This dissertation is dedicated to all the mothers who have premature and medically fragile infants in the neonatal intensive care unit (NICU). It is hoped that this and other works with infants and mothers in the NICU will give you the hope, courage, and information needed to “mother” in the complex environment of the NICU, during your infant’s first precious days. This dissertation is also dedicated to my husband, Jose, for his endless source of love and inspiration. It is also dedicated to my children, Alan and Marissa, whose early birth made me realize the importance of education and support for mothers, as well as to my daughter Abigail, whose premature birth in the middle of this research gave me the extra steam to see it through. This dissertation is especially dedicated to my mom, Barbara Gittens Valentine, whose expertise with mothers and babies was critical during my own son’s hospitalization.
ACKNOWLEDGMENTS

This research would not have been possible without the support and guidance of Dr. Lorie Richards, who has been my advisor, mentor, and friend. I want to thank Lorie for having faith in me and inspiring me to do my best. I would like to thank the nurses and health care professionals at Shands Hospital who participated in this research endeavor. In particular, I give special thanks to Annmarie Brennan, who enabled this research project to occur in the neonatal intensive care unit (NICU) at Shands and supported the project every step of the way. I also would like to thank Cammy Pane, the co-author of the Educational Module; Stephanie Meeks for your hours of work on “A Mother’s Gift”, and other members of the Lactation Committee at Shands who helped with my research: Elayne McNamara, Sandra Sullivan, Brenda Owens, Sheila Walker and Jeannette Sexton. I want to give special thanks to Susan Frazier from Medela for your support at the inservices. I also want to thank all those who provided donations as incentives for participation: Sonny’s Barbeque, Atlanta Bread Company, Scholotsky’s Deli, and TGIF. I want to thank Dr. David Burchfield, the medical director of the NICU at Shands, for assisting with this project. I thank Sarah Boslaugh for guiding me through the statistics and for all your patience from the many questions that came up along the way. I would also like to thank my committee for sticking with me through the years, and the move to St. Louis and the addition of the new baby. I appreciate your endless patience, high expectations and sincere enthusiasm for my interests and work. I want to thank Drs. Richards, Foss, Krueger, Seung, and Rosenbek!
I would finally like to thank my parents who always showed unconditional love and always motivated me to strive to do better. I extend special thanks to my husband, Jose, for always being there when I needed you most and giving me patience and love every step of the way. You enabled me to go back to school and were there when it came to crunch time. You have made this all possible and I am eternally grateful for your love and support.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>viii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>ix</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>x</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1 INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>The Importance of Breast Milk and Breastfeeding</td>
<td>2</td>
</tr>
<tr>
<td>Health Benefits of Breastfeeding for the Full Term Infant</td>
<td>3</td>
</tr>
<tr>
<td>Health Benefits of Breastfeeding for Premature Infants</td>
<td>4</td>
</tr>
<tr>
<td>Long Term Benefits of Breastfeeding</td>
<td>5</td>
</tr>
<tr>
<td>Developmental Benefits of Breastfeeding</td>
<td>5</td>
</tr>
<tr>
<td>Benefits of Breastfeeding for the Mother</td>
<td>6</td>
</tr>
<tr>
<td>Current Breastfeeding Recommendations</td>
<td>7</td>
</tr>
<tr>
<td>Why More Women Are Not Giving Their Infants the Benefits of Breast Milk</td>
<td>8</td>
</tr>
<tr>
<td>General Breastfeeding Barriers</td>
<td>9</td>
</tr>
<tr>
<td>Barriers to Breastfeeding Premature Infants</td>
<td>9</td>
</tr>
<tr>
<td>Health Care Professionals Can Hinder the Breastfeeding Process in the</td>
<td>14</td>
</tr>
<tr>
<td>Neonatal Intensive Care Unit</td>
<td></td>
</tr>
<tr>
<td>Treatments to Foster Improved Breastfeeding Rates</td>
<td>16</td>
</tr>
<tr>
<td>Need for an Educational Package for Health Care Professionals and Mothers of Infants in the Neonatal Intensive Care Unit</td>
<td>19</td>
</tr>
<tr>
<td>Synactive Theory and Breastfeeding Interventions in the Neonatal Intensive Care Unit</td>
<td>20</td>
</tr>
<tr>
<td>Theory Governing the Behavior of Health Care Professionals</td>
<td>25</td>
</tr>
<tr>
<td>Transtheoretical Model of Behavior Change and Methods of Education</td>
<td>31</td>
</tr>
<tr>
<td>Summary and Research Questions</td>
<td>33</td>
</tr>
<tr>
<td>2 METHODOLOGY</td>
<td>35</td>
</tr>
<tr>
<td>Participants</td>
<td>35</td>
</tr>
<tr>
<td>Research Interventions</td>
<td>36</td>
</tr>
<tr>
<td>Intervention 1: Breast Pump Loaner Closet</td>
<td>36</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Intervention 2: Health Professional Education Initiative</td>
<td>37</td>
</tr>
<tr>
<td>Intervention 3: Breastfeeding Guideline</td>
<td>38</td>
</tr>
<tr>
<td>Intervention 4: Educational Pamphlet for New Mothers of Neonatal</td>
<td>38</td>
</tr>
<tr>
<td>Intensive Care Unit Infants</td>
<td>38</td>
</tr>
<tr>
<td>Intervention Plan Modification</td>
<td>39</td>
</tr>
<tr>
<td>Design</td>
<td>39</td>
</tr>
<tr>
<td>Procedures</td>
<td>40</td>
</tr>
<tr>
<td>Program Evaluation</td>
<td>41</td>
</tr>
<tr>
<td>Data Collection</td>
<td>42</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>42</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>43</td>
</tr>
<tr>
<td>Adjusting the Alpha Level</td>
<td>44</td>
</tr>
<tr>
<td>3 RESULTS</td>
<td>46</td>
</tr>
<tr>
<td>Intervention Implementation</td>
<td>46</td>
</tr>
<tr>
<td>The Sample</td>
<td>48</td>
</tr>
<tr>
<td>Inter-Rater Agreement</td>
<td>50</td>
</tr>
<tr>
<td>Demographics</td>
<td>50</td>
</tr>
<tr>
<td>Investigation for Selection Differences</td>
<td>52</td>
</tr>
<tr>
<td>Results Per Research Question</td>
<td>52</td>
</tr>
<tr>
<td>4 DISCUSSION</td>
<td>59</td>
</tr>
<tr>
<td>The Effect of the Interventions on Breastfeeding Practices in the Neonatal Intensive Care Unit</td>
<td>59</td>
</tr>
<tr>
<td>Limitations</td>
<td>64</td>
</tr>
<tr>
<td>Recommendations for Further Research</td>
<td>69</td>
</tr>
<tr>
<td>Conclusions</td>
<td>71</td>
</tr>
<tr>
<td>APPENDIX</td>
<td></td>
</tr>
<tr>
<td>A OUTLINE OF THE EDUCATION MODULE</td>
<td>73</td>
</tr>
<tr>
<td>B OUTLINE OF ITEMS ADDED TO THE INDIVIDUALIZED CARE PLAN</td>
<td>75</td>
</tr>
<tr>
<td>C OUTLINE OF THE EDUCATIONAL BOOKLET FOR MOTHERS</td>
<td>76</td>
</tr>
<tr>
<td>LIST OF REFERENCES</td>
<td>78</td>
</tr>
<tr>
<td>BIOGRAPHICAL SKETCH</td>
<td>87</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Stages of change in which particular processes of change are emphasized</td>
</tr>
<tr>
<td>2-1</td>
<td>Hypothesis testing according to dependent variable</td>
</tr>
<tr>
<td>3-1</td>
<td>Demographics of the pre-intervention and post-intervention groups with test statistics for selection differences</td>
</tr>
<tr>
<td>3-2</td>
<td>Breast milk feeding initiation rates</td>
</tr>
<tr>
<td>3-3</td>
<td>Comparison of rates of breastfeeding after 30 weeks gestation</td>
</tr>
<tr>
<td>3-4</td>
<td>Rates of ever breastfed in the neonatal intensive care unit</td>
</tr>
<tr>
<td>3-5</td>
<td>Rates of breast milk feedings at discharge</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>Number of times breastfed per day after 30 weeks gestation</td>
<td>54</td>
</tr>
<tr>
<td>3-2</td>
<td>Proportion of the stay that breast milk was provided</td>
<td>58</td>
</tr>
</tbody>
</table>
Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

BREASTFEEDING PRACTICES IN THE NEONATAL INTENSIVE CARE UNIT BEFORE AND AFTER AN INTERVENTION PLAN

By

Roberta Gittens Pineda

August 2006

Chair:  Lorie Richards
Major Department:  Rehabilitation Science

The benefits of breastfeeding for both mother and infant are cited extensively in the literature. Premature infants hospitalized in the neonatal intensive care unit (NICU) have a great need for the benefits that breast milk offers, due to their fragile health states. However, mothers of very low birth weight infants hospitalized in the NICU have magnified barriers to the breastfeeding process due to the complexity of medical conditions that warrant admission to the NICU and the separation of the infant from the mother to enable medical care. Studies have cited lack of education about lactation among health care professionals and discrepancies in education dissemination to mothers as a major barrier to the breastfeeding process. A three-part intervention within the NICU was implemented that consisted of an educational initiative for health care professionals who instruct and support mothers, modifications to the individualized care plan that included a new breastfeeding pathway, and an educational booklet for mothers with infants hospitalized in the NICU. Change in breast milk feeding initiation rates,
breastfeeding rates, breast milk at discharge rates, and proportion of the hospital stay that breast milk was provided was investigated between pre-intervention and post intervention groups. Results indicated general positive trends in all variables, but only one variable achieved statistical significance. The percentage of infants who were ever breastfed while in the hospital increased from 25.9% before the intervention to 44.4% after the intervention, and this reached statistical significance with a $p$ value of .025. Full implementation of strategies learned in the interventions was questionable. This study provides partial support of the three-part intervention in facilitating breastfeeding in the NICU. Possible reasons for lack of change across all variables, as well as other possible interventions that could affect change, are explored.
CHAPTER 1
INTRODUCTION

Breastfeeding is an important part of the occupation of mothering. However, mothers of infants admitted into the neonatal intensive care unit (NICU) are not able to function in the traditional role of mother. They are usually separated from their infants, and the role of caregiver shifts to health care professionals. In addition, many infants may be attached to life-saving or monitoring equipment, which can be intimidating for new parents. Even more intimidating is that many of these infants are fragile or lack neurological maturity, which affects how the mother will interact with and care for her infant. This environment presents significant barriers to the provision of breast milk, including the fragility of the infant, the separation of the infant from the mother, and the behavior of the health care professionals who are focused on the medical interventions necessary for these infants. This is unfortunate, because the established benefits of breast milk may be even greater in these medically fragile and maturationally immature infants.

The rate of breastfeeding in the United States, despite repeated advertisement of its benefits, is only 71.4% (Li, Darling, Maurice, Barker, & Grummer-Strawn, 2005). Unfortunately, due to the many barriers to breastfeeding in the NICU environment, this percentage is significantly lower for infants discharged from the NICU, with breast milk feedings in premature infants reaching only approximately 50% (Espy & Senn, 2003). However, despite the medical complexities of the NICU and the shift of care to health care professionals, with adequate circumvention of barriers, mothers can be supported in the occupation of mothering through support of breastfeeding.
Studies have identified that health care professional support is predictive of success with breastfeeding (Swanson & Power, 2005). However, health care professionals must be given the tools to foster breastfeeding in the complex NICU environment. Therefore, the aim of this study was to test the efficacy of an intervention to support breastfeeding practices in the NICU. The intervention centered on health care professional behavior change through an educational initiative for health care professionals, modifications to the individualized care plan (ICP) with a breastfeeding protocol, and educational materials for mothers with infants in the NICU. It was hypothesized that the intervention plan would foster change in health care professionals, which would then enable positive changes in breastfeeding practices in the NICU.

**The Importance of Breast Milk and Breastfeeding**

Breast milk can be provided to the infant either directly through infant suckling at the breast (breastfeeding) or by having the mother express the breast milk with a pump and providing the milk via enteral feedings or bottle (breast milk feedings). The health benefits of breastfeeding for the infant are cited in the literature extensively (Wolf, 2003). Breast milk has a protective effect against many childhood health problems. Breast milk differs from formula in that it has unique ingredients that are difficult, if not impossible, to duplicate. Important components of breast milk are IgA antibodies, which aid in preventing infection by creating a non-inflammatory response in body cells. This enables a more active immune system, which demonstrates better defense against infection. Other factors in breast milk, such as lactoferrin and oligosaccharides have also been isolated and are believed to prevent mucous attachment, the origin of most infections (Hanson, 1998; Hanson et al., 2002).
Infant formulas continue to strive to be similar to breast milk and have become nutritionally advanced in the last decade, however, research continues to illustrate that breast milk is far superior to formula (Agostoni & Haschke, 2003; Baker, 2003; Wold & Adlerberth, 2000). Thus far, formula companies have been unable to replicate the exact ingredients of breast milk. Perhaps predominantly due to the IgA antibodies found in human milk, breastfed infants have superior protection from many ailments that compromise health and prevent optimal functioning.

Health Benefits of Breastfeeding for the Full Term Infant

When comparing babies who are fed breast milk to those who are formula fed, there is a significant reduction in respiratory infections, diarrhea, necrotizing enterocolitis, meningitis, sepsis, urinary tract infections, atopic dermatitis, celiac disease, and inflammatory bowel disease in the breastfed babies (Dai & Walker, 1998; Hanson, 1998; Hylander, Strobino, & Dhanireddy, 1998; Laubereau et al., 2004; Marild, Hansson, Jodal, Oden, & Svedberg, 2004; Wold & Adlerberth, 2000). Although preliminary studies have not been conclusive, it is also suggested that allergies and asthma are also diminished among breastfed babies (Kemp & Kakakios, 2004; Oddy et al., 2004). Breastfed babies have a diminished risk of sudden infant death syndrome (Alm et al., 2002; McVea, Turner, & Peppler, 2000), as well as a significantly lower risk of mortality after the neonatal period (Chen & Rogan, 2004).

Because it is associated with less infant illness, breast feeding may cut medical expenses for the infant. Ball and Wright (1999) addressed excess medical costs for 3 common childhood illnesses: gastrointestinal infection, respiratory tract infection and otitis media among breast fed versus formula fed infants in the first year of life. There was evidence that children who were never breast fed incurred significantly more office
visits, hospitalizations, prescriptions and subsequently had higher health care costs (Ball & Wright, 1999). Thus, the health advantages associated with breastfeeding create less financial burden as health care costs diminish (Ball & Wright, 1999) and, more importantly, they improve the quality of life and health status among mother-infant dyads.

There have been a multitude of studies that have also investigated health and developmental benefits of breast milk for premature and high risk neonates (Callen & Pinelli, 2005). The fragile health states of these infants make them more susceptible to infection, gastrointestinal problems, and life threatening illnesses than full term infants (Lanari et al., 2001; Lugo-Vicente, 2003). Therefore, breast milk is perhaps more important in this fragile population, because it diminishes the risk of multiple medical problems, which can complicate the medical course and put them at a higher risk of developmental sequelae.

**Health Benefits of Breastfeeding for Premature Infants**

Breast milk fed infants from the NICU differ significantly from formula fed infants in incidence of infection and diagnosis of sepsis/meningitis (Hylander et al., 1998), necrotizing enterocolitis, and retinopathy of prematurity (Hylander et al., 1998; Hylander, Strobino, Pezzullo, & Dhanireddy, 2001; Schanler, Hurst, & Lau, 1999). Breast fed premature babies have been noted to experience less stress than bottle fed infants as evidenced by fewer episodes of oxygen desaturation and temperature instability (C. H. Chen, Wang, Chang, & Chi, 2000). Breastfeeding has been cited as an intervention that has lasting, long term benefit beyond discharge from the hospital (Harrold & Schmidt, 2002), and studies have detected significant reductions in length of stay among breastfed premature infants (Gomez, Acosta, Sevillano, Curbelo, & Alvarez, 1997).
Long Term Benefits of Breastfeeding

More recent studies are suggesting that the effects of breast milk extend beyond the period of infancy and early childhood, and promote long term immunity and protection from chronic diseases. Lower risk of developing childhood cancers, obesity, type I diabetes, and cardiovascular disease have been cited as long term benefits of breastfeeding (Davis, 2001; Hanson, 1998; Schack-Nielsen & Michaelsen, 2006; Singhal, Cole, Fewtrell, & Lucas, 2004). Studies of long term effects of breast milk on premature infants have also found benefits with lower blood pressure readings in adolescence (Owen, Whincup, Odoki, Gilg, & Cook, 2002). Despite concerns that breastfeeding results in suboptimal growth in infancy, studies have demonstrated an increased growth velocity in late childhood in breastfed groups (Schack-Nielsen & Michaelsen, 2006). Additionally, improved parental attachment in the teenage years has been linked to breastfeeding (Fergusson & Woodward, 1999).

Developmental Benefits of Breastfeeding

Research also points to the importance of breastfeeding on infant development. Breastfeeding results in improved oral motor development and orthodontics (Page, 2001), with early weaning increasing the risk of malocclusion, mouth breathing, dysfunctional oral motor development and subsequent suboptimal speech development (Neiva, Cattoni, Ramos, & Issler, 2003; Viggiano, Fasano, Monaco, & Strohmenger, 2004). Breastfed infants have improved visual motor skills (Birch et al., 1993), have better responses to pain (Gray, Miller, Philipp, & Blass, 2002) with improved neurobehavioral organization (Hart, Boylan, Carroll, Musick, & Lampe, 2003) and have demonstrated improved scores on mental functioning (Gomez-Sanchiz, Canete, Rodero, Baeza, & Avila, 2003).
Premature infants have a greater risk of poor neurological outcome, which suggests that breast milk may be critical to enable optimal developmental functioning. Research has demonstrated improved cognitive and motor functioning scores among premature infants who had breast milk feedings (Lanari et al., 2001; Schanler et al., 1999). Studies demonstrate improved cognitive scores and intelligence quotients that continued to be evident through middle childhood among breastfed infants (Lucas, Morley, Cole, & Gore, 1994; Lucas, Morley, Cole, Lister, & Leeson-Payne, 1992; Morley, Cole, Powell, & Lucas, 1988; Smith, Durkin, Hinton, Bellinger, & Kuhn, 2003).

**Benefits of Breastfeeding for the Mother**

In addition to the benefits given to the baby through breastfeeding, there are also benefits for the mother. Women who succeed with breastfeeding comment on the special bonding experience (Torgus, Gotsch, & La Leche League International, 1997). Women who breastfeed have less postpartum bleeding (Chua, Arulkumaran, Lim, Selamat, & Ratnam, 1994) and have a faster rate of pregnancy related weight loss (Dewey, Heinig, & Nommsen, 1993). Women who breastfeed also postpone ovulation (Rea, 2004), and breastfeeding has been demonstrated to serve as a natural and effective birth control method in the postpartum period ("How breast-feeding postpones ovulation," 1985; "What is best birth control to use after having a baby?," 1989). In addition, women who succeed with breastfeeding lower their risk of osteoporosis (Chantry, Auinger, & Byrd, 2004), obesity (Rooney & Schauerger, 2002), ovarian cancer, breast cancer (Mikiel-Kostyra, 2000), diabetes and rheumatoid arthritis (Rea, 2004).

Mothers of preterm infants have additionally reported an improved sense of well being, as they feel that they are actively contributing to the health of their babies (Schanler et al., 1999). Having an infant in the NICU is a difficult challenge. Mothers
may feel shut off from their infant as the nurses take on the role of primary caregiver. Being able to provide the best source of nutrition can be one task that embraces the mother in her role and fosters parental involvement, as it is something only she can do for her baby.

**Current Breastfeeding Recommendations**

The health benefits of breastfeeding for mother, baby and health care systems are evident and extensive. Therefore, the American Academy of Pediatrics (AAP), as well as the American Dietetic Association, have responded to the benefits of breastfeeding for mother and baby by recommending exclusive breastfeeding for the first 6 months with breastfeeding and supplemental solids until the infant is 1 year old ("Breastfeeding and the use of human milk. American Academy of Pediatrics. Work Group on Breastfeeding," 1997). The World Health Organization recommends breastfeeding for at least 2 years ("The optimal duration of exclusive breastfeeding: results of a WHO systematic review," 2001). However, breastfeeding statistics continue to demonstrate a gap between these recommendations and how the general population of mothers in the United States chooses to feed their infants (Li et al., 2005).

Some women never breastfeed, some breastfeed exclusively, some supplement breastfeeding with bottle feeds of human milk, some supplement breastfeeding with bottle feeds of formula, some bottle feed formula only, some bottle feed breast milk only, and some women start out breastfeeding and completely wean once formula is introduced. Statistics from the year 2003 indicated that 71.4% of women in the general population initiated breastfeeding while in the hospital, and 35.1% of mothers were still breastfeeding when their babies turned 6 months of age. At one year of age, 16.1% continued to provide some breast milk for their infants (Li et al., 2005). Variable rates of
breastfeeding have been reported for infants in the NICU. The rates for infants receiving some breast milk at some point range from 50% to 83% (Byrne & Hull, 1996; Espy & Senn, 2003; Meier, Engstrom, Mingolelli, Miracle, & Kiesling, 2004; Smithers, McPhee, Gibson, & Makrides, 2003; Yip, Lee, & Sheehy, 1996). However, studies have found that the rates of breast milk feeds at discharge are 64%, with the rate of breastfeeding being 38% (Yip et al., 1996). One study found that at 4 months of age, only 24% of infants born at less than 33 weeks gestation continue to receive some breast milk feedings (Smithers et al., 2003). Subsequently, breastfeeding rates at hospital discharge for infants born prematurely are significantly lower than those of full term, healthy infants (Yip et al., 1996).

To understand the suboptimal breastfeeding rates for premature and high risk neonates, it is beneficial to investigate the barriers to breastfeeding. By understanding the barriers to breastfeeding, appropriate interventions can be developed and implemented to facilitate improved breastfeeding practices.

Why More Women Are Not Giving Their Infants the Benefits of Breast Milk

Maternal demographics are strong predictors of breastfeeding. Women with higher socioeconomic status, more education, previous children but smaller family size, Caucasian race, and women who are married are more likely to succeed with breastfeeding (Bueno et al., 2003; Kronborg & Vaeth, 2004; Mitra, Khoury, Hinton, & Carothers, 2004). However, perinatal medical condition is also an important predictor of successful breastfeeding (Espy & Senn, 2003; Powers, Bloom, Peabody, & Clark, 2003). Scott (2006) discovered that the infant being admitted to the intensive care unit was the strongest predictor of not being exclusively breastfed at discharge (Scott, Binns, Graham, & Oddy, 2006). Other studies have concluded that having a cesarean section, as well as
having a low birth weight infant, makes a woman less likely to breastfeed (Hwang, Chung, Kang, & Suh, 2006). Demographic factors as well as medical condition and type of delivery have been shown to be strong influences on the decision to breastfeed and the success of breastfeeding.

**General Breastfeeding Barriers**

The barriers to breastfeeding full term, healthy infants include lack of family and spouse support and perceptions of lack of support; (Arora, McJunkin, Wehrer, & Kuhn, 2000; Matthews, Webber, McKim, Banoub-Baddour, & Laryea, 1998; Scott et al., 2006), social withdrawal and isolation (Stewart-Knox, Gardiner, & Wright, 2003), perceived inconvenience (Zimmerman & Guttman, 2001), perceived inadequacy to provide adequate nutrition (Arora et al., 2000; Matthews et al., 1998), early supplementation or first feeding of formula (Wheeler, Chapman, Johnson, & Langdon, 2000), lack of appropriate education (Arora et al., 2000), functional problems with the process of breastfeeding; (Bick, MacArthur, & Lancashire, 1998), intent to return to work (Arora et al., 2000; Matthews et al., 1998; Piper & Parks, 1996; Ryan, Wysong, Martinez, & Simon, 1990), and maternal illness (Black & Hylander, 2000; Riskin & Bader, 2003).

**Barriers to Breastfeeding Premature Infants**

Breastfeeding challenges are stronger and even more numerous for the high risk neonate, despite these babies having an even greater need for human milk. Mothers of infants who are born prematurely have unique challenges to successful breastfeeding. One barrier to breastfeeding the premature infant is that when an infant is born prematurely and warrants admission into the NICU, the mother is separated from her baby (Black & Hylander, 2000). The time after birth is very different for these mothers compared to those with full term infants. There is usually not a period of being able to put
the baby to breast immediately after birth, and breastfeeding may not be possible for several weeks or months, depending on the infant’s level of prematurity and medical instability.

When visitation is possible, mothers may visit their baby in the intensive care unit. Here, they may have difficulty with the transition to motherhood as the doctors and nurses make decisions related to the care of the baby, including whether or not the mother may hold her new baby (Holditch-Davis & Miles, 2000; Lupton & Fenwick, 2001). The machines and equipment present and being utilized by the baby in the NICU can be overwhelming for many parents (Wheeler et al., 2000), and this environment is very different from the quiet, home-like environment one would typically envision during the first days of the baby’s life. An additional barrier is that the ability to achieve let down, in which breast milk begins to flow during infant feeding and pumping, is hindered by the inability to relax in this stressful environment (Beresford, 1984; Nyqvist, Ewald, & Sjoden, 1996; Wheeler, Johnson, Collie, Sutherland, & Chapman, 1999).

Many low birth weight infants are unable to breast feed for several weeks or months following birth (Hill, Andersen, & Ledbetter, 1995). Their gastrointestinal systems are immature and feedings can be dangerous or life threatening. During the first days, a baby may be fed intravenously or through an orogastric or nasogastric tube, in which feeds may be slowly introduced and advanced. When the gastrointestinal system is ready for bolus feeds directly into the stomach, the baby’s immature central nervous system may not enable consistent presentation of sucking and swallowing responses to enable safe oral feeding (Nyqvist, Sjoden, & Ewald, 1999; Ziemer & George, 1990). Although breastfeeding may not be possible initially, breast milk can be expressed by the
mother with a breast pump, and the infant can be advanced on gastric feeds with breast milk.

Just as the first feeding by breast is a good predictor of sustained breastfeeding in full term infants, timely pumping for those mothers who are unable to put the baby to breast is an important predictor of sustained breastfeeding in the premature baby (Jaeger, Lawson, & Filteau, 1997). Women of premature babies may express their breast milk and supply it to hospital staff so that the baby may be tube fed with human milk instead of infant formula (Meier & Brown, 1996). Additionally, this process establishes and maintains a milk supply so that the mother will not have diminished or absent milk supply, when the baby is stable enough to engage in the breastfeeding process. Barriers to breastfeeding related to this early process include increased amounts of stress (Docherty, Miles, & Holditch-Davis, 2002; Miles, Funk, & Kasper, 1992) and time constraints placed on these new mothers, difficulty in acquiring hospital grade breast pumps for milk expression, lack of special bonding and emotional feedback received from using a pump, delayed initiation of milk expression, separation from the infant, reliance on medical technology to feed the baby, and psychological adjustment to the idea of not being able to breastfeed for weeks or even months (Byrne & Hull, 1996). With the mother experiencing stress associated with coping with her sick baby (Miles et al., 1992) and a shift of care from the mother to the baby after the birth, there may be delayed initiation of pumping and lack of accessibility of hospital grade pumps to promote milk supply in an efficient manner.

New studies are highlighting the importance of investigating barriers at different time periods during an infant’s hospitalization (Callen & Pinelli, 2005). If a mother
successfully overcomes the challenge of maintaining her milk supply, there are additional challenges as an infant approaches discharge from the hospital. Poor central nervous system maturity may initially prevent complete success with breastfeeding, and dysphagia is common in this population (Hill, Hanson, & Mefford, 1994). The literature cites problems with the mechanics of breastfeeding a premature baby as a barrier to breastfeeding (Kavanaugh, Mead, Meier, & Mangurten, 1995). Once discharge is approaching, there frequently is little time to enable a mom and baby to achieve successful breastfeeding (Meier & Brown, 1996). Bottle feeding is often preferred as it allows nurses to orally feed the baby when the mother is not present and the exact amount ingested can be accurately measured (McGrath & Braescu, 2004). Additionally, infants can be fed more passively with bottle feeding compared to the active process of breastfeeding. Although this can have negative side effects of desaturations and bradycardic events as well as increased risk of gastroesophageal reflux, it is frequently preferred because of the efficiency of oral feeding. However, breastfeeding can be achieved in this population despite the preferences of health care staff and the challenges that must be overcome.

Infants in the NICU are fed according to a schedule, typically every 3 to 4 hours, and may be fed via bottle, tube or breast to optimize the nutritional status. The inability of a preterm baby to breastfeed on demand in an environment with scheduled feedings via different modes is a significant barrier to breastfeeding (Black & Hylander, 2000). It undermines the typical procedures associated with breastfeeding a full term infant which involves feeding a baby when he/she shows hunger signs and not supplementing until breastfeeding is well established. This allows for the infant to ingest a smaller feeding
and thus become hungrier and to have a more rigorous, larger feeding for the next one. However, scheduled feedings of specific amounts can affect the transition to active breastfeeding in the NICU. If the infant typically receives a prescribed amount of breast milk by bottle or nasogastric tube and the mother attempts to breastfeed, not knowing the exact amount of breast milk ingested by breastfeeding may result in the health care professional doubting if there was adequate intake. Thus supplementation frequently occurs, which inhibits the next breastfeeding session, decreases the demand for breast milk produced by the mother and diminishes milk supply, and thus becomes a cyclic problem.

Diminished milk supply is cited extensively in the literature as one of the significant barriers to breastfeeding in the NICU (Callen & Pinelli, 2005). Among the earliest of premature infants, the average duration of providing breast milk is 4-5 weeks (Byrne & Hull, 1996). Lack of ability to engage in active breastfeeding due to the health status of the infant, lack of presentation of sucking and swallowing capabilities of the infant and the need for the mother to demonstrate consistent milk expression via a breast pump to establish and maintain a milk supply all contribute to diminished milk supply in mothers of infants hospitalized in the NICU.

Infants who are born prematurely have different nutritional needs than full term infants. Thus, there are premature infant formulas that are utilized in the neonatal period and many are used until one year of life. When gastric feeds are being established, physicians are concerned with establishing a good weight gain trend. If an infant is not gaining weight as desired, the physician may increase caloric density or add lipids to infant formula or expressed breast milk to foster weight gain. Frequently nutrients and
calories are added to human milk by the way of human milk fortifiers (Chan, 2001), which promote establishment of a good weight gain curve. However, this is a barrier to breastfeeding as the mother perceives that the composition of her breast milk is not adequate to promote the health of her child. She may perceive that formula or fortified breast milk by bottle is essential to enable the appropriate milk composition (Kavanaugh et al., 1995). However, studies suggest that mother’s milk of premature babies differs from that of full term infants with the most notable differences evident between 4-6 weeks after delivery (Gross, David, Bauman, & Tomarelli, 1980). Additionally, the use of hind milk, the milk at the end of a breastfeeding session that is very high in fat content, has been shown to facilitate weight gain in premature babies (Slusher et al., 2003).

Research is identifying that there are factors in the hospital setting that influence breastfeeding decisions. The site of care is a strong predictor of choice and success with breastfeeding (Powers et al., 2003). In addition, literature is highlighting the important role of health care professionals on the decision to initiate and continue breastfeeding (Nyqvist, Sjoden, & Ewald, 1994; Swanson & Power, 2005).

**Health Care Professionals Can Hinder the Breastfeeding Process in the Neonatal Intensive Care Unit**

There are many inconsistencies in what parents are educated about and many disparities in what parents are instructed to do by health care professionals, and this can be confusing and frustrating for new mothers (Byrne & Hull, 1996; Nyqvist et al., 1994). One study identified that 48% of mothers reported receiving conflicting advice about breastfeeding in the NICU (Jaeger et al., 1997).

Mothers rely on health care professionals in the NICU to provide accurate, complete, and consistent information about breastfeeding their high risk infant. Many of
the mothers of preterm infants have not had an opportunity to fully prepare for motherhood before the birth of their baby. Some may have planned on taking a breastfeeding or parenting class, but the early arrival dampened these plans. In addition, the NICU is a medically complex environment, and parents need guidance on how to function in their role as mother with the environmental constraints. The literature suggests that there is a lack of health care professionals who are trained in lactation and breastfeeding with premature babies, and that many health care professionals have incorrect knowledge and negative beliefs about lactation (Berens, 2001; Pantazi, Jaeger, & Lawson, 1998; Register, Eren, Lowdermilk, Hammond, & Tully, 2000; Spicer, 2001). Yet, it is the health care professionals in the NICU, despite lack of education, who are teaching and instructing these new mothers on breast milk feedings and breastfeeding.

Health care professionals can influence breastfeeding behaviors, and their own values and beliefs concerning breastfeeding can have supporting or damaging results on the breastfeeding process (Ekstrom, Matthiesen, Widstrom, & Nissen, 2005). Studies have identified that education and training can affect attitudes and knowledge about breastfeeding (Bernaix, 2000; Siddell, Marinelli, Froman, & Burke, 2003; Swanson & Power, 2005). However, to date, there are no studies that have investigated the indirect impact of health care professionals’ behavior change with acquisition of knowledge and attitude change on breastfeeding outcomes in mothers and infants in the NICU.

The American Academy of Pediatrics issued a statement in February 2005 that stated that breastfeeding or human milk feedings are recommended for all healthy, premature and high-risk infants for whom breastfeeding is not specifically contraindicated. It further states that health care professionals should provide complete,
current and accurate information to parents on the benefits and techniques involved with breastfeeding (Gartner et al., 2005). However, to date there has been no specific, standard set of tools developed and utilized to achieve education of health care professionals to enable consistent information dissemination to parents.

**Treatments to Foster Improved Breastfeeding Rates**

The United States Surgeon General, David Satcher, identified breastfeeding as a national health priority and released the “Health and Human Services, Blueprint for Action on Breastfeeding” in October 2000. In response to this, The World Health Organization in conjunction with UNICEF is promoting breastfeeding through the baby friendly hospital initiative. To be designated as “baby friendly,” the hospital must follow the ten steps to successful breastfeeding:

Every facility providing maternity services and care for newborn infants should:

- Have a written breastfeeding policy that is routinely communicated to all health care staff.
- Train all health care staff in skills necessary to implement this policy.
- Inform all pregnant women about the benefits and management of breastfeeding.
- Help mothers initiate breastfeeding within half an hour of birth.
- Show mothers how to breastfeed, and how to maintain lactation even if they should be separated from their infants.
- Give newborn infants no food or drink other than breast milk, unless medically indicated.
- Practice rooming-in (i.e., allowing mothers and infants to remain together) 24 hours a day.
- Encourage breastfeeding on demand.
- Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
• Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.


These ten steps specifically involve how health care professionals and the hospital system will deal with mother-infant dyads on regular maternity floors within a hospital. Once these ten steps are put into practice, the hospital may apply for designation as a baby friendly hospital. Hospitals that have been through the process of baby friendly designation have demonstrated improvement with breastfeeding rates (Philipp, Malone, Cimo, & Merewood, 2003). For example, Boston Medical Center was designated as baby friendly in 1999, with increased breastfeeding rates of 58% in 1995 to 86.5% in 1999. Breastfeeding rates were maintained at this high rate from 1999 to 2001.

Although the baby friendly designation is specifically for the maternity floors of a hospital system and not designed for the unique needs of the high risk population, there have been positive effects on breastfeeding practices in the NICU following designation (Vannuchi, Monteiro, Rea, Andrade, & Matsuo, 2004). However, a program specifically designed for the high risk population with its significant barriers to breastfeeding, could have the potential for greater enhancement in breastfeeding rates in the NICU. Premature infants are a unique population and warrant individualized breastfeeding strategies and interventions (Kavanaugh et al., 1995; Meier, 2001)

Many hospitals have implemented practices that will educate and promote breastfeeding practices for infants within the NICU. However, only a few have evaluated their programs for effectiveness. The Rush Mother’s Milk Club has proven to be effective in increasing breastfeeding rates (Meier et al., 2004) by enabling free access to
hospital grade breast pumps, by offering lactation support 24 hours a day, by use of cue
based feeding when an infant consumes at least 50% of feeds orally, and by providing of
breastfeeding peer support. Other studies have found positive increases in breastfeeding
initiation with the introduction of counseling as well as contact with lactation consultants
among mothers with low birth weight infants (Pinelli, Atkinson, & Saigal, 2001; Sisk,
Lovelady, Dillard, & Gruber, 2006). A workbook program introduced at 2 different time
periods during the hospital stay was also shown to have positive effects on breastfeeding
with premature infants in one hospital setting (Jang, 2005).

Many papers have documented specific protocols to instruct mothers and promote
breastfeeding (Isaacson, 2006; Premji, Paes, Jacobson, & Chessell, 2002; Spicer, 2001),
but no research has been conducted to determine the effectiveness of such
recommendations. Although studies have shown increased knowledge acquisition by
health care professionals in the NICU following an education plan (Siddell et al., 2003),
there are no studies that have investigated the effect of education of health care
professionals coupled with protocols and standard written information for parents on
changes in breastfeeding practices in the NICU.

Of all interventions for breastfeeding with the high risk neonate, the Rush Mother’s
Milk Club is probably the most well known. The health care providers in the NICU at
Rush University have an increased level of knowledge regarding breastfeeding in the
NICU. With this knowledge, they are able to implement advanced strategies, such as
putting breast milk in a centrifuge to modify the fat content to promote weight gain
(Meier, 1998). Many studies have been conducted to evaluate the effectiveness of the
Rush Mother’s Milk Club with positive results (Meier et al., 2004). However, the high
level of education about breastfeeding among health care professionals at Rush University likely underlies the capability to implement the more advanced interventions. For many hospitals, basic education on lactation with high risk infants is lacking. In addition, many interventions that have proven to be effective, including the use of free access to pumps and accessibility to lactation counseling, have associated costs, which many hospitals do not have budgets to support.

**Need for an Educational Package for Health Care Professionals and Mothers of Infants in the Neonatal Intensive Care Unit**

Breastfeeding and human milk feedings are possible and beneficial in the NICU, however, there is significant support and education that must occur to enable success among mothers in the NICU (do Nascimento & Issler, 2004). Education and treatments should be based on research with premature and high risk infants, as they have unique needs in the breastfeeding process (Meier, 2001). The use of developmental care practices can drive the understanding of appropriate breastfeeding interventions based on infant readiness cues (Karl, 2004).

Although there have been many articles and books written on the subject of breastfeeding with the high risk neonate, there was no up to date, comprehensive, evidence based education packet with complementary information for both parents and health care professionals available on the market. By understanding each of the challenges to breastfeeding the medically fragile infant and the specific developmental and nutritional needs of the high risk infant, an education initiative can be developed and then evaluated for efficacy.
Synactive Theory and Breastfeeding Interventions in the Neonatal Intensive Care Unit

While investigating, developing and implementing appropriate interventions targeted to improve breastfeeding rates, it is important to consider the vulnerability of the special population in the NICU and the impact of environmental stressors on this population. One theory that can be used to guide appropriate interventions in the NICU is the synactive theory, which identifies the process of neurobehavioral maturation of the infant. Breastfeeding interventions should be individualized, based on infant readiness cues and tailored to the responses of the infant (Blackburn, 1998). Review of the synactive theory and its application to breastfeeding should be part of any education initiative for health care professionals who serve the vulnerable infants in the NICU.

The synactive theory was developed by Heidelese Als in the early 1980’s (Als, 1982). The process of developmental care, related to the synactive theory, is intended to facilitate a well organized, stable infant who may optimally grow and develop. Developmental care has been instituted in many neonatal intensive care units around the country as a developmental care initiative. It provides a framework for interacting with these fragile infants without jeopardizing health. The synactive theory of development describes the process of neurobehavioral maturation related to an infant’s internal and external environment. As the infant attempts to interact with the external environment, a dynamic process occurs internally among 5 different subsystems. The dynamic process among the 5 subsystems can explain the behaviors and responses exhibited by the premature infant and can guide appropriate interventions.

The 5 distinct, yet interdependent subsystems are physiological or autonomic, motor, state organization, attention and interaction, and the state regulation subsystems.
These subsystems are believed to impact the functional organization of the infant’s system in an ordered fashion. The subsystems are not hierarchical, but they are believed to be ordered and interdependent (Als, 1982; Als, 1994).

The physiological subsystem is considered the core of the system. It is the foundation for which all of the other systems gain stability. This physiological subsystem allows the infant to have control over autonomic functions such as voiding, breathing, maintaining steady vital signs, and processing nutrition. The motor system provides control over movement, muscle tone, and posture. The state subsystem gives the infant control over his/her level of consciousness. It enables the infant to move through identifiable states and move smoothly from one state to another. The attentional/interactive subsystem enables control over functional responses to stimulation in the environment and governs the ability to interact. The state regulation subsystem gives the infant the ability to balance environmental stressors and recover by modulating all the other systems (Als, et al, 1982). While the autonomic subsystem serves as the foundation of the system, the state regulation subsystem serves as the gatekeeper and is achieved with increasing maturity.

A cone shaped diagram is used to represent the complex development of the infant as it relates to the five subsystems (Als, 1982). The cone has its tip at the bottom with the funnel going upward. The five subsystems can be viewed at the top of the open cone. At the smallest center is the physiological subsystem with the remaining (motor, state, attentional/interaction) forming layers outside the center, much like an onion. The youngest fetus is represented at the bottom of the cone and has with it only components (not yet a fully developed system) from the autonomic subsystem. This indicates that
infants who are born early are unable to integrate the higher order systems. Stressors within the system interfere with the physiologic capabilities of the infant. Subsequently, early premature infants are incapable of any interaction and need all their energy to maintain homeostasis of the system to sustain life. There is also instability in the physiologic system, which is why premature infants frequently have medical or physiological problems when born early and have to contend with the stressful environment.

With the earliest fetus at the bottom of the cone, increasing gestational age is associated with increasing maturity spreading out to the other layers of the system. With increasing gestational age and thus maturity, the infant may extend its control out to the next level, the motor subsystem. The infant may demonstrate improved muscle tone and postural control. This concept parallels the literature, which demonstrates improvement in muscle tone and reflex development with increasing gestational age (Allen & Capute, 1990). Further maturity may extend the infant’s control out to the state subsystem enabling the infant to demonstrate some awake periods and to smoothly transition from one state to another. As maturity continues, the infant may be able to achieve some attention and interaction with caregivers and the environment. Lastly, as the infant approaches term and achieves more maturity, he/she will be able to tolerate stressors, cope with them, reorganize and continue interaction without being knocked down to functioning at the lower subsystems.

The term synaction refers to the relationship between all the subsystems and how instability in one system has the potential to affect all the other subsystems and thus the integrity of the child’s health and well-being (Als, 1982). On the right side of the cone
are gestational ages that reflect the increasing maturity of the system (dependent on the subsystems) with increasing gestational age. On the left side of the cone are influences of the environment on the maturation of the system, with a break in the intrauterine and extraterrene environment before term to indicate the premature birth, thus representing the role of environmental stresses before full maturity occurs. With earlier birth and more stressors from the environment, there will be a resultant decrease in neurobehavioral maturity.

When an infant is stressed from the environment, he/she may initially demonstrate stress reactions based on the predominant level of neurobehavioral maturation. If he/she is primarily functioning in the physiological state, he/she may demonstrate bradycardic events, oxygen desaturations, hiccups, stooling, or spitting up. If he/she is primarily in the motor state, he/she may demonstrate grimacing, arching, saluting, finger splaying, or sitting on air. If he/she is in the state subsystem he may shut down or move to a light sleep state. If he/she is in the attentional/interactive subsystem, he/she may avoid interaction by turning away. The infant has the capability to re-achieve organization with time outs or specific strategies designed to help him cope. Interventions designed to help infants cope with stressors include providing boundaries, swaddling, positioning in flexion, bringing hands to mouth, minimizing environmental stimulation, non nutritive sucking, and enabling grasping. Infants additionally will demonstrate approach signals such as smiling, mouthing, ooh face, cooing, quiet and alert state, and soft and relaxed facial expressions when they are ready for interaction (Hussey-Gardner, 1996). Once reorganized and demonstrating approach signals, the stressor may be reintroduced slowly.
The synactive theory defines the subsystem along with stress and coping signs consistent with each of the subsystems to enable caregivers to identify and respond to behaviors appropriately. When stress signs are recognized, the caregiver can then withdraw the stressor that contributed or help facilitate the infant to cope. Once a time out is given and the infant reorganizes, the treatment or interaction can continue. This “give and take” enables the infant to function optimally within the environment and allows him/her to continue to benefit from interaction and stimulation, including breastfeeding, as he/she tolerates. The synactive theory proposes an approach for each individual child that is adapted to fit the needs of that infant. It promotes infant development to occur as normally as possible, despite medical complications and immaturity brought on by an early birth.

Infants born at earlier gestational ages and with decreased neurobehavioral maturation are not capable of handling environmental stressors typically experienced by newborns. When interventions for these neurobehaviorally immature infants are done without respect for readiness cues, the infant is at risk for regressing to one of the more primitive states, putting them at risk of developmental and medical sequelae. Breastfeeding is an environmental stressor. Without observing infant readiness cues and introducing breastfeeding at the appropriate time individualized for each infant, optimal responses to the environment as well as optimal neurological maturation are delayed. Therefore, breastfeeding cannot be introduced at a prescribed time or introduced in the same way that it would be for a full term infant, but it must be based on the neurobehavioral maturation of the infant and advanced according to stress and readiness cues. These concepts need to be in any educational program for both health care
professionals and for mothers of infants in the NICU to help them implement the best breast milk feeding program for these infants.

While the synactive theory defines the appropriate time and way to introduce interventions, it also assists with understanding that many extremely low birth weight infants and low birth weight infants are too neurologically immature and fragile to engage in any breastfeeding. Subsequently, mothers of infants in the NICU need equipment that will enable them to achieve and maintain a milk supply, in the absence of infant suckling at the breast, until the infant is appropriate for nutritional breastfeeding. Hospital grade breast pumps that will enable long term milk expression are necessary for mothers with infants in the NICU to maintain adequate milk supplies while they are waiting for their babies to become medically and developmentally stable enough to engage in feeding at the breast.

Understanding the synactive theory and implementing developmentally supportive care can instruct and guide interventions and NICU practices as they relate to breastfeeding the premature infant. One case study in the literature highlighted the significant benefits of a developmentally supportive plan on the breastfeeding process in a premature infant (Nyqvist et al., 1996). The synactive theory should guide the development of any educational module and inservice for health care professionals who serve infants in the NICU.

**Theory Governing the Behavior of Health Care Professionals**

Studies have identified that there is a lack of education about lactation and lack of consistent support and instruction about breastfeeding among health care professionals in the NICU (Ekstrom, Widstrom, & Nissen, 2005; Pantazi et al., 1998). Having educated health care professionals will not necessarily impact breastfeeding practices. It is how
those health care professionals respond and utilize that education to execute new interventions that will foster change and subsequent improvement in human milk feedings. The behavior of health care professionals in the NICU needs to change to support the breastfeeding process. Studies have shown that behavior change is much more successful when interventions are matched to the stage of readiness to change (Prochaska, Prochaska, & Levesque, 2001). The transtheoretical model (TTM) provides a description of how the individual’s state of readiness to change translates into behavioral change.

The premise of the TTM is that there are several stages associated with behavior change. Individuals go through these stages on their way to making a change. They may start anywhere along the continuum of the 5 stages and they may move forward or backward or skip stages, but there is some progression through the stages on their way to behavior change. The TTM has been used to describe many health behavior changes, such as use of sunscreen, use of condoms, self examination breast checks, smoking cessation and initiating an exercise plan. Appropriate interventions can be tailored to the stage of readiness to change.

The five stages of the TTM are precontemplation, contemplation, preparation, action and maintenance. Each stage identifies if the individual has an intention of changing behavior and identifies how significant the intention to change behavior is (Prochaska & DiClemente, 1983). Someone in the precontemplation stage does not intend to take action within 6 months. A person in the contemplation stage intends to take action within the next 6 months. Someone in the preparation phase intends to take action in the next 30 days. The action stage refers to persons who have made obvious
changes less than 6 months ago. The maintenance stage refers to individuals who have made significant changes more than 6 months ago.

Interventions that are implemented to enable behavior change should be conducted in such a way that the intervention matches the stage an individual is in, or should be tailored to how ready the person is for change. Ten fundamental processes that can affect change have been identified along with interventions that can be matched to the stage of readiness to change (Table 1-1) (Prochaska et al., 2001). Certain interventions will only be effective if they are appropriate for the stage of readiness for behavioral change of the individual. For example if someone is in the precontemplation stage, interventions should be focused on educational initiatives and strategies to promote reflection about how the change may impact the person’s situation and how it will benefit others, while interventions for the person in the contemplative stage should be about supporting and motivating the person to actually initiate the intended behavioral change. These latter interventions provided to the precomtemplater would not be effective because the person has not yet formed the conviction that change is needed or desired and could actually create significant resistance and prevent behavioral change from succeeding (Prochaska et al., 2001). By enabling stage matched interventions, education and strategies can be implemented to foster movement across stages to enable successful change.

The TTM has been used to address behavior change within organizations by targeting employees. By providing stage matched interventions, all employees can be given opportunities to participate in the change process. Although stage matched interventions have been shown to facilitate movement toward action, not all employees may achieve action. Change at the organizational level should include interventions that
are stage matched to each stage of change to give all employees the opportunity for participation in the change initiative (Prochaska et al., 2001).

Table 1-1. Stages of change in which particular processes of change are emphasized

<table>
<thead>
<tr>
<th>Stages</th>
<th>Precontemplation</th>
<th>Contemplation</th>
<th>Preparation</th>
<th>Action Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>Conscious</td>
<td>Self</td>
<td>Self - Liberation</td>
<td>Contingency-Management, Helping Relationship, Counter Conditioning, Stimulus Control</td>
</tr>
<tr>
<td></td>
<td>Raising,</td>
<td>Self</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dramatic Relief,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental -</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reevaluation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To foster behavior change regarding support and information dissemination about breastfeeding within the NICU, the TTM can be utilized to structure an intervention program. By matching breastfeeding interventions to stages of readiness to change, all health care professionals can have the opportunity to participate in the change process. By introducing interventions that can target health care professionals in each stage of readiness to change, a meaningful intervention plan can be implemented to foster change at the organizational level. A breastfeeding intervention for the NICU with 4 parts could theoretically target individuals in all of the stages of readiness to change.

For those health care professionals in the pre-contemplation stage, there is no intention of making a behavior change. Health care professionals in the contemplation stage intend to make a change within the next 6 months. Both of these stages describe
individuals who are not yet ready for action, and interventions for those in either of these stages would be the same. Interventions for those in these stages should be two-fold. One intervention, education, would be aimed directly at the health care professional. With education, conscious raising can be fostered. With it, it is hoped that health care professionals will have the resources needed to become aware of the need for breastfeeding support in premature infants and will start to see solutions to the problem. However, because those in the pre-contemplation stage have no intention of making a behavior change, there would be no motivation to participate in an educational initiative. Likewise, those in the contemplation stage also may need incentives to push them to participate. Therefore, incentives on annual review, food, prizes and continuing education units could serve as motivation for participation among those who lack motivation to attend without some perceived personal benefit. With the participation in the educational initiative, they would be exposed to content of the education that highlights the great benefits of breast milk and the need for support and education among mothers. With this increased awareness of the problem and possible solutions, behavior change could be fostered.

The other intervention should be aimed at achieving some level of support and education for the mothers. Materials that provide consistent and thorough information could be issued to all new parents in the NICU to ensure that all mothers receive information about initiating and sustaining breast milk feedings in the NICU. Although this intervention would serve to enable education of mothers, it also may serve as a conscious raising effort for the health care professional, who may be asked for guidance and support by the mother on information contained in the educational materials. The
health care professional may then better understand the problem and the need for behavior change to facilitate success with the breastfeeding process.

Individuals in the preparation phase intend to make a change in the next 30 days. These individuals are ready for action oriented interventions. Therefore, clinical pathways or protocols could foster change in how they deal with breastfeeding mothers. Protocols or pathways, which become a part of required paperwork, could theoretically facilitate professionals to make a commitment to change by giving protocols that necessitate action.

Those in the action and maintenance stages have already made changes. The mother’s positive experiences could serve as motivation from the environment, and there could be other motivators for continued compliance from within the organizational structure, such as acknowledgement on the annual review and identification as one who has expertise in breastfeeding with high risk infants. Those in the action and preparation phase also may take an active part in motivating others and facilitating more positive change related to breastfeeding interventions in the NICU.

Thus based on the TTM, an educational initiative that includes educational materials to parents, opportunities for education with incentives for health care professionals, and protocols or pathways of care could be effective in facilitating change in breastfeeding practices in the NICU, and each is theoretically matched to all of the stages of readiness to change.

Although the primary focus of the intervention for this research is health care professional behavior change, interventions structured to enable change in breastfeeding practices also must target behavior change in the mothers. Theoretically, developed
interventions for the health care professionals can also be matched to mothers in each stage of readiness to change. An educational booklet for new mothers could enable conscious raising for mothers in the precontemplation and contemplation stages. A breast pump loaner closet as well as milk expression guidelines and a breast milk log (that could be included in the educational booklet) could be appropriate interventions for those in the preparation and action stages. Appropriate interventions for those mothers in the action and maintenance stages would include concepts such as the first feeding being at the breast and enabling breastfeeding while in the hospital to support continued breast milk feedings in the presence of the decision to initiate breast milk feedings.

Interventions targeted at health care professional change can be structured to move mothers to decide to breastfeed and help them maintain that behavior once they start. Theoretically, interventions including a breast pump loaner closet, an educational booklet for new mothers, a breastfeeding pathway, and an educational initiative for health care professionals can support behavior change in two different groups, the health care professionals as well as the mothers. The health care professional group functions as a primary support for the mothers to initiate and sustain breastfeeding.

**Transtheoretical Model of Behavior Change and Methods of Education**

Equally important with providing stage matched interventions for health care professionals is consideration of what mode of learning to utilize for the conscious raising strategy. Self learning modules can be considered easy to implement and enables staff to participate in the learning initiatives at their own pace, enables them to take modules home if work responsibilities prevent participation during working hours, and is rather inexpensive when compared to other modes. The literature reflects good success with self-directed learning modules, with good performance on post tests and learning
retention (Coleman, Dracup, & Moser, 1991). When compared with lecture-discussion formats, self learning methods were comparable in achieving the educational objectives being targeted within the nursing field (Nikolajski, 1992).

Computer based training is another method of education gaining increased acceptance and use in the last several years with the increasing capabilities of technology. Harrington and Walker (2004) discovered that, although both groups significantly improved their post test scores, a group of individuals who engaged in computer based training did significantly better than individuals in an instructor led course on fire safety (Harrington & Walker, 2004). Research and experience are beginning to define computer based learning as a viable option for educational purposes. However, the access to technology and to the people who format and design the computer systems is a significant barrier to widespread use of such learning practices today.

Not all individuals have the same learning style. While some may prefer self paced methods, others may be more motivated and embraced in a face to face lecture and discussion with peers. Goldrick, Gruendemann, and Larson (1993) found that 64% of nurses in a pediatric intensive care unit had an abstract learning style and preferred self learning modules. However, there remained 36% who preferred more traditional methods (Goldrick, Gruendemann, & Larson, 1993).

Self directed learning, through an educational module, is an effective form of educating health care professionals. However, not all individuals possess the learning style necessary for successful completion of self learning modules and prefer lecture-discussion formats. By providing both forms of educational opportunities, more health
care professionals could be encouraged to participate in an educational initiative. Computer based training could also be effective if access to technology can be achieved.

**Summary and Research Questions**

The provision of breast milk has important benefits to infants, especially those in the NICU who are less healthy and less mature at birth than full term infants. Yet significant, but not insurmountable, barriers to breast milk feedings and breastfeeding exist in the NICU. Health care professionals are a powerful influence (Swanson & Power, 2005). It is proposed that change from the health care professionals can enable mothers and infants to overcome many of the barriers to breastfeeding, and subsequently, positive changes in breastfeeding practices can occur in the NICU. Therefore, in this study, the effect of a 4-pronged education and support intervention to promote breastfeeding in the NICU, based on the synactive theory and transtheoretical model of behavior change, will be explored. The four parts of the proposed intervention are a breast pump loaner closet, a breastfeeding pathway on the individualized care plan, an educational booklet for mothers, and an educational initiative for health care professionals who work with infants and mothers in the NICU. The research questions are

- Is there a significant difference in breast milk feeding initiation in very low birth weight (VLBW) infants admitted to the NICU before and after implementation of the intervention plan?

- Is there a significant difference in the rate of breastfeeding in the hospital among women with VLBW infants hospitalized in the NICU before and after the implementation of the intervention plan?

- Is there a significant difference in breast milk feedings at discharge in VLBW infants admitted to the NICU before and after the implementation of the intervention plan?
• Is there a significant difference in the proportion of the hospital stay that breast milk is provided in VLBW infants admitted to the NICU before and after the implementation of the intervention plan?
CHAPTER 2
METHODOLOGY

The purpose of this study was to test the efficacy of a 4-part intervention on improving breastfeeding practices in the neonatal intensive care unit (NICU). The overall goal was to attempt to develop an effective intervention to assist mother-infant dyads in the complex NICU environment.

Participants

Very low birth weight (VLBW) infants (<1500 grams) were included in the study if they were 1) admitted to the Level II or III nursery at Shands Hospital during the study periods and 2) had a length of stay greater than or equal to 7 days, 3) were admitted to the NICU within the first 3 days of life, 4) were hospitalized less than 4 months, 5) achieved full gastric feeds during their stay, and 6) had a hospital stay that did not cross over from the pre-intervention group time period into the education initiative time period. Very low birth weight infants were excluded from the study if they 1) had a length of stay less than 7 days, 2) were transferred to Shands Hospital after the third day of life, 3) were hospitalized greater than 4 months, 4) did not achieve full gastric feeds during the hospital stay, 5) had a hospital stay that crossed over from the pre-intervention group time period to the education plan time frame, or 6) had conditions that would make breastfeeding contraindicated as established by the physician.

Power indicates the probability of rejecting the null hypothesis, if a condition exists. With a power of 80%, which is frequently used in the literature, there is a 20% chance of failing to reject the null hypothesis when it should be rejected.
Prior to conducting the study, a power analysis was conducted to determine the appropriate sample size. The mean and standard deviations of breast milk feeding initiation were unavailable from other studies to compute an effect size and subsequently a sample size. Therefore Cohen’s Criteria was utilized to make sample size estimations (Cohen, 1988). According to Cohen, a .2 standard deviation change is a small effect, a .5 is a medium effect, and a .8 is a large effect. For the purposes of this study, a medium size effect was selected. By using Cohen’s criteria and determining the sample size necessary with a power of 80%, alpha of .05, and looking for a medium size effect of .5, Cohen’s Criteria indicated a needed sample size of 82 per group. Therefore the research plan consisted of intent to conduct quota sampling with participants enrolled from the beginning study dates for both the pre-intervention and post-intervention groups until 82 were achieved in each group.

The planned pre-intervention group consisted of all very VLBW infants admitted to Shands Hospital NICU from April 15, 2004 forward until 82 participants were enrolled in the study. The intervention started on March 1, 2005 with conclusion of the educational initiative on April 15, 2005. The planned post-intervention group consisted of all very low birth weight infants admitted to Shands Hospital NICU after implementation of the intervention plan, from April 15, 2005 until 82 were admitted into the study. Data from participants were collected from the same time of year to account for seasonal confounds.

**Research Interventions**

**Intervention 1: Breast Pump Loaner Closet**

Intervention 1 consisted of the development of a breast pump loaner closet for use by mothers with infants hospitalized in the NICU. Hospital grade breast pumps could be checked out by mothers who had infants in the NICU to enable them to express their milk
the recommended 8 to 12 times per 24 hour period. This would enable a supply of expressed breast milk for initiation of breast milk feedings in the infant and would enable the mothers to establish and maintain a milk supply until the infant was able to go directly to breast.

**Intervention 2: Health Professional Education Initiative**

Although there are many different recommendations and published articles about breast milk feedings and breastfeeding in the NICU, there was no up to date, available educational plan that could be utilized for staff education. Therefore, an education initiative encompassing key areas of education on breastfeeding special care babies was developed to educate as many of existing staff in the NICU as possible. The initiative consisted of education to staff on breastfeeding to enable health care providers to have the education and tools to support mothers in the breastfeeding process. The education was offered through completion of a self study educational module on breastfeeding in the NICU or through attendance at an inservice on breastfeeding in the NICU.

Education topics contained in the self study module and discussed in the inservice included the benefits of breastfeeding, the barriers to breastfeeding, the physiology of lactation, use of breast pumps, pre feeding interventions based on the synactive theory and breastfeeding interventions that acknowledge the readiness of the infant. All the information contained in the module was based on an extensive literature review to represent evidence based practice and was designed to foster success with breastfeeding in the high risk neonate population while acknowledging their unique needs. The educational module was reviewed by two individuals considered to be experts in the area of breastfeeding for establishing validity of information provided. Minor adjustments were made to the education plan based on the expert feedback. Refer to the outline of the
educational module, appendix A, or contact the author for further details. The successful completion of the health professional education was defined as completion of the module or attendance at one of the inservices and a passing score of at least 80% on a post test that was identical for either form of the education.

**Intervention 3: Breastfeeding Guideline**

Each medical chart contains an individualized care plan (ICP) for documentation by nurses. This ICP was modified to also have a pathway of care for providing breastfeeding support to new mothers (appendix B). This ICP necessitated documentation of education and support by nurses at critical times in the breastfeeding process. The guideline called attention to and necessitated documentation on specific key points that were identified in the literature to be predictive of success: achieving and maintaining a milk supply, timely pumping, skin to skin contact, and first feeding being at the breast. It also included areas to check off, date, and sign at the following critical times in the breastfeeding process: within 6 hours of delivery, issue and instruct in proper pumping and breast milk storage techniques; within 24 hours, ensure proper pumping and storage technique; on day 3 to 5, ensure that the milk has come in and trouble shoot any problems; weekly, foster continued pumping and skin to skin care; first oral feeding, ensure that it is a breastfeeding session; 10 days, monitor milk supply and make referrals as appropriate.

**Intervention 4: Educational Pamphlet for New Mothers of Neonatal Intensive Care Unit Infants**

An educational pamphlet, “A Mother’s Gift”, for mothers who had an infant admitted to the NICU was developed. The outline of the educational booklet (see appendix C) addressed the following key points: benefits of breastfeeding, how to
express and store human milk, pre-breastfeeding strategies, and cue based breastfeeding interventions. The back of this pamphlet also included a place for mothers to document breast milk production to facilitate communication with nurses about their milk supply. This educational pamphlet was developed to ensure that all mothers received a standard set of educational points during their infant’s hospitalization, and that the information contained in it was consistent with the education that the health care professionals received.

**Intervention Plan Modification**

The original intervention plan consisted of 4 parts: a breast pump loaner closet, an education module and inservicing, changes to the individualized care plan and an educational booklet. Prior to the initiation date of March 1, 2005, it was learned that external funding for the breast pump loaner closet could not be obtained. Therefore, this prong of the intervention had to be deleted from the intervention program. The study was then conducted with the following being the intervention/education plan: the education initiative, the mother’s educational booklet, and the breastfeeding pathway addition to the individualized care plan.

**Design**

This study was a quasi experimental, matched through cohort controls, design (Shadish, Cook, & Campbell, 2001), investigating indirect changes in breastfeeding practices following a 3-part breastfeeding intervention in the NICU. Through this design the pre-intervention group consisted of a group of VLBW infants hospitalized in the NICU before the implementation of the intervention plan. This group was then compared to the post-intervention group, which consisted of a group of VLBW infants who were hospitalized in the NICU after the implementation of the intervention plan.
The independent variable was the implementation of the intervention as described above. Dependent variables included 1) breast milk feeding initiation rate (was breast milk ever consumed/breast milk feeds initiated? (yes/no)), 2) breastfeeding rate (number of times the infant was put to the mother’s breast after 30 weeks gestation divided by the number of days hospitalized after 30 weeks gestation), 3) breast milk feeding at discharge rate (did the infant continue to have breast milk feedings at discharge? (yes/no)), and 4) the proportion of the hospital stay that breast milk was provided (total number of days into the hospitalization that breast milk was provided divided by the length of stay).

**Procedures**

The educational intervention was implemented March 1, 2005 to April 15, 2005 with opportunities for health care professionals to complete the self study educational module or participate in an inservice. “A Mother’s Gift”, the educational booklet for mothers was issued to all new mothers with infants admitted to the NICU on or after March 1, 2005. Last, the modified individualized care plan was used in the medical chart on all new admissions after March 1, 2005.

To promote completion of the educational initiative, incentives were given to those who participated in the breastfeeding education initiative by way of food, prizes, continuing education credits and documentation on the annual review of their performance. Following the six week educational initiative, completion of the self study educational module on breastfeeding in the NICU became part of the orientation process to enable the same education for those staff who were not employed at Shands Hospital during the six week educational initiative.

The educational opportunities during the initiative dates included a self study module and/or inservices. A breastfeeding module was available for health professionals
to check out and complete at home or work. Food and prize incentives as well as 2 continuing education credits were awarded for those who completed the educational module. For those who preferred lecture-discussion formats for learning, 1 hour inservices were offered at least one time per week throughout the education initiative period. Those who attended the inservices were educated on the same information contained in the education module, however in a condensed amount of time. Therefore one continuing education credit, in addition to food and prizes, were awarded to those who attended an inservice during the initiative dates.

The booklet entitled “A Mother’s Gift” was issued to mothers with infants admitted into the NICU after March 1, 2005. There was a central location at the reception desk where nurses who had new admissions could access and issue them to mothers. Nurses were instructed to issue these booklets during staff meetings, through the monthly bulletin and in the breastfeeding inservice that occurred over the six week period.

The modified individualized care plan with the breastfeeding pathway replaced the old ICPs and were placed in the chart as routine paperwork as of March 1, 2005. Nursing staff were instructed to use it by way of a monthly written bulletin. It was also discussed in staff meetings and further reminders were given to document on it during the breastfeeding inservices that occurred over the six week period.

**Program Evaluation**

The desired impact of this program was increased breastfeeding in the NICU. However, the intervention strategies used in the current study can only be effective if they are implemented. The full implementation of the 3-pronged intervention was evaluated in four ways. All the educational tools (the educational module, the inservice, the educational booklet for he mothers and the modified ICP) stressed that the first oral
feeding should be at the breast. Therefore the primary outcome measure to determine implementation of the intervention was whether the first oral feeding was at the breast. Second, attempts were made to track the percentage of mothers of infants newly admitted to the NICU to whom educational booklets were issued to determine if, in fact, most mothers were being issued this educational booklet. Last, weekly communications with the nursing administrator indicated the degree of compliance with educational key points based on her monthly experiences as a bedside nurse, in which she worked directly with mothers and their babies in the NICU.

**Data Collection**

Participants were recruited by way of a data base containing all admissions and discharges from the NICU during the two different time periods. For each infant admitted to the hospital during the applicable time periods, an extensive retrospective chart review was conducted. Each identified chart was first investigated to ensure that the infant did not have any exclusion criteria. Given that inclusion criteria were met, the dependent variables as well as demographics were collected and recorded on a laptop computer.

Inter-rater reliability was determined in 3 different participants to ensure that accurate variables were collected from the charts. This occurred by having another researcher collect data on the same participants following data collection by the principal investigator and comparing if the variables collected by the two different researchers were in agreement.

**Data Analysis**

Retrospectively, charts were reviewed and data was analyzed for significant differences in the proportion of mothers who initiated breast milk feedings, the number of
times per day the mother breastfed after 30 weeks gestation, the proportion of mothers who provided breast milk at discharge, and the proportion of the hospital stay that breast milk feedings occurred. Table 2-1 summarizes the dependent variables and null hypotheses.

Table 2-1. Hypothesis testing according to dependent variable

<table>
<thead>
<tr>
<th>Group</th>
<th>Breast milk feedings initiated (yes, no)</th>
<th>The Number of Times the Mother Breastfed Per Day After 30 EGA</th>
<th>Breast milk provided at discharge (yes, no)</th>
<th>Proportion of the hospital stay that breast milk was provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Intervention Group</td>
<td>A1</td>
<td>B1</td>
<td>C1</td>
<td>D1</td>
</tr>
<tr>
<td>Post – Intervention Group</td>
<td>A2</td>
<td>B2</td>
<td>C2</td>
<td>D2</td>
</tr>
</tbody>
</table>

**Hypotheses**

The following hypotheses and data analysis plan guided this study.

- The rate of breast milk feeding initiation will be higher in the post intervention group (A2>A1).

**Data Analysis Plan:** A Pearson’s Chi Square was used to test two proportions for significant differences between the two groups.

- The number of times per day that an infant is breastfed after 30 weeks gestation will be higher in the post-intervention group (B2>B1).

**Data Analysis Plan:** A one-way analysis of variance (ANOVA) was not possible secondary to a violation of the assumption of normality. Therefore, the nonparametric Mann Whitney was used to test for differences between the 2 groups.
• The rate of breast milk feedings at discharge will be higher in the post intervention group (C2>C1).

**Data Analysis Plan:** A Pearson’s Chi Square was used to test two proportions for significant differences between the two groups.

• The proportion of the hospital stay that breast milk was provided will be higher in the post intervention group (D2>D1).

**Data Analysis Plan:** A one-way analysis of variance (ANOVA) was not possible secondary to a violation of the assumption of normality. Therefore, the nonparametric Mann Whitney was used to test for differences between the 2 groups.

In this study, the pre-intervention group and post-intervention group were compared for significant differences in four different variables. For the purposes of this study, an alpha level of .05 was chosen, which is standard throughout the literature.

**Adjusting the Alpha Level**

There are no statistical procedures that can simultaneously test multiple outcomes, some of which are continuous and some of which are dichotomous. Therefore, the significance levels of the individual tests were adjusted by the ranked Bonferroni adjustment. There has been criticism of the standard Bonferroni adjustment being too conservative and that, in theory, if many tests were run, the level of significance would be so low that no differences could be detected. The ranked Bonferroni adjustment was preferred over a standard Bonferroni adjustment to enable maximum power in initial comparisons, by adjusting the alpha level with each additional comparison to prevent inflation of the type I error rate. This would help to prevent the researcher from rejecting the null hypothesis inappropriately while minimizing inappropriate stringent $p$ value
constraints (Benjamini & Hochberg, 1995). For this study, the questions were ranked in order of importance. The first question, whether or not there was a difference in breast milk feeding initiation, was tested at an alpha of .05. The second question, whether or not there was a difference in number of times breastfed after 30 weeks gestation, was tested at an alpha of .025 (.05/2). The third question was tested at an alpha of .017 (.05/3). The fourth question was tested at an alpha of .013.

Each statistical analysis was conducted as a one sided test as it was assumed that trends would be toward increased rates of breastfeeding with the interventions that were implemented.
CHAPTER 3
RESULTS

Intervention Implementation

One hour inservices were conducted 1 to 3 times per week for a total of 10 inservices during the intervention period of March 1, 2005 through April 15, 2005. General attendance at each inservice was low with approximately 2 to 5 participants at each one. Self-study modules were also available for check out during this time. Overall response to complete the self-study modules was also low in the month of March. Therefore, in April, the researcher started directly asking health care professionals to complete the modules and offered food prizes for those who did. It appeared that directly requesting participation was beneficial in promoting participation by the health care professionals. There were 11 health care professionals who completed the self study education modules from March 1 through March 31, 2006, and there were 45 health care professionals who completed the educational module from April 1 through April 15, 2006.

The total number of health care professionals who participated in the educational initiative was 88, which was 63% of health care professionals working in the neonatal intensive care unit (NICU). The total number of nurses who participated in at least one of the methods of education was 75, which was 77% of all nurses who care for infants in the NICU. There were 3 rehabilitation therapists (100%), 1 nurse practitioner (9%), 2 neonatologists (20%), 2 social workers (100%), 1 respiratory therapist (10%), and 5 other
health professionals (83%). All those who participated in the education achieved a passing score of 80% on a post test.

Nursing managers reported variable levels of compliance with the new strategies presented in the educational initiative, contained in the educational booklet for mothers, and on the modified individualized care plan (ICP). Starting on March 1, 2005 the nurses initiated use of a new, revised individualized care plan (ICP) for documentation. The revised ICP was supposed to replace the old one. However, in mid April, it was realized that some old stores of the previous ICP, that did not include the breastfeeding pathway, had been pulled from the shelf and were being utilized. According to the nursing manager, this problem was resolved with full use of the new ICP by May 1, 2005.

Although all nurses were expected to follow the established guidelines on the breastfeeding pathway, during data collection it was observed that the new ICP was not utilized fully. One example of the lack of full implementation of the new pathway concerned whether the first oral feeding was at the breast. On the breastfeeding pathway, all mothers should have been encouraged to have the first feeding at the breast with documentation accordingly or documentation stating why care deviated from the pathway. However, the first feeding being at the breast occurred in only 25% of mothers in the post intervention group, and with full implementation it should have approached 100%. Although it is possible that mothers were encouraged, but declined to participate in the first feeding at breast, it is more likely that there was lack of full compliance with the educational key points and the modified individualized care plan.

Starting on March 1, 2005 “A Mother’s Gift”, the educational booklet for mothers, was available to be issued to new mothers with infants in the NICU. Initial “Mother’s
Gift” educational booklets were tracked to be able to determine if the number of booklets that were issued matched the number of admissions. Not all mothers were given the pamphlet over the first few weeks of the intervention. There were reports of running out of the booklets and not being able to find them. Multiple copies of these were distributed during and after the educational initiative, but they became impossible to track as they were frequently misplaced, redirected to the maternity floor rather than remaining in a central location in the NICU, and others outside of the research initiative made copies of the booklet for distribution.

Nursing managers reported variable levels of compliance with the new strategies presented in the educational initiative, contained in the educational booklet for mothers and on the modified ICP. One nursing administrator, who would function in the role of bedside nurse approximately once a month and would work directly with mothers and their babies during this time, reported certain personnel to be implementing strategies while others, even those who participated in the educational initiative, to be consistently ignoring the pathway of care contained in the medical chart. The nursing administrator’s occasional role of bedside nurse revealed that there were mothers who never received the educational materials and that ICPs in the medical chart had inadequate documentation.

The Sample

The pre-intervention sample data was obtained before the education plan implementation using quota sampling from the beginning study date of April 15, 2004. The post-intervention group was obtained after the intervention period implementation from April 15, 2005 onward. Eighty one participants were obtained for the pre-intervention group from April 15, 2004 through discharges on December 7, 2004. Data collection in the pre-intervention group was stopped at 81, because the subsequent 2
admissions crossed into the treatment period. Data from only fifty four participants in the post-intervention group was collected from April 15, 2005 through discharges on November 29, 2005. There were no discharges from the NICU of participants who met inclusion criteria from November 29, 2005 to December 7, 2005.

This sample included all admissions of VLBW infants admitted during the pre-intervention study dates except for 17 infants who did not meet inclusion criteria. Among the 17 infants who were excluded, 13 of them were extremely low birth weight and expired shortly after birth, thus never achieved full gastric feeds. Two of them did not achieve full gastric feeds before being transferred to another hospital, and 2 of them had a length of stay that extended into the treatment period. The pre-intervention group consisted of 83% of all admissions of VLBW infants admitted to the NICU at Shands during the study dates. The sample included all admissions of VLBW infants admitted during the post-intervention study dates except for 11 infants. Among those 11 infants who were excluded were 9 infants who never achieved full gastric feeds and expired shortly after birth and 2 who had genetic disorders that made eventual oral feeding contraindicated. The post-intervention group also consisted of 83% of all admissions of VLBW infants admitted to the NICU at Shands during the study dates.

The data collection period was not extended in order to capture the remaining 17 participants for two reasons: the first is that a long period of time had passed since the intervention plan, and new interventions were scheduled to be implemented in the NICU. These would have introduced significant additional confounds into the study. Secondly, a new power analysis based on actual effect sizes of this partial sample indicated a need for data from an additional 124 participants in the post-intervention group and 95 in the pre-
intervention group to achieve 80% power because of the already high breast milk
initiation rate (74.1%). Continuing data collection to enroll 82 in each group based on
the original research plan would have increased power from 38.6% to 45.6%, an increase
that was considered to not be feasible given the potential confounders listed above, or
likely to change the statistical outcomes.

**Inter-Rater Agreement**

To ensure accurate documentation of the research variables, inter-rater agreement
was tested on the chart review procedures. Another researcher conducted data collection
on 3 charts that the principal investigator had already collected data from. There was
100% agreement in 2 out of 3 of the charts. However, one chart revealed agreement of
92%, for a total inter-rater agreement of 97% for this study. The principal investigator
reviewed the chart that did not have complete agreement to find 100% agreement with
her initial findings.

**Demographics**

Table 3-1 includes sample demographics and $p$ values for statistical tests to rule out
selection differences. All demographics were collected as continuous or dichotomous
variables, with the exception of race. Race in the medical chart was classified as White,
Black, Asian, Hispanic or Other. Therefore, race is documented with the same
classifications. The pre-intervention group was 4% Hispanic, 42% Black, and 54%
White. The post-intervention group was 2% Asian, 3% Hispanic, 49% Black, 42% White
and 4% with undocumented race in the medical chart. Due to the majority of participants
being Black or White, with minimal representation of other racial backgrounds, and due
to Black being a known predictive factor in the literature, race was dichotomized into
Black and not Black for statistical purposes to rule out selection differences.
Table 3-1. Demographics of the pre-intervention and post-intervention groups with test statistics for selection differences

<table>
<thead>
<tr>
<th></th>
<th>Low SES</th>
<th>Race (Black)</th>
<th>Maternal Age</th>
<th>Marital Status (not married)</th>
<th>Transferred Instead of DC Home</th>
<th>Length of Stay</th>
<th>Birth Weight</th>
<th>EGA</th>
<th>No. of Sibs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Intervention Group</td>
<td>.775</td>
<td>.42</td>
<td>25.46</td>
<td>.56</td>
<td>.432</td>
<td>50</td>
<td>1074</td>
<td>28.57</td>
<td>1.01</td>
</tr>
<tr>
<td>Post-Intervention Group</td>
<td>.70</td>
<td>.49</td>
<td>25.62</td>
<td>.57</td>
<td>.327</td>
<td>54</td>
<td>1114</td>
<td>28.7</td>
<td>.86</td>
</tr>
<tr>
<td>( p ) Value to Investigate Selection Differences</td>
<td>.339</td>
<td>.256</td>
<td>.899</td>
<td>.860</td>
<td>.225</td>
<td>.534</td>
<td>.368</td>
<td>.762</td>
<td>.297</td>
</tr>
</tbody>
</table>

There was a large percentage of participants of low socioeconomic status (77.5% in pre-intervention group and 70% in the post-intervention group), Black race (42% in the pre-intervention group and 48% in the post-intervention group), and unmarried mothers (56% in the pre-intervention group and 57% in the post-intervention group). Average maternal age in the pre-intervention group was 25.46 and in the post-intervention group was 25.62 years. The average birth weight in the pre-intervention group was 1074 grams, and the average birth weight in the post-intervention group was 1114 grams. The average gestational age (abbreviated EGA) at birth was 28.57 weeks gestation in the pre-intervention group and 28.7 weeks in the post-intervention group. The average number of siblings (abbreviated No. of Sibs) in the pre-intervention group was 1.01 and in the post-intervention group was .86. Eighty four percent of the pre-intervention group consisted of single births, and 83.3% of the post-intervention group consisted of single births. In the pre-intervention group there were 43.2% of participants who were transferred to another hospital instead of discharge home, and in the post-intervention group there were 32.7% who were transferred to another hospital. Average length of stay in the pre-intervention group was 50 days and in the post-intervention group was 54 days.
Investigation for Selection Differences

Due to the matching through cohort controls research design, it was important to first determine if there were selection differences in the two groups being compared. Socioeconomic status was categorized into Women, Infants and Children (WIC) or Medicaid eligibility or not WIC/Medicaid eligible. Difference in this variable between the two groups was investigated by use of a z test for 2 proportions. Hypothesis testing of two proportions with a z test was used to test for group differences in maternal race, which was dichotomized as Black or not Black. Group dissimilarity based on maternal age was investigated through an independent samples t test, while differences in marital status (married, not married) and sex of the infant were investigated by use of a z test for two proportions. Gestational age at birth, birth weight and number of siblings was investigated by use of an independent samples t test. Discharge status was investigated with a z test of 2 proportions and length of stay with an independent samples t test. By testing each of the demographic variables at an alpha of .05, none of the demographic variables were significantly different between the two groups (see table 3-1). Subsequently, having no selection differences supports the ability to use the matching through cohort controls design.

Results Per Research Question

The primary aim of this study was to implement a breastfeeding intervention that would improve breastfeeding practices in the NICU. The results of this study are provided per research question.

- Is there a significant difference in breast milk feeding initiation in very low birth weight (VLBW) infants admitted to the NICU before and after implementation of the intervention plan?
Table 3-2 summarizes breast milk feeding initiation results. The breast milk feeding initiation rate in the pre-intervention group was 74.1%. The breast milk feeding initiation rate in the post-intervention group was 85.2%. This represents an increase of 11.1%. However, through a Pearson’s Chi Square Test of 2 proportions, the p value is .124, indicating no significant difference between groups when tested at an alpha of .05. The odds ratio of breast milk feeding initiation is 2.013 with a confidence interval of .818 to 4.952.

Table 3-2. Breast milk feeding initiation rates

<table>
<thead>
<tr>
<th></th>
<th>Was Breast Milk Ever Provided?</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pre-Intervention</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>21</td>
<td>60</td>
<td>81</td>
</tr>
<tr>
<td>% within subject</td>
<td>25.9%</td>
<td>74.1%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Post-Intervention</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>8</td>
<td>46</td>
<td>54</td>
</tr>
<tr>
<td>% within subject</td>
<td>14.8%</td>
<td>85.2%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>29</td>
<td>106</td>
<td>135</td>
</tr>
<tr>
<td>% within subject</td>
<td>21.5%</td>
<td>78.5%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Pearson’s Chi-Square Significance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds Ratio Confidence Interval</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Is there a significant difference in the rate of breastfeeding in the hospital among women with VLBW infants hospitalized in the NICU before and after the implementation of the intervention plan?

For the continuous variable of number of times breastfed per day after 30 weeks estimated gestational age (EGA), see figure 3-1. The graph is clearly skewed toward 0. Due to the violation of normality, a Mann Whitney nonparametric test was used to test significance of this variable. Interpretation of this graph and variable is difficult as the
rate of breastfeeding in the NICU is significantly low at .059 in the pre-intervention group, which is once every 17 days, and .139 in the post-intervention group, which is once every 7 days (see Table 3-3). This variable proved to be significantly different between the two groups with a $p$ value of .011.

Figure 3-1. Number of times breastfed per day after 30 weeks gestation
Table 3-3. Comparison of rates of breastfeeding after 30 weeks gestation

<table>
<thead>
<tr>
<th>subject</th>
<th>Number of Times Breastfed Per Day After 30 EGA</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Intervention Group</td>
<td>Mean</td>
<td>.0593937</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.18818812</td>
</tr>
<tr>
<td>Post-Intervention Group</td>
<td>Mean</td>
<td>.1389242</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.24433376</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>.0912059</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.21513898</td>
</tr>
<tr>
<td>Mann Whitney Significance</td>
<td></td>
<td>.011</td>
</tr>
</tbody>
</table>

To enable easier interpretation of this variable, it was dichotomized into whether a mother ever participated in breastfeeding while in the hospital. In the pre-intervention group, there were 25.9% of mothers who ever breastfed their infant in the hospital. In the post-intervention group, there were 44.4% of mothers who ever breastfed their infants in the hospital (see Table 3-4). This represented an increase of 18.5%, which achieved a $p$ value of .025 through a chi-square test of 2 proportions. Therefore, there were significant differences in proportion of women who ever breastfed in the two groups, using an alpha of .025. The odds ratio of ever breastfed in the hospital was 2.286 with a confidence interval of 1.1 to 4.750.
Table 3-4. Rates of ever breastfed in the neonatal intensive care unit

<table>
<thead>
<tr>
<th>Group</th>
<th>Frequency</th>
<th>Was the Infant Ever Breastfed While in the Hospital?</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Pre-Intervention</td>
<td>Count</td>
<td>60</td>
<td>21</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>% within subject</td>
<td>74.1%</td>
<td>25.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Post-Intervention</td>
<td>Count</td>
<td>30</td>
<td>24</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>% within subject</td>
<td>55.6%</td>
<td>44.4%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>90</td>
<td>45</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>% within subject</td>
<td>66.7%</td>
<td>33.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Pearson’s Chi Square Significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds Ratio Confidence Interval</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Is there a significant difference in breast milk feedings at discharge in VLBW infants admitted to the NICU before and after the implementation of the intervention plan?

There were 35.8% of infants who were provided with breast milk at the time of discharge in the pre-intervention group. There were 40.7% of infants in the post-intervention group who were provided with breast milk at discharge. This 4.9% increase resulted in a p value of .562 through a chi-square test of 2 proportions, indicating no statistically significant difference among groups. The odds ratio was 1.233 with a confidence interval of .607 to 2.502.
**Table 3-5. Rates of breast milk feedings at discharge**

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Intervention</th>
<th>Count</th>
<th>% within subject</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td>52</td>
<td>29</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within subject</td>
<td>64.2%</td>
<td>35.8%</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>Post-Intervention</td>
<td></td>
<td>32</td>
<td>22</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within subject</td>
<td>59.3%</td>
<td>40.7%</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>84</td>
<td>51</td>
<td>135</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within subject</td>
<td>62.2%</td>
<td>37.8%</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>Pearson Chi-Square</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.344</td>
</tr>
<tr>
<td>Significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.233</td>
</tr>
<tr>
<td>Odds Ratio Confidence Interval</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.607 to 2.502</td>
</tr>
</tbody>
</table>

- Is there a significant difference in the proportion of the hospital stay that breast milk is provided in VLBW infants admitted to the NICU before and after the implementation of the intervention plan?

Looking at figure 3-2, both groups have peaks at 0 and 1. However, there is a larger peak at 0 in the pre-intervention group. The variable, proportion of the hospital stay that breast milk was provided, did not achieve the assumption of normality as the graphs are u-shaped. Therefore, an ANOVA could not be run on this variable without violating assumptions. The nonparametric Mann-Whitney test was used to test for significant differences. This test indicated that the $p$ value was .108, therefore there were not significant differences between the two groups in proportion of the hospital stay that breast milk was provided.
To look at effect size in a variable that does not have a normal distribution, the proportion of the hospital stay was dichotomized into breast milk provided for most of the hospitalization or not. This variable represented whether breast milk feeds were supplied to the infant more than 50% of the length of stay not. There were 51% of the pre-intervention group who provided breast milk for most of the hospital stay, and there were 57% of the post-intervention group who provided breast milk for most of the hospital stay. This gives an odds ratio 1.219 with a confidence interval of .608 to 2.444 for breast milk feeds being provided for most of the hospital stay.

Figure 3-2. Proportion of the stay that breast milk was provided
CHAPTER 4
DISCUSSION

The Effect of the Interventions on Breastfeeding Practices in the Neonatal Intensive Care Unit

This research investigated if a three-part intervention plan designed to promote increased breastfeeding in premature infants would have an effect on breastfeeding practices in the neonatal intensive care unit (NICU). The three-part intervention consisted of opportunities for education of health care professionals over a 6 week educational initiative, an educational booklet for new mothers in the NICU, and modifications to the individualized care plan (ICP) with a pathway of care for breastfeeding. This intervention did have an effect on breastfeeding practices in the NICU, but it did not result in changes across all breastfeeding variables as hypothesized.

Evidence of improved breastfeeding practices was that rates of breastfeeding (mothers putting their infants directly at the breast) in the NICU improved following intervention. The number of times infants were breastfed per day after 30 weeks gestation was significantly greater in the post-intervention group than in the pre-intervention group. Mothers in the pre-intervention group breastfed their infants after 30 weeks gestation .059 times per day, and in the post intervention group they breastfed .139 times per day. This works out to an average of once every 17 days in the pre-intervention group and once every 7 days in the post intervention group. Although a statistically significant increase was observed following the intervention, the resultant rate of breastfeeding in the NICU remained low. After dichotomizing this variable, it was noted that there were
25.9% of mothers who ever breastfed their infant in the hospital in the pre-intervention group. In contrast, there were 44.4% of mothers who ever breast fed their infants in the post intervention group. This represented a significant increase of 18.5%. This provides some support that the program had a positive effect with increased participation in breastfeeding among mothers in the NICU. However, the overall rate of breastfeeding participation remains low in the NICU.

The variable of ever breastfed while in the hospital is an important one, as it requires active participation by the mother and infant. Diminished milk supply is cited as one of the most significant barriers to breastfeeding in the NICU population. Maternal stress has been linked to inhibition of oxytocin, which is responsible for the let down response during pumping and breastfeeding (Lang, 1996). However, physiologically, oxytocin is facilitated with increased mother-infant contact and environments that foster breastfeeding ("How breast-feeding postpones ovulation," 1985). Mothers with infants in the NICU typically experience high levels of stress and anxiety and many are overwhelmed by the NICU environment (Nyqvist et al., 1994). Many also comment on the loss of control of their infant to others during stays in the NICU (Lupton & Fenwick, 2001). Close contact, as in skin to skin, as well as breastfeeding, are important in maintaining bonding in a difficult environment, promoting the milk supply and providing some control over care for mothers (Kirsten, Bergman, & Hann, 2001). This direct interaction of the mother and infant can be assumed to be critical to the other breastfeeding outcomes.

Although positive trends in favor of the post-intervention group were observed across all variables, the intervention did not have a strong enough impact to result in
significant changes in breast milk feeding initiation rates, breast milk feeding at discharge rates and proportion of the hospital stay that breast milk was provided. This could be due to lack of a strong enough impact of the intervention with a need for a more extensive list of interventions or adjustment of the interventions proposed in this study, need for consistent compliance with the research interventions to promote change, or a different time frame for the study to detect changes.

The breast milk feeding initiation rate (was breast milk ever provided) in the pre-intervention and post-intervention groups appears to be fairly comparable to other research findings, which have documented rates of breast milk feeding initiation in the NICU at 64% (Byrne & Hull, 1996), 72.9% (Meier et al., 2004), and 83% (Yip et al., 1996). Although breast milk feeding initiation failed to reach statistical significance, there was an increase in breast milk feeding initiation of 11.1%, which was a positive change in the right direction as more infants received some breast milk following the intervention. Scientists are beginning to refer to breast milk as medicine and have initiated discussing breast milk in terms of a dose (Meier et al., 2004). Thus following the intervention, 11.1% more infants in the post-intervention group received breast milk at the most critical stage of their recovery. However, this variable did not achieve statistical significance, which could indicate that the impact of the interventions was not strong enough or that there was not enough compliance with the interventions to promote change. It is important to note that breast milk feeding initiation reflected whether breast milk was ever provided and not if breastfeeding ever occurred or if breast milk continued to be supplied after the 2nd day of life or at discharge.
Although the rate of breast milk feedings at discharge (was breast milk provided to the infant at discharge) increased slightly by 4.9%, this difference failed to reach statistical significance. Succeeding with breast milk feedings until discharge in the NICU population is a significant challenge for mothers with infants in the NICU. Discharge for many of these infants did not occur until they were 1 to 4 months old. This supports other research findings that state that some of the strongest predictors of not breastfeeding by discharge is being low birth weight, having decreased gestational age and being admitted into the NICU (Hwang et al., 2006; Li et al., 2005; Powers et al., 2003; Scott et al., 2006). The findings of this study in both the pre-intervention (35.8%) and post-intervention (40.7%) groups are comparable to other research findings, which document breast milk feedings at discharge to be 38% (Yip et al., 1996). The low rate of breast milk feeding in the NICU at discharge gives some insight into the significant challenges that women encounter with succeeding with breast milk feedings through a NICU hospitalization. However, to enable mothers with this process, it is critical that strategies to promote long term success are implemented. Although lack of full implementation and compliance with intervention strategies may have factored into this research study, these results suggest that this 3-pronged intervention was not sufficient to enable mothers to overcome the barriers to maintaining breastfeeding until the time of hospital discharge in this complex and challenging environment.

There was no difference between the groups in the proportion of the hospital stay that breast milk was provided. These results again highlight the importance of determining strategies for long term success to enable mothers to succeed with the
breastfeeding process for a larger proportion of the hospitalization. Such strategies could enable breast milk feedings until discharge and beyond.

This study complements conclusions from other studies that attention to and education about lactation affects health care professional knowledge and support of the breastfeeding process (Siddell et al., 2003). Many studies cite lack of health care professional education as a significant barrier to the breastfeeding process in the NICU (Register et al., 2000). Although improvement in breastfeeding rates in the NICU was observed in the post education group, there is no way to determine which part of the intervention plan may have had an effect on this variable. Other studies have concluded that health care professionals play a significant role in breastfeeding practices in the NICU (Swanson & Power, 2005) as does increased knowledge about breastfeeding among mothers in the NICU (Bernaix, 2000). However, because all the interventions were implemented together as a 3-pronged approach, it is unclear if the educational materials for mothers, the educational initiative, or the modifications to the ICP/breastfeeding pathway resulted in the effect on breastfeeding in the NICU.

According to the transtheoretical model of behavior change, change is a process and sometimes requires multiple approaches that are stage matched in addition to the passage of time. The real impact of the education perhaps could not be fully observed in assessing the indirect impact on breastfeeding practices among mothers and infants. By assessing the indirect impact of the education intervention on breastfeeding strategies without measuring the knowledge and behavior change of the health care professionals, it cannot be determined if there was a change in the health care professionals and what the magnitude of such a change was. This calls into question whether the educational
initiative did what it was intended, which was to change health care professional behavior. With knowledge of a change in health care professional behavior, the true impact of education and intervention strategies on breastfeeding outcomes in the NICU could be assessed. In addition, there were 2 behavior changes that could have been assessed, the health care professional as well as the mother. Further measuring the mothers’ behavior change, in the presence of education from the health care professional, would have provided useful information on whether the intervention was strong enough to elicit positive changes in the mothers.

Although positive changes are evident, the reported compliance with strategies and follow through of education key points was called into question by the nursing administration. Other studies have determined that education about breastfeeding has had an effect on breastfeeding knowledge and supportive behaviors (Ekstrom, Widstrom et al., 2005). This research study did not measure the behaviors of health care professionals following education. Therefore, it could be that the 3 part intervention plan was not strong enough to elicit changes in health care professional behavior, that not enough time passed post intervention to enable successful change or that the health care professional change elicited following the intervention was not enough to result in positive outcomes across all proposed breastfeeding variables. Subsequently, this study provides only partial support for positive changes in breastfeeding practices in the NICU following the 3 part intervention.

**Limitations**

This study is not without limitations. Limitations included inadequate implementation of all the intervention strategies by the health care professionals, lack of methods to determine behavior change and implementation by health care professionals,
lack of ability to give ample time for changes to be implemented without introducing other confounds, lack of participation by key decision makers in the NICU, the inability to control for other changes in the NICU environment, lack of a more comprehensive breastfeeding intervention plan, and lack of a randomized sample.

An important limitation of this study was the questionable full implementation of the strategies learned in the educational initiative as well as inconsistent use of the modified ICP and inconsistent distribution of “A Mother’s Gift”. Although there was a high health care professional participation rate in the education initiative of 63%, health care professional behavior change and attitudes were not measured. Therefore, there is no way to know the direct effect of the education and placement of the modified ICP in the medical chart on health care behavior and attitudes. It can be assumed that although there was good participation in the educational initiative by bedside nurses and the breastfeeding pathway on the ICP was added to the medical record, there was a lack of movement to action among many health care professionals based on the observations by nursing administration as well as by the first feeding at the breast variable remaining low in the post-intervention group.

Despite education about promoting breastfeeding in the NICU and how to introduce such practices, there remained a large percentage of women (56%) who never breastfed while in the hospital. This demonstrates that although the education may have occurred, change was not fully embraced and implemented. Health care professionals care for infants, including caring for nutritional feeds, in the NICU 24 hours a day, and parents are visitors to the NICU when they come to see their infant. Breastfeeding is typically something that health care professionals would enable, and thus its low rate
could be attributed to low health care professional support of the breastfeeding process. This study investigated breastfeeding outcomes in the natural NICU environment in which health care professionals may have had other priorities, may have had negative beliefs about breastfeeding in the NICU, may have had control issues that interfered with promoting a feeding method that they eventually cannot participate in, or may have been suffering from burn out. However, without the intermediate measure of health care behavior, it is difficult to determine if the intervention could be effective if health care professionals demonstrated an appropriate behavior change and were called to action.

According to the trantheoretial model of behavior change (TTM), change is a process with people moving through different stages of readiness to change (Prochaska et al., 2001). The intervention plan was designed to provide interventions that are appropriate for individuals in each stage of readiness to change. However, the educational initiative and interventions were introduced with data collection occurring in the post intervention group 6 short weeks later. This may not have been a long enough period of time to enable individuals to respond to the intervention and move them to action. According to the TTM, those in the pre-action stages are the precontemplators (no intention of making a change), the contemplators (intention of making a change in the next 6 months) and those in the preparation stage (intend on making a change in the next 30 days). Theoretically a six week period may not have been enough to enable movement through the stages of change to promote action toward increasing breastfeeding support and implementing strategies learned in the educational initiative. In contrast, other confounds were being introduced in the NICU in the months following the conclusion of this study, as more interventions were set to be implemented.
Therefore, this study could not account for the possible inadequate time frame due to the potential introduction of confounds that could bias the results.

Another limitation was the weak participation in the education modules by physicians and nurse practitioners, who are key decision makers in the NICU. Prior to the educational initiative dates, they participated in a short, general inservice about breastfeeding to facilitate discussion and direction. Due to this recent meeting, it was difficult to get them to participate in the research educational initiative. Therefore, participation was low with only 20% of neonatologists and 9% of nurse practitioners attending an inservice or completing the self study educational module. Although the researcher did meet with the physician medical director of the unit to discuss key points of the educational initiative, the initiative may have been much more successful if the neonatologists and nurse practitioners had higher levels of participation. Nursing staff and parents look to physicians and neonatal nurse practitioners for direction, and their lack of participation was a significant limitation to this study.

The NICU is a constantly changing environment that can not be fully controlled in a study like this, where all infants during a specific time frame are being enrolled. This study does not account for other changes that may have occurred, such as staff changeover, other education that health care professionals may be receiving and implementing, and changes made to the physical NICU environment. Cosmetic changes were made to the NICU environment during the course of this study, and it was impossible to determine if this may have had an effect on the results.

The lack of optimal resources that may facilitate breastfeeding may also pose a limitation to this study. During the early stages of planning this research project, funds
were applied for to provide a breast pump loaner closet that would provide a needed resource for long term maintenance of the milk supply (Meier et al., 2004). These funds were not achieved, making it impossible to provide this resource to enable long term success with maintaining the milk supply, and subsequently with addressing the idea of providing breast milk all the way until the infant was discharged from the NICU. Providing breast milk or breastfeeding at the time of discharge would be the goal, as this would indicate that a mother succeeded with providing milk during the hospitalization and would enable breastfeeding at discharge home. Without the funding, women were left to find their own resources to access a hospital grade pump for milk expression. Some may have accessed one for use at home while others may have used store bought pumps or self expressed.

This study is a cohort study. Due to lack of randomization, there is the possibility that there are unseen differences in the two groups that lead to differences or similarities in breastfeeding practices that cannot be attributed to the intervention. Results from this study can only give conclusions about the population of infants being studied at Shands Hospital. In addition, the small sample size limited the ability to achieve adequate power, which can affect being able to detect significant differences, if they exist. Based on the utilized sample size, 38.6% power was achieved on the primary variable of breast milk feeding initiation. This indicates that the probability of finding a difference in the two groups was only 38.6%. The already high breast milk feeding initiation rate in the pre-intervention group, 74.1%, gave less room for improvement in this variable. Although comparable with other rates reported in the literature, the rate in this unit was expected to be lower due to lack of lactation services in the unit and the large population
of Black mothers, mothers with low socioeconomic status and single mothers, which are all predictive of decreased breastfeeding behaviors (Powers et al., 2003). The nature of the population may have been a limitation, in that perhaps the effect of the intervention would be different given a different demographic presence in the NICU. Given the effect of the current intervention, a larger sample size would be needed to determine if there are significant differences in the pre-intervention and post-intervention groups. Such sample size was not feasible during the study period given the number of admissions and discharges. Prolonging enrollment was not feasible given the risk of introducing potential bias. To

**Recommendations for Further Research**

Women with infants in the NICU face unique challenges to the breastfeeding process. These barriers result in decreased breastfeeding initiation rates and breast milk feedings at discharge from the hospital. However, these fragile infants are at an increased need for the benefits of breast milk. Therefore, further studies looking at trends in breastfeeding and looking at interventions that can assist mothers in overcoming barriers is necessary.

Future research could investigate the efficacy of educational interventions that measure the intermediate effects of the intervention on health care professional behavior as well as the effect on breastfeeding outcomes. With similar findings as this study, this would make it easier to interpret if the educational interventions did not cause health care professional behavior change and thus did not affect breastfeeding outcome or if the educational interventions did affect health care professional behavior but that the resultant effect of this was not strong enough to result in positive breastfeeding outcomes.
Future studies addressing an educational initiative for health care professionals with more time to enable change would be appropriate to run in this population. If change takes time to occur, a longer period between the intervention and the start of data collection in the post intervention group would help identify change that occurred over a longer period of time following the interventions. However, such a study would require close control of the environment to prevent other confounds from being introduced as time from the education initiative elapses.

Although an intervention with many parts that addresses milk expression and breastfeeding over the course of hospitalization may be optimal in promoting breastfeeding practices in the NICU, a look at intervention specific studies could help to declare which interventions are successful and which are not. Such a study, although it may require a much larger sample size and perhaps random assignment to groups and a multi-center trial, could assist with understanding which, if any, and in what combination, treatment(s) have an effect on breastfeeding practices in the NICU.

Further research could also investigate the specific results, amount of milk expression and success with breastfeeding among women who had a nurse who was in an action oriented stage of behavior change regarding support for lactation compared to those receiving traditional NICU care. The effects of support and education for the mother could further be investigated by including success and failure with breastfeeding among mothers who demonstrated compliance with strategies in “A Mother’s Gift” compared to those who were not fully compliant.

With the paucity of breastfeeding (putting the infant to breast) in the NICU, it is of great interest to determine the predictive effect of breastfeeding on breast milk feedings
at discharge, milk production, amount of breast milk feedings in the hospital, as well as
the effect on maternal and child health. Likewise, it would be of great interest to
determine if there are any negative effects of not enabling breastfeeding on the ability to
maintain the milk supply, success of breastfeeding at discharge and beyond and the
ability to transition from breast milk feeds to direct breastfeeding.

Conclusions

This study investigated change in breastfeeding practices following implementation
of an intervention plan with 3 parts; an educational booklet for new mothers, an
educational opportunity for health care professionals who serve mother-infant dyads in
the NICU, and changes to the individualized care plan that necessitate breastfeeding
practice documentation by nurses. There were general positive trends across all
variables, which make this type of intervention have some promise for affecting positive
changes in breastfeeding practices in the NICU, given the limitations of this study and the
difficulties that can be expected in the complex NICU environment. There were
statistically significant differences between groups in the rate of breastfeeding, with
infants in the post-intervention group being more than twice as likely to be breastfed in
the hospital.

While health care professionals may play a significant role in the breastfeeding
process, perhaps an educational plan and breastfeeding pathway as well as
complementary educational materials for mothers is not enough to promote full
participation and optimal breastfeeding practices in the NICU. This study demonstrated
limited, but encouraging, support for an intervention plan focused on education to
facilitate change in breastfeeding within the NICU, but perhaps a multifaceted
intervention plan, including hospital grade breast pump allocation may optimize positive
changes in breastfeeding practices. An important limitation of this study was lack of full implementation of the intervention strategies. Future studies can be designed to better measure compliance with educational interventions as well as the individual effect of each intervention and the additive effect of multiple interventions implemented together. Randomized multi-institutional studies will enable larger intervention trials as well as generalization of findings.
APPENDIX A
OUTLINE OF THE EDUCATION MODULE

Breastfeeding in the Neonatal Intensive Care Unit
An Educational Module for Health Care Professionals

Introduction

Benefits of Breastfeeding for the Full Term Infant
  Health Benefits
  Developmental Benefits
  Financial Benefits

Benefits for Preterm or High Risk Infants

Benefits for the Mother

Barriers to Breastfeeding
  Full-term infants
  High-risk infants
  Contraindications

Breast Milk
  Composition
  Transition to Mature Milk

The Breast and Lactogenesis
  Anatomy
  Neuroendocrine control
  Sucking pattern

General Interventions for Supporting Breastfeeding

Appropriate Timing of Interventions
  Interventions in the NICU

Interventions Prior to Active Breastfeeding
  Breast pumps
  Maintaining a milk supply
  Kangaroo Care
  Non-nutritive suckling
Early initiation of direct breastfeeding

Monitoring Physiologic Responses
Transition to Direct Breastfeeding

Interventions for Supporting Breastfeeding
Privacy
Positioning
Timing
Special Techniques

Determining Adequacy of Intake

Conclusion

Post-test

References

For further information, contact the authors:
Roberta Gittens Pineda: jopineda@pol.net
Cammy Pane: cam92460@yahoo.com
APPENDIX B
OUTLINE OF ITEMS ADDED TO THE INDIVIDUALIZED CARE PLAN

Breastfeeding Guidelines:

Within 6 hours of delivery: Mom is given “A Mother’s Gift”

Within 24 hours: Ensure proper pumping (with hospital grade pump) and storage

3 to 5 days of life: Assess Mom’s milk production. Address problems

10 days of life: Mom’s milk supply should be at least 350 ml per 24 hours

With each parent contact: Offer support and discuss any problems

Kangaroo care is encouraged as soon as possible

First oral feeding is at breast

Mom is encouraged to breastfeed at each visit with supplementation only when medically indicated

At discharge: Encourage transition to full breastfeeding while monitoring weight gain
A Mother’s Gift
Breastfeeding and Pumping for Your Baby in the NICU

Breast milk is the best food for your baby’s start in life
Each mother’s milk is prefect for her baby
Babies who drink breast milk are healthier and smarter
This makes breast milk even more important for premature babies
Breastfeeding is healthy for the mother too!

Providing breast milk for your baby is something very special you can do to help your child
It is important to begin expressing your milk as soon after delivery as possible, and to keep pumping
Pumping may seem complicated at first, but it is worth it for your baby
During pumping, relax and enjoy gentle thoughts about your baby
At first, you may not get any milk, or only a few drops
Here is how to store your milk
Every mother wants to know-“Am I making enough milk”
In order to maintain a good milk supply…

Most mothers really want to hold their babies
Kangaroo care is good for your baby
Kangaroo care is good for parents too

Privacy is more important to some than others…

Suckling at the breast is the best way to nourish your baby… and it takes practice
Positioning during breastfeeding will become easier with practice…
Is my baby really, really, really getting enough milk

Please take extra care of yourself too!
If you are taking medications
Making milk for twins or more…

Please ask if you have questions or need help

How to obtain a pump for home use…

Chart for tracking milk production
On-line resources

For more information, contact:
Roberta Gittens Pineda: jopineda@pol.net
LIST OF REFERENCES


What is best birth control to use after having a baby? (1989). *Contracept Technol Update, 10*(10), 1S-2S.


BIOGRAPHICAL SKETCH

Dr. Roberta Gittens Pineda received her doctor of philosophy degree at the University of Florida. She received her Bachelor of Science in occupational therapy at the Florida Agricultural and Mechanical University in 1992 and achieved her Master of Health Science degree at the University of Florida in 1994. She has worked as an occupational therapist, primarily in the inpatient pediatric setting, and has been a lecturer at University of Florida as well as Washington University.

Dr. Pineda’s primary clinical setting is the neonatal intensive care unit, where she most recently has specialized in treatment of feeding and swallowing problems in these complex, medically fragile infants. In addition, she suffered premature labor with her 3 pregnancies and learned, first hand, the difficulties associated with being a mother of an infant hospitalized in the neonatal intensive care unit.

Dr. Pineda decided on her dissertation topic following an invitation by the chief of neonatology at Shands Hospital to be part of a March of Dimes Advisory Committee. The University of Florida at Shands Hospital had decided to participate in a program sponsored by the March of Dimes aimed at making the unit more developmentally supportive and family centered. Through this project, she joined efforts with a pediatrician to design a plan aimed at making the neonatal intensive care unit (NICU) more breastfeeding friendly. As she had frequently assisted mothers with breastfeeding in the unit as part of occupational therapy intervention and had struggled with the issues of nursing in the NICU when her own son was born at 29 weeks gestation, she found
herself very passionate about fostering changes and quickly decided to focus her research around the changes that were set to be made. Dr. Pineda’s dissertation topic is entitled “Breastfeeding Practices in the Neonatal Intensive Care Unit before and after an Intervention Plan”. Dr. Pineda has thoroughly enjoyed the research process and looks forward to a career in research and teaching.