstem maturation compared to preterm infants fed formula (Amin, Merle, Orlando, Dalzell, & Guillet, 2000). Finally, when mothers have skin-to-skin contact with their preterm infants, the mothers produce antibodies to the microorganisms found in the NICU which are then passed on through their milk, offering protection (Schanler, 2001).

A cost analysis of breastfeeding in the U.S. in 2010 estimated that $13 billion a year could be saved if 90% of mothers were to breastfeed exclusively for six months; at 80%, $10.5
billion would be saved (Bartick & Reinhold, 2010). Bartick and Reinhold used breastfeeding data from the 2005 birth cohort of the National Immunization Survey. The study analyzed ten childhood diseases which are mitigated by breastfeeding, including NEC, which mainly affects preterm infants, and factored in direct and indirect costs of each disease (2010). Interventions to improve rates of breastfeeding for mothers of preterm infants are also important in the fight to reduce health disparities, a key ethical principle of public health professionals.

A literature review on breastfeeding preterm infants demonstrates that the variables under study differ greatly in the published research. Many articles define their study population by gestational age while others use birth weight as the defining factor. Among these distinct categories, there is further classification, such as LBW (1500 grams—2500 grams) and VLBW (< 1500 grams). Still other authors look at breastfeeding interventions for all infants in a NICU, some of whom are preterm and others who are full term with medical complications. Another complicating factor is that some studies look at exclusive breastfeeding or quantify dose response, while others do not quantify the amount of human milk given to infants. Furthermore, much of the research takes place in urban hospitals or outside the U.S. This wide variability in the literature makes comparability and generalizability difficult; nevertheless, there are many identified barriers and successes that are common across the literature. Based on the literature, this paper will now describe barriers unique to mothers of preterm and low birth weight infants.

**Barriers to Breastfeeding**

*Background*

It is important to note that many mothers face barriers to continuing breastfeeding to at least one year of age, the current recommendation by the American Academy of Pediatrics (2005). This problem is exemplified in the national and state breastfeeding rates. In 2007, 75%
of mothers initiated breastfeeding in the U.S. while 73.5% of mothers initiated breastfeeding in North Carolina (National Immunization Survey, 2010). The Healthy People 2020 objective is to increase the proportion of infants ever breastfed to 81.9% (U.S. Department of Health and Human Services, n.d.). Although state and national breastfeeding initiation rates are high, and the national Healthy People 2010 goal of 75% was met, breastfeeding continuation and exclusive breastfeeding remain low, especially in the Southeast region of the U.S. In 2007 in North Carolina, the breastfeeding rate dropped to 35.9% at six months and 19.4% at twelve months (CDC, 2011). The exclusive breastfeeding rate at six months was even lower at 8.7% (CDC, 2011). These numbers are far below the Healthy People 2020 objectives of 60.6% and 34% for any breast milk at six and twelve months respectively, and 25.5% of exclusive breast milk at six months (U.S. DHHS, n.d.).

Although there is no national or statewide data on breastfeeding rates for preterm infants, the research suggests much lower initiation and continuation rates for preterm infants, with the lowest rates among infants of younger gestational ages. For example, the 2001 study in Massachusetts by Merewood et al. demonstrated that the breastfeeding initiation rate for mothers of full term infants was 76.4% while the breastfeeding initiation rate was 70.1% for infants born at 32 to 36 weeks GA and 62.9% for infants born at 24 to 31 weeks GA. An exploration of barriers will help to explain the reasons behind low breastfeeding rates for mothers of preterm infants. When initiating breastfeeding, mothers of preterm infants are presented with unique challenges related to the immaturity of their infants, long hospitalization and separation from their infants, and the NICU environment, among others. Additionally, after infant discharge, mothers face significant barriers to continuing lactation. This paper will first examine barriers to initiation that are unique to mothers of preterm and low birth weight infants.
Barriers to initiation

Preterm infants usually require hospitalization in the NICU, which can last days or even months if infants are early preterm (less than 32 weeks gestation) or VLBW. Furthermore, infants are physiologically unable to coordinate sucking and swallowing until they are between 32 and 35 weeks gestational age due to their immaturity (Zachariassen et al., 2010). Separation from their infants who are unable to breastfeed creates a unique set of barriers to breastfeeding initiation for mothers of preterm infants. Separation at birth means that mothers of preterm infants must initiate lactation by expressing milk with an electric pump; furthermore, in order to produce and maintain sufficient milk supply, mothers need to begin right away and should pump every eight to twelve hours, mimicking the infant’s feeding schedule (American Academy of Pediatrics, n.d.). Even if mothers are able to pump early and frequently, milk supply may still be low, as the mechanical expression of milk does not produce the same effect on milk supply as an infant suckling at the breast (Morton et al., 2009). Another factor associated with low milk supply is maternal stress, which is also common to mothers of infants who are ill or hospitalized; even a prolonged labor and delivery or urgent Caesarean section can prohibit lactation (Dewey, 2001).

To further compound the problem, maternal illness might prevent mothers from initiating pumping soon after birth. Many mothers who deliver prematurely have medical conditions that inhibit the initiation of pumping. For example, magnesium sulfate is an intravenous drug commonly given to mothers to prevent preterm delivery for women in preterm labor and to prevent seizures for women with preeclampsia, conditions which are both associated with preterm birth (WebMD, 2009). Common side effects include lethargy, nausea, fatigue, headache, and muscle weakness (WebMD, 2009). Such side effects may make it difficult for a
mother to begin pumping, especially for a woman who is being treated with magnesium sulfate for twenty-four hours after delivery, the standard course of treatment for prevention of seizures in women with preeclampsia (Barss & Repke, 2010).

Another barrier to initiation of pumping is the lack of information or inconsistent information given to mothers by health care professionals. Several qualitative studies have reported inconsistent advice on breastfeeding to mothers of infants hospitalized in the NICU. Sisk, Quandt, Parson, and Tucker surveyed 32 mothers of VLBW infants in a Winston-Salem NICU and reported that health care professionals gave inconsistent advice about when to initiate pumping (2010). Another study conducted in London, England surveyed 44 mothers of infants in area NICUs and found that 34% of the women reported inconsistent advice from NICU personnel; furthermore, 34% of the women also reported that they were not given enough information about breastfeeding (Jaeger, Lawson, & Filteau, 1997). Another study conducted with 178 mothers of full term infants admitted to a NICU in Sweden found that 71% of the mothers reported advice on breastfeeding to be poor (Nyqvist & Sjoden, 1993). Although these studies are qualitative in nature and their sample sizes are small and heterogeneous (including one study that involved full-term infants only), these findings are able to illuminate a perceived barrier by some mothers of infants hospitalized in the NICU.

Another common barrier to initiating pumping is access to breast pumps. Mothers who must be separated from their infants need to use high-quality, electric breast pumps in order to maintain adequate milk supply. The literature even suggests that mothers of preterm infants should use hospital grade electric pumps in order to maintain milk supply (Meier, Engstrom, Mingolelli, Miracle, & Kiesling, et al., 2004). While infants are inpatient, hospitals do offer hospital-grade pumps for mothers for use in the NICU; however, mothers must also pump
several times a day while at home. Purchasing a high-quality electric breast pump is expensive, costing between $200 and $350, and renting a hospital-grade pump may cost between $30 and $70 a month (Chamberlain, McMahon, Philipp, & Merewood, 2006). Low income women in North Carolina may be able to obtain an electric pump through the Women Infants and Children (WIC) program, and some insurance companies may provide reimbursement for pumps, but navigating the system can be difficult; furthermore, many insurance companies do not provide payment for breast pumps. For example, although WIC in North Carolina loans hospital grade breast pumps to mothers of infants hospitalized in the NICU, the mothers are not allowed to receive formula at the same time (H. Miranda, personal communication, March 7, 2011). This can be problematic, as many infants may require supplementation due to their mothers’ low milk supply.

A barrier common to initiating and maintaining lactation is the stressful NICU environment and the lack of privacy for both pumping and putting the baby to breast. Furman, Minich and Hack studied 82 mothers of VLBW infants in a Cleveland, Ohio NICU; barriers reported by the mothers included a lack of privacy and a great deal of stress and noise in the NICU (1998). Sisk et al. report the lack of privacy as a major barrier, with friends, family, or health care professionals interrupting pumping routines, making it difficult for some mothers to pump the recommended eight to twelve times a day (2010).

Finally, low social support is a barrier common to both initiation and maintenance of lactation. In a Canadian study conducted with 125 mothers of preterm and low birth weight infants in the 1980s, mothers who initiated breastfeeding had significantly more social support than mothers who fed their infants formula (Kaufman & Hall, 1989). The authors also report that social support was the most important factor in the continuation of lactation; mothers who
identified no social support were six times more likely to discontinue lactation compared to mothers who identified six sources of support (Kaufman & Hall, 1989). Furman et al. report that mothers who were pumping at discharge had a high level of support from the father of the infant (1998). Sisk et al. also report that social support in the form of practical help and emotional support was important for mothers to continue pumping (2010).

**Barriers to continuation**

According to the literature, low milk supply, or the perception of low milk supply, is a key reason why mothers discontinue lactation and is commonly cited across multiple studies. A study on maternal anxiety and lactation counseling for mothers of VLBW infants in a Winston-Salem NICU found that the primary reason mothers ceased lactation before infant hospital discharge was low milk supply (Sisk, Lovelady, Dillard, & Gruber, 2006). This finding is corroborated by another study of mothers of VLBW infants in a Cleveland NICU; again, the principal reason mothers gave for discontinuation of lactation was low milk supply (Furman, Minich, & Hack, 2002). In a Canadian study of breastfeeding counseling on the effect of breastfeeding duration of 128 mothers of VLBW infants, the mothers reported that low milk supply was the main reason for discontinuation at ages 1 month, 3 months, and 6 months corrected infant age (Pinelli, Atkinson, & Saigal, 2001). In a survey of 110 mothers of LBW infants from eight mid-western hospitals, mothers cited that insufficient milk supply was the principal reason for lactation discontinuation (Hill, Hanson, & Mefford, 1994). It should be noted that this study is qualitative in nature and the sample is unrepresentative of the population, as the mothers were mostly white and middle class.

As it is especially difficult to maintain lactation for extended periods of time by solely expressing milk, many mothers’ goal is to eventually feed their infants at the breast. Again,
feeding at the breast poses more challenges for preterm infants due to their physiological immaturity, making it difficult to suck, swallow, and breathe (Zachariassen et al., 2010). Before infants are ready to coordinate sucking and breathing at the bottle or breast, they are given milk (either formula or human milk) through a nasogastric tube, also known as gavage feeding (Stine, 1990). Additionally, small size may make it difficult for infants to latch properly as well as exhausting the infants’ energy while breastfeeding (Wheeler, 2009; Hill et al, 1994). These barriers can be classified under the general category of “transfer of milk to the infant,” another major reason given by mothers for discontinuation of breastfeeding (Hill et al., 1994, p. 169). Hill et al. identified fussiness, poor latch, and poor suck as barriers to breastfeeding (1994). Pinelli et al. found that infant sleepiness was a problem while the infants were hospitalized and breastfeeding discomfort was a concern once the infants were discharged (2001).

A related, often-cited barrier is that of “nipple preference,” although the data does not clearly support this as a barrier. Nipple preference is thought to arise when infants are given bottles before being breastfed, making it difficult to latch and feed at the breast successfully. Many NICUs introduce bottles before attempting infants at the breast, but Stine argues that infants do not have prolonged hospital stays and more mothers (with intent to breastfeed) are exclusively breastfeeding at discharge due to the Indianapolis NICU protocol to go directly from gavage feeding to breastfeeding (Stine, 1990). A review of the literature by Ahmed and Sands also supports a gavage feeding protocol, as infants were more likely to be exclusively breastfed if supplemented by nasogastric tube than if they were supplemented with bottles (2010). However, Furman et al. reported that nipple preference was not a factor in their study of 119 VLBW infants; there were no significant differences in discontinuation between mothers of infants who were bottle-fed first and mothers whose infants were not given bottles (2002).
Another barrier for many mothers is related to transportation and the distance between home and the NICU. Sisk et al. report that travelling to the NICU was a significant barrier for the mothers in their Winston-Salem study. Women living several miles away from the NICU found it difficult to pump frequently enough to maintain sufficient milk supply due to the amount of time required to travel to and from the NICU. Even women living closer to the NICU had difficulty managing the time and separation from their infants, as many had to rely on friends or the public bus system for transportation (2010). Travelling long distances to the NICU is problematic in a rural state such as North Carolina, where many mothers may live very far from the nearest hospital with a level II or level III NICU.

Finally, many mothers discontinue lactation due to the barriers related to the burden of pumping. As discussed above, while infants are hospitalized, mothers must express milk, sometimes for weeks or months. Even after discharge, many infants are unable to feed at the breast for all of their feedings and are often unable to empty the breast at each feeding; mothers must thus continue to pump for weeks or months in order to maintain milk supply. It is especially difficult to maintain lactation for extended periods of time by solely using a pump to express milk. Research by Jane Morton et al. has demonstrated that both the quality and quantity of milk expression by pumping is greatly enhanced by the addition of hand expression, but this approach has not yet been widely adopted (2009). Sisk et al. report that managing the amount of time required to pump frequently was an important barrier for mothers of VLBW infants (2010). Hill et al. and Wheeler identify exhaustion with pumping as a barrier (1994; 2009). Furman et al. report the following reasons for discontinuation: time management, exhaustion, and the burden of pumping (2002).
Social Ecological Model of Health

Mothers of preterm infants face multiple, complex challenges to initiation and maintenance of breastfeeding. Breastfeeding, like any health behavior is complex and has multiple determinants. These determinants include individual behaviors and beliefs, social support, the community environment, and finally, fundamental, or macrosocial factors. While the medical field has traditionally focused on individual behaviors, the field of public health is increasingly aware of the need to impact multiple determinants in order to improve health outcomes. The social ecological model is a useful framework for visualizing the various health determinants and how they are intertwined (Figure 1). For example, if a mother is aware of the benefits of breastfeeding and is willing to express milk, it may still be difficult for her to achieve this goal if she lacks access to professional and social support, is unable to buy a breast pump, or lacks transportation to the hospital, all of which are barriers common to mothers of preterm infants, as discussed above. Interventions to promote breastfeeding in the NICU must thus be multi-tiered and target different levels of the social ecological model to be most effective.

Figure 1: Social Ecological Model of Health

Source: Golden (2008)
**Recommendations for NICUs**

Admission to the NICU presents many challenges for breastfeeding, but the NICU environment can also present an opportunity to promote milk expression and breastfeeding with greater access to professional support and resources. A review of the literature reveals that many NICU interventions have been successful at improving breastfeeding initiation and duration rates. This paper will now recommend and discuss the following inpatient and post discharge interventions to increase breastfeeding initiation and duration among mothers of preterm infants:

- Comprehensive written NICU policy
- Staff training
- Skin-to-skin contact
- Lactation counseling
- Transportation assistance
- Peer counseling
- Home visits
- Access to pumps and education on milk expression

**Inpatient interventions**

An important first step in promoting breastfeeding in the preterm population is for NICUs to have a comprehensive, written policy on breastfeeding which focuses on the special needs of infants admitted to the NICU and their mothers. Not only should there be formal policy on breastfeeding in the NICU, but the policy must be communicated to all NICU personnel. The CDC’s Maternity Practices in Infant Nutrition and Care survey [mPINC] ranks each state on its hospitals’ and birthing centers’ breastfeeding practices and policies. We can look at North Carolina data to illustrate how poorly the state has fared in hospital breastfeeding policies and
training. In 2007 North Carolina ranked 29th overall, with a score of 61 out of 100. North Carolina fared particularly poorly on breastfeeding policy, as only 10% of respondents had formal breastfeeding policies based on the Academy of Breastfeeding Medicine protocols (CDC, 2010). However, the mPINC does not have questions related to NICUs, so it is impossible to know how many NICUs have formal policies on breastfeeding. Furthermore, the Academy of Breastfeeding Medicine, which issues clinical protocols in order to promote and facilitate breastfeeding for physicians, does not have any protocols specifically addressing early preterm, LBW, or VLBW infants (Academy of Breastfeeding Medicine, 2008). I therefore also recommend that the Academy of Breastfeeding Medicine issue protocols for breastfeeding the preterm population while in the NICU.

Next, all NICU personnel must be trained in lactation and breastfeeding support. North Carolina hospitals did not score very well on staff training, as only 5% of facilities reported breastfeeding education for new staff and 29% of facilities reported breastfeeding education for current staff (CDC, 2010). Again, the mPINC is not designed for questions about the NICU, but this finding is indicative of a need for more staff training in North Carolina NICUs as well. All staff must be trained so that they are equipped to offer consistent education on breastfeeding and expressing milk, thereby eliminating inconsistent advice among different personnel.

Skin-to-skin contact is an intervention that targets individual determinants of health. In the literature, skin-to-skin contact is often referred to as kangaroo care, which was developed in Bogotá Columbia in 1979 as a way to care for preterm infants in a hospital setting lacking incubators to keep preterm infants alive. In that setting, mothers placed their infants unclothed against their chest for continuous 24/7 skin-to-skin contact in order to act as the incubator and keep the infants alive (Véras & Traverso-Yépez, 2011). Today in the U.S., modified kangaroo
care is now utilized frequently in NICUs, which is the “skin-to-skin holding of diaper-clad preterm infants in an upright position on the parent’s chest” (Bell & McGrath, 1996, p. 387). Skin-to-skin contact has many known health benefits for both mothers and infants, including increasing milk volume and protecting the infant against microorganisms found in the NICU (Hake-Brooks & Anderson, 2008). Skin-to-skin contact has also been shown to increase breastfeeding duration and exclusivity. Hake-Brooks and Anderson conducted a randomized trial with 66 mothers who intended to breastfeed and their preterm infants aged 32-36 weeks gestation. The average duration of skin-to-skin contact in the intervention group was 4.5 hours while the control group did not participate in skin-to-skin contact, receiving only the standard care of holding the infant fully clothed. The intervention group had significantly longer breastfeeding duration rates (5.08 months compared to 2.05 months, p value= 0.003) and breastfeeding exclusivity (p value=0.047) (Hake-Brooks and Anderson, 2008).

Modified kangaroo care, or skin-to-skin contact is now in wide use in U.S. NICUs due to its many benefits and low risks; however, skin-to-skin contact is not standardized across all NICUs. Some NICUs may have written policies on how to implement modified kangaroo care, but many NICUs lack consistent guidelines on how to implement it safely. A national survey of nurse managers on skin-to-skin contact in the NICU (response rate 59%) reported that 82% of respondents practiced this. However, 87% of those implementing such care did so only upon request by the parents (Engler et al., 2002). Furthermore, lack of guidance and information about skin-to-skin contact was cited as a barrier by 20% of the respondents (Engler et al., 2002).

The literature vastly supports the use of skin-to-skin contact in the NICU, so it needs to be implemented as standard practice. Policies and guidelines must be written and communicated to all NICU personnel, especially nurses, and they must receive adequate training on how and
when to use modified kangaroo care. Bell and McGrath report that the practice of skin-to-skin contact increased by 40% in their NICU at Maricopa Medical Center in Phoenix after the implementation of formal policy and education of staff and parents (1996). Having clearly communicated policies and trained staff will ensure consistent use of skin-to-skin contact in the NICU, which will in turn help to improve breastfeeding rates.

Another intervention affecting individual behavior is lactation counseling. An International Board Certified Lactation Consultant, or IBCLC, is an internationally credentialed lactation consultant “who has specialized skills in breastfeeding management and care” promoting self-care for mothers (IBCLCE, 2011). As mothers of preterm infants have special needs, it is very important that all NICUs employ an IBCLC who is available primarily for the infants admitted to the NICU. A lactation consultant is a valuable resource who can provide education, instrumental support, and be able to support a mother’s self-efficacy, an important factor in determining positive health behavior. Research has shown that IBCLCs have helped to improve breastfeeding rates among mothers of full term infants; however, there is less data about the use of IBCLCs for preterm infants (Gonzalez et al., 2003).

A randomized controlled trial with 128 mothers of VLBW infants in Canada reported that there were no significant differences in breastfeeding duration between the mothers who received regular, individualized lactation counseling and the mothers who were in the control group, receiving standard breastfeeding support from NICU personnel (Pinelli et al., 2001). However, generalizability is difficult, as the mothers involved in the study were mainly middle class and had prior breastfeeding experience; additionally, community resources were easily accessible (Pinelli et al., 2001).
Studies conducted in the U.S demonstrate that lactation counseling is more effective at improving breastfeeding rates than the trial conducted by Pinelli et al. A pre- and post-intervention evaluation of breastfeeding rates of the use of IBCLCs for 350 preterm infants in a Norfolk, Virginia NICU demonstrated that both the rates of breastfeeding initiation and breastfeeding at hospital discharge increased from 31% to 47% (p value=0.002) and 23% to 37% (p value=0.004) respectively after IBCLCs were utilized (Gonzalez et al., 2003). Another study with 196 mothers of VLBW infants in a Winston-Salem NICU demonstrated that when counseled, mothers who had initially planned to feed their infants formula initiated breastfeeding at a rate of 85% with high initiation rates regardless of race or socioeconomic status (Sisk et al., 2006). Furthermore, maternal anxiety did not increase for these mothers after receiving lactation counseling; this is important, as health care professionals are often reluctant to cause further anxiety and stress for mothers who have initially decided to formula feed and thus do not provide any education about the benefits of breast milk (Sisk et al., 2006).

A certified lactation consultant is a valuable resource in the NICU who can provide education about the benefits of breastfeeding for all mothers, regardless of initial feeding choice. It is important that lactation consultants in the NICU deliver different messages to mothers of preterm infants than to mothers of full term infants in order to promote self-efficacy and lessen anxiety: “critical to the introduction of breastfeeding is the message that there is no right way to provide OMM [own mother’s milk] in the NICU. Instead, mothers are encouraged to express OMM for early infant feedings and make a decision about continued lactation or feeding at breast later in the NICU experience” (Meier et al., 2004, p. 165). Additionally, a lactation consultant can provide very concrete information about how to express and store milk; this is especially important, as research has shown that beginning milk expression less than six hours
after delivery and expressing milk at least five times per day is associated with higher breastfeeding rates, due to the establishment and maintenance of milk supply (Furman et al, 2002). Although more research is needed for the preterm population, it is clear that lactation counseling can be beneficial. Thus, based on the literature, I recommend that NICUs utilize lactation consultants who are available specifically for infants admitted to the NICU.

Social support is an interpersonal determinant of health and includes emotional support, instrumental support, and informational support (Golden, 2008). Social support comes from one’s social network, such as friends, family, community, or professionals. As discussed in the section on barriers, women with more social support have higher breastfeeding rates. Peer counseling is an intervention that targets the interpersonal level of the social ecological model. Peer counseling has been shown to be effective in increasing breastfeeding rates in low-income mothers of full term infants, but the research is somewhat limited for preterm infants (Merewood et al, 2006).

The available research on preterm infants does suggest that peer counseling is effective and viable. A randomized, controlled trial was conducted with 85 mothers of preterm infants (between 26 and 37 weeks GA) at the NICU of Boston Medical Center between 2001 and 2004. The intervention group received multiple face-to-face meetings with a peer counselor while in the NICU and telephone contact after infant discharge while the control group received standard hospital care, which was access to a lactation consultant as needed, breastfeeding classes, and a free breast pump for use in the home. The peer counselors were trained on breastfeeding management and hospital policies and were supervised and supported by professional staff. Furthermore, the peer counselors were of diverse ethnic backgrounds, were mothers of former NICU infants, and resided in the local community. The study found that at twelve weeks
postpartum, the intervention group had an odds ratio of 2.81 (p value=0.03) of providing any breast milk over the control group; furthermore, African American mothers in the intervention group had an odds ratio of 3.59 (p value=0.03) compared to the control group (Merewood et al., 2006).

Another effective program, the Rush Mother’s Milk Club, is a comprehensive program in the NICU that includes peer counseling, among other interventions, at Rush University Medical Center in Chicago. The peer counselors are well trained and certified, come from diverse ethnic and economic backgrounds, and are mothers of infants previously hospitalized in the NICU. Some of the peer counselors are employed by the hospital while others are volunteers. The peer counselors hold weekly luncheon meetings with mothers and also do home visits after infant discharge. An evaluation of the program after two years of operation showed a lactation initiation rate of 73% for VLBW infants (Meier, 2004).

Utilizing peer counselors is a strategy that can be employed in the NICU to increase various types of social support for mothers of preterm infants. It is necessary that peer counselors have face-to-face contact with mothers and for peer counselors to be well trained and well supported by health care professionals for the intervention to be successful (Merewood, 2006). Peer counseling might also be a potentially cost effective intervention, as many peer counselors are volunteers. However, the research is limited on cost effectiveness of peer counseling for mothers of preterm infants. Furthermore, the implementation of a peer counseling program requires a substantial investment of time and money to recruit, train, and support peer counselors. This may not be feasible for many hospitals, especially due to an economic environment of ever increasing health care costs; furthermore, hospitals cannot bill insurance companies for peer counseling, so any costs associated with a program would have to come
directly from hospital budgets. Another potential problem with peer counseling is that there is wide variability in the “content and implementation” of such programs, making comparisons across programs difficult (Merewood et al., 2006, p. 684). I therefore recommend that a) more research be done to determine the cost effectiveness of peer counseling for mothers of preterm infants and b) peer counseling programs for mothers of preterm infants be standardized based on further research and best practices.

Community determinants of health include community resources and the built environment. Transportation is a community determinant of health and the lack of transportation may be a significant barrier for some mothers, making it difficult for mothers to travel long distances to see their infants during long hospitalizations. This could be particularly problematic for women living in rural North Carolina where they may have to travel many miles to a hospital with a level II or level III NICU. Hospital NICUs should provide gas vouchers, bus tickets, or even taxi vouchers to ensure mothers are able to travel to the NICU daily to see their infants. The type of transportation assistance would vary, depending on if the hospital is in a rural or urban setting. Many hospitals do provide some type of transportation assistance to their patients, so this is not an overly burdensome intervention for NICUs. Additionally, Medicaid offers transportation assistance in every North Carolina county, so NICU personnel or hospital social workers should assist Medicaid recipients in signing up for this service.

*Post discharge interventions*

More research is needed about the effectiveness of home visits from a community nurse or peer counselor for the parents of infants hospitalized in the NICU. Home visits by medical professionals have been successful in a variety of health care settings for improving health outcomes for high risk patients, yet there is a paucity of research on home visits for parents of
the preterm population. The Rush Mothers’ Milk Club effectively utilizes home visits as part of its comprehensive program in the NICU, but other research is limited about the effectiveness of home visits for mothers of preterm infants. A randomized, controlled trial in Toronto measured whether receiving up to three home visits by nurses who were certified as lactation consultants would improve breastfeeding rates for full term and late preterm (35 weeks-37 weeks GA) infants. Although the full term infants receiving home visits did have significantly higher breastfeeding duration rates than the control group, there were no significant differences among mothers of late preterm infants. The study should be interpreted with caution, however, as the sample size was small for the late preterm group (n=37), included only mothers who were breastfeeding at discharge, and the mothers were of high socioeconomic status (McKeever et al., 2002). The comparability of the findings with late preterm infants is further reduced in that infants born at much earlier gestational ages face different challenges to breastfeeding than more physiologically mature late preterm infants.

Another issue is that home visits are costly and may not be reimbursable under most health care plans, making it difficult for many hospitals to implement such a program without assurance of cost effectiveness. This is an area where further research on cost effectiveness is needed. The North Carolina Division of Medical Assistance (DMA) provides some limited information about the feasibility of home visits, since it pays for programs for Medicaid recipients that utilize home visits. For example, the Baby Love program and the newly implemented Pregnancy Care Management program (formerly known as Maternity Care Coordination) utilize home visits in prenatal and postpartum care for Medicaid recipients (DMA, 2011). These programs seek to improve pregnancy outcomes and reduce health care spending for high risk pregnant women, but they are based in the local health departments and are only
available for Medicaid recipients; furthermore, although breastfeeding education is given during prenatal and postpartum home visits, the program does not focus on solving lactation problems for mothers but instead refers women to WIC or other community-based programs for lactation support.

At this time, home visits cannot be recommended as an integral part of a breastfeeding support program due to the lack of evidence in increasing lactation rates after infant discharge. I recommend the need for more research on the efficacy and cost effectiveness of home visits to increase human milk feeding rates among mothers of preterm infants. If research demonstrates that home visits are effective in increasing lactation rates after infant discharge from the NICU, then perhaps a large, research-based institution such as UNC Hospitals could implement a pilot program utilizing home visits by peer counselors for the parents of preterm infants, modeling such programs as Baby Love and pregnancy care management.

A barrier on the level of community determinants is that of access to high quality electric pumps. NICUs can impact the community level of the social ecological model by providing free hospital grade pumps to low income women. Access to quality pumps is a major barrier to lactation, especially as it is not standard hospital practice to properly teach hand expression for full removal of colostrum and mature milk. I therefore recommend that NICUs offer hospital grade pumps free of charge or for a nominal fee to low income women who are not eligible for WIC combined with skilled support in their use and the concurrent need for hand expression. The study by Morton et al. of 67 mothers and their preterm infants younger than 31 weeks gestation demonstrated that by utilizing a combination of hand expression and electric pumping, mothers were able to maintain higher milk production levels with less frequent expression
(2009). This is especially important, due to the significant challenge of finding time to pump frequently and often for several weeks.

Providing electric pumps and skilled support may be a difficult hurdle for NICUs due to the cost of providing pumps and skilled support. Electric pumps are expensive, and NICU personnel would have to be trained in proper hand expression techniques, as this is not commonly taught in most NICUs. There is no easy solution to this problem, but the Rush Mothers’ Milk Club utilizes private donations and consultation fees to pay for breast pumps and for the skilled support needed to use them effectively (Meier et al., 2004). Another program at Boston Medical Center provides commercial pumps free to low income women and to mothers of infants in the NICU. The team at Boston Medical Center was able to achieve this by working with a local charity. The team also met with local health insurance companies to encourage them to pay for breast pumps by discussing long term cost savings of breastfeeding and by arguing that women would choose their health plans if they offered free pumps (Chamberlain, McMahon, Philipp, & Merewood, 2006). NICU staff should also educate low-income women that WIC will provide breast pumps for women enrolled in the program and assist women to navigate the process. Using a quality breast pump combined with proper expression techniques is integral to breastfeeding success for mothers of preterm infants, so it is therefore of utmost importance that NICUs take the initiative to provide access to breast pumps and provide education on proper pumping and hand expression techniques.

**Donor human milk**

Finally, many mothers of preterm infants are not able to provide sufficient breast milk to meet all the needs of their infants, so supplementation is often necessary. Still others may find there are simply too many challenges to continue lactation. Donor human milk is potentially an
option for those mothers, as it has many health benefits making it preferable to formula. This paper will now examine the benefits of donor human milk and recommend how to increase its use in the NICU and post-discharge.

Current evidence suggests that human donor milk is especially beneficial at preventing NEC in the NICU, compared to preterm formula (Quigley, Henderson, Anthony, & McGuire, 2007). There are concerns that human donor milk causes slower short term growth and that it lacks some beneficial immunological benefits due to the pasteurization process (Quigley et al., 2007; Bertino et al., 2009). However, researchers widely agree that fortified human donor should be used instead of preterm formula in the NICU when mother’s own milk is unavailable, primarily due to its protection against NEC (Arslanoglu, Ziegler, & Moro, 2010).

Utilizing fortified donor human milk in the NICU has also been shown to be cost effective. In a 2001 cost savings analysis looking at direct costs of NEC and sepsis in California, Wight estimated that NICUs could save approximately $11 per $1 spent on donor human milk (2001). Arnold analyzed the cost effectiveness of donor human milk in the prevention of NEC and found that utilizing donor human milk in the NICU would help to prevent NEC and thereby shorten hospital stays for infants. In this analysis, Arnold found that if a hospital stay was cut by one day the cost savings would be $1950 per infant; a shortened hospital stay by fifteen days meant a cost savings of $48,150 per infant (2002).

The Human Milk Banking Association of North America, or HMBANA, operates eleven milk banks in the U.S. HMBANA milk banks screen donors and pasteurize donor milk so that the milk is not infectious with such pathogens as HIV. HMBANA also establishes standards and guidelines for milk banks in North America and Mexico, as human milk banks are not currently federally regulated by the FDA or in most states (http://www.hmbana.org/). The Pediatric
Advisory Committee (PAC) of the FDA recently held an informational session in December 2010 to discuss the safety and efficacy of donor human milk, partly in response to the growing practice of informal human milk exchange over the internet. The PAC stated that HMBANA milk banks posed very little risk of human milk contamination due to their careful screening and pasteurization process, but it did express concern over unregulated human milk exchanges over the internet. However, the PAC did not recommend federal regulation of donor milk banks at this time, instead noting only that “some federal oversight or guidelines might be beneficial” (FDA, 2010, p. 6). The PAC also recommended that more research be conducted on donor human milk to find out more about its risks and benefits.

The American Academy of Pediatrics and the Academy of Breastfeeding Medicine both support human donor milk as an alternative to mother’s own milk; however, neither organization gives preference to donor human milk over formula (AAP, 2005; ABM, 2008). Although there is a lack of federal regulation or policy on donor human milk, many hospitals and NICUs do utilize donor human milk, as they recognize its benefits and cost-effectiveness. The Wake Med Mothers’ Milk Bank in Raleigh, North Carolina, is a HMBANA milk bank and serves hospitals in North Carolina and the Southeast region. According to the Wake Med Mothers’ Milk Bank coordinator, it serves 15 North Carolina hospitals and ships between 14,000 to 18,000 ounces per month to state and regional hospitals, most of it being used in NICUs. The Milk Bank charges area hospitals $5 per ounce, many of which absorb the cost themselves (S. Evans, personal communication, March 1, 2011). Although there is widespread use of donor human milk in many North Carolina hospitals, it is important that national, formal policies are written to recommend fortified donor human milk as the first alternative to mother’s own milk in the
NICU. Formal policies and guidelines issued by such organizations as the AAP will ensure greater consistency in the use of donor human milk in the NICU.

Donor human milk is also utilized post-discharge, in the outpatient setting. Wake Med Mothers’ Milk Bank ships between 5,000 to 8,000 ounces a month in outpatient sales, charging $3.50 per ounce. The women pay for the donor human milk themselves, as no statewide health insurance plans provide reimbursement for it (S. Evans, personal communication, March 1, 2011). Paying $3.50 per ounce is cost-prohibitive for most families, even though special preterm formulas cost about $15 per 12.8 ounce can, or $1.17 an ounce. Once the direct and indirect costs of formula are considered, it would make financial sense for health insurance companies to partially offset the cost of donor human milk. WIC in North Carolina provides vouchers for formula for its recipients, and Medicaid also will pay for very expensive specialty formulas for infants with certain medical conditions. It is therefore logistically and economically feasible that these programs would also pay for donor human milk which has been shown to be cost effective. Thus, I recommend that Medicaid and WIC subsidize the cost of human donor milk for such special populations as preterm infants in order to improve health outcomes and mitigate health care costs.

Conclusions

Low breastfeeding rates for mothers of preterm infants is a serious public health problem that requires further research and more comprehensive data collection on breastfeeding patterns of mothers of preterm infants. This paper recommends a range of interventions, both in the inpatient setting and post-discharge, that should be undertaken by NICUs in order to improve human milk feeding initiation and duration rates for preterm infants; these recommendations include a specific set of recommendations for NICUs in North Carolina. A common element in
all of these recommendations is greater education and training of mothers and NICU personnel on the benefits of breastfeeding as well as on successful strategies to overcome the significant barriers that mothers of preterm and low birth weight infants face.

It is important that national surveys such as the PRAMS include specific questions on human milk feedings for preterm infants, as feeding practices and barriers are very different than for full term infants. Further research is needed, especially on the benefits of donor human milk and on the efficacy of certain NICU-based interventions, such as peer counseling and home visits. Additionally, formal policies should be drafted by health care and public health agencies about the need for specific interventions to increase human milk feeding for preterm infants. There is no easy solution to increasing human milk feeding among mothers of preterm infants. Interventions undertaken by NICUs and public health agencies must be comprehensive and focus on multiple levels of the social ecological model in order to be most effective.
References


Food and Drug Administration. (2010, December 6). Pediatric Advisory Committee meeting


of human milk feedings with a reduction in retinopathy of prematurity among very low
birthweight infants. Journal of Perinatology, 21, 356-362. doi:10.1038/sj.jp.7210548
breast-feeding in mothers of preterm infants. Research in Nursing and Health, 12, 149-
159. doi:10.1002/nur.4770120305
IBCLCE. (2011). What is an IBCLC?. IBCLCE in the Americas. Retrieved from
http://americas.iblce.org/what-is-an-ibclc
research effort needed to prevent early births. Office of News and Public Information.
Retrieved from
1519-152. doi:10.1016/0140-6736(90)93304-8
Martin, J.A., Osterman, M.J.K., & Sutton, P.D. (May 2010). Are preterm births on the decline in
the United States? Recent data from the National Vital Statistics System. National Center
for Health Statistics Brief. (Publication No. 39). Retrieved from
McKeever, P., Stevens, B., Miller KL, MacDonnell, JW, Gibbins, S., Guerriere, D., Dunn, M., &
Coyte, P. (2002). Home versus hospital breastfeeding support for newborns: A
randomized controlled trial. Birth, 29 (4), 258-265. doi:10.1046/j.1523-
536X.2002.00200.x


