2016

Infant-Driven Feeding vs. Scheduled Feeding: The Effect on Hospital Length of Stay

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has been found to be complete and satisfactory in all respects,
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Abstract

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MS, Stony Brook University, 2003

BSN, University of Delaware, 2001

Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Developmental delays related to feeding dysfunction in premature infants can lead to lengthy hospitalizations and increased healthcare costs initially and throughout the first year of the child's life. The purpose of this project was to use readiness-to-feed assessments to evaluate the impact of an infant-driven feeding protocol on length of stay. The project compared the length of stay of 2 groups of infants: a demand fed according to a readiness-to-feed protocol (protocol group, $n = 14$) and a traditionally fed according to scheduled, volume-driven feedings (traditional group, $n = 15$). The logic model served as the change management framework and synactive theory of infant development provided the theoretical framework. According to Als' synactive theory, a shortened hospital stay for premature infants may reduce adverse effects related to neurosensory development, delayed bonding, and a distant parenting experience. A quantitative research design was used, and data were collected through a retrospective chart review of the 2 groups. Descriptive statistics and analysis of variance were completed. The findings indicated that the length of stay in the protocol group was less than the length of stay in the traditionally fed group and that the difference was statistically significant ($p = 0.03$). Social change benefits related to the project include improved family bonding, improved neurosensory development of infants, and a reduction in healthcare costs as a result of a shortened length of stay. The findings of this project demonstrated that by using the readiness-to-feed protocol, neonatal intensive care nurses can decrease lengths of stay and costs of hospitalization while reducing adverse effects of traditional care on infant development and bonding.

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Dedication

I would like to dedicate this to my friends and family whose never-ending support and encouragement have moved me deeply. To my daughter, Annie, my faith in you has no limits. Always follow your dreams. To my husband, Joseph, you are why I am here today. Your love, positive attitude, and words of encouragement are never-ending. Thank you for being with me through all of our challenges and triumphs.

Acknowledgments

I would like to thank Dr. Murielle Beene for her understanding and incredible support during some difficult times. Without her leadership, sensitivity, and sincerity this project would not have been completed.

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Section 1: Nature of the Project

Introduction

Each year there are approximately a half a million premature infants born in the United States. This means one out of every eight infants is born prematurely (Centers for Disease Control and Prevention, 2012). The Institute of Medicine (2007) has declared low birth weight and premature births a serious public health issue. According to the U.S. Department of Health and Human Services, Health Resources and Services Administration, and Maternal and Child Health Bureau (2014), the rate of premature births has increased over the last several years by approximately one percent in the low birth weight category and less than one percent in the very low birth weight category. The significance of these statistics is not the rate of increase, but the increase in survival of premature infants who previously would have died. The survival of these infants results in a cost of approximately $26 billion a year (Institute of Medicine, 2007).

Innovations in technology and advances in healthcare have increased the likelihood of survival of severely premature infants. The increased survival of these infants has led to increased healthcare-related costs including increased length of stay (LOS), increased use of technological advances, and the need for highly skilled practitioners. Cuevas et al. (2005) found that charges for initial hospitalizations decreased as gestational age increased. Initial charges for infants born at less than 28 weeks gestation were greater than $200,000, while those charges for infants greater than 29 weeks were between $50,000 and $100,000.

One method to help facilitate a decrease in hospital costs is delivering care that is developmentally appropriate. Developmental care is imperative to promote normal physiologic development, neuro-sensorial development, decreased LOS, and improved outcomes for these infants while congruently decreasing healthcare costs (Als, 1982; Als & McAnulty, 2011; Shaker, 2012).

Problem Statement

Approximately 10%-15% of all infants born in the United States need the skilled care of a Neonatal Intensive Care Unit (NICU) (March of Dimes, 2013). NICUs employ highly skilled practitioners to care for fragile premature infants. There are different levels of intensive care ranging from stable physiologic infants needing time to grow and mature, to the sickest of infants requiring highly skilled care delivered through complex technologies. The economic impact of premature birth is substantial. The cost of preterm births in the United States in 2005 was estimated to be greater than $26 billion (Boardman, 2008). Additionally, the costs of readmissions of premature infants throughout the first year of life are driving up healthcare costs. According to Cuevas et al. (2005), 60% of infants born at less than 28 weeks gestation were readmitted to the hospital during the first year of life. These infants were often readmitted because of chronic illnesses related to their prematurity.

Preterm infants are prone to complications and prolonged hospital stays because of immature physiologic systems and the impact of the environment on their continuing development (Als, Butler, Kosta, & McAnulty, 2005). Lengthy hospitalizations have negative consequences on newborns and families. A shortened hospital stay for the

premature newborn may decrease the likelihood of adverse effects for the infant and parents that often result from lengthy hospitalizations and delayed bonding (American Academy of Pediatrics, 2008). Healthcare professionals must find ways to safely decrease the hospital LOS for premature infants while maintaining or improving quality of care. Developmentally based infant-driven feeding protocols may shorten the time to full bottle feeding and allow for an earlier discharge of the premature infant (McCormick, Tosh, & McGuire, 2010).

Accomplishing the milestone of successful oral feeding is a complex process for the preterm infant. Feeding skills must be learned as the infant matures and develops. The timing of these skills is dependent on a maturational development of complex systems in infants born prematurely. Ideally, these systems develop in a regulated protective environment of the mother's uterus, but this is not the case for the premature infant (Als et al., 2005). Physiologic stability is rightfully the focus immediately after birth. Unfortunately at birth, the bright lights, noise, temperature, and environment are not well regulated for the developmental support required by the premature infant. Once admitted to the NICU, developmental care is a priority but often not accomplished through the admission process and stabilization of a critically ill infant. This lack of developmental support is due to the multiple invasive procedures required for admission and subsequent days in the NICU. Central line placement, lab tests, intubations, and x-rays all hinder the developmentally appropriate environment for the preterm infant.

The maturity of the neurological and motor systems is different for the preterm infant as opposed to the term infant. Once the preterm infant is physiologically stable,

reflexes remain immature. Care providers sometimes discount immaturity because of the visual stability of the infant (Fernandez & Valdebenito, 2007). Successful feeding is dependent on recognition of these immature reflexes, gestational age, medical history, the status of complications, behavioral state, and development of sensorimotor coordination and progression. Many premature infants find oral feeding challenging and stressful. The negativity associated with feeding may lead to long-term feeding dysfunction. Failure to thrive is a prevalent diagnosis for premature infants and is a direct result of undiagnosed feeding disorders and dysphagia in the NICU (Bingham, 2009).

Feeding dysfunction including oral aversion may be associated with poor development of oral motor skills caused by negative touch and sensation from procedures encountered in the NICU. These uncomfortable or painful interventions endured by the premature infant in the NICU are often centered near the infant's face. These procedures range from frequent intubations, suctioning, nasal continuous positive airway pressure (CPAP) devices, passing of orogastric tubes, and removal of tape around the mouth. This negative touch can lead to extensive oral sensory aversion and require particular attention during attempted feedings to decrease the long-term effects associated with painful or unpleasant interactions (Breton & Steinwender, 2008).

Oral aversion can also develop in these infants due to discomfort associated with feeding. Abdominal distension, poor motor control, weak muscle tone, and poorly coordinated suck-swallow-breathe can lead to episodes of apnea and physiologic stress. Furthermore, the dependence on tube feedings in the premature infant potentiates sensory deprivation, which may affect feeding success. Additionally, the prolongation of tube

feedings may lead to the development of dysphagia in the preterm infant. The majority of the feedings in the NICU are time and volume driven, leaving little room for the development of hunger and appetite that are significant nutritive learning experiences (Bingham, 2009).

Non-nutritive sucking (NNS) is a necessary precursor to oral feeding readiness, and serves as a method for assessing a premature infant for readiness-to-feed. NNS improves the transition of feeding from gavage to bottle and the digestion of food. Additionally, infants express fewer defensive behaviors and remain organized for longer periods of time prior to and after feedings (Pinelli & Symington, 2010).

Many feeding problems for premature infants are associated with the lack of a suck-swallow-breathe coordination. According to synactive theory (Als, 1982), the premature infant is continuously striving for self-regulation in its environment. The caregiver must pay attention to the cues and behaviors demonstrated by the infant and respond accordingly to promote successful interaction with the infant. Feedings that are scheduled and volume-driven ignore the interaction with the infant and base the time to feed on the clock. Scheduled feedings may alter the infant's self-regulating behavior leading to increased stress and interruption of weight gain, growth, and development, thereby delaying discharge (Shaker & Woida, 2007). An infant-driven feeding protocol can assist the premature infant in achieving optimal neurodevelopment outside of the mother's womb, and may lead to safer, more developmentally appropriate interactions (Breton & Steinwender, 2008).

Purpose Statement

The purpose of this project was to evaluate the impact of an infant-driven feeding protocol using readiness-to-feed assessments and LOS. Organization of behavior is important in the growth and development of the premature infant. For a preterm infant to transition to oral feeding, a rhythmic suck-swallow-breathe pattern must be established (Kirk, Alder, & King, 2007). Additionally, an assessment of the infant to determine the readiness-to-feed determines volume, route, time, and duration of feedings. Feeding based on neurobehavioral signs and infant readiness for feeding may stress the infant less, increase weight gain, and allow the infant to achieve full feedings earlier, thereby allowing earlier discharge from the hospital (Shaker & Woida, 2007). Furthermore, the progression of feedings based on infant cues may promote long-term success with feedings, and may decrease readmissions to the hospital within the first year of life (Ludwig & Waitzman, 2007). According to Breton and Steinwender (2008), a readiness-to-feed assessment should be completed when transitioning a preterm infant to oral feeding (Breton & Steinwender, 2008). Performing this assessment enables a care provider to consider the infant's developmental abilities and physiologic stability when making the decision to bottle-feed. Assessing the infant's neuro-developmental status prior to feeding is important. A readiness-to-feed assessment and evaluation of signs of stress during a feeding can improve the care of the premature infant while hospitalized, promote family infant bonding, and may decrease costs within the first year of life. Adopting an infant-driven feeding protocol gives nurses the opportunity to make a

difference in the outcomes of these premature infants and improve the financial stability of the organization.

Nature of the Doctoral Project

The American Academy of Pediatrics published guidelines for discharge of the high-risk infant in 1998 and updated them in 2008. One of the indicators established for safe discharge of infants was the ability to safely nipple all feedings (Smith, Hwang, Dukhovny, Young, & Pursley, 2013). Delays in this process have led to increased LOS and increased healthcare costs (Lessen, 2011). A standard definition of a successful feeding in the neonatal intensive care unit is threefold. It includes (a) the ability to retain a calculated minimum volume based on ml/kg/day; (b) a specified duration of time to accomplish the feeding; and (c) a specified amount of time between feedings (Drenckpohl, Dudas, Justice, McConnell, & Macwan, 2009). If the infant consumes the full volume of the feeding, the feeding is considered successful. The caregiver may have pumped the feeding into the mouth through rocking and twisting motions of the bottle and chin support. The outcome of a feeding such as this results in leakage of the feeding from the mouth with increased physiologic instability, but is still considered successful. However, there is evidence that this may not be the best way to transition premature infants from gavage to bottle-feeds. A comprehensive, organized, systematic method of transitioning the infant to oral feedings must be developmentally supportive and promote fewer long-term morbidities in the preterm infant than traditional feeding transitions (Breton & Steinwender, 2008). An explicit, systematic process to transition to oral

feedings is necessary to facilitate safe progress toward discharge and decrease untoward effects of poor feeding practices (Bingham, 2009).

Significance

The setting for this project was a suburban level III neonatal intensive care unit located in a university teaching medical center. In this NICU, feedings were traditionally scheduled and volume driven. Discharges were often delayed due to the inadequacy of oral feedings. There was little standardization of feeding methods, which led to confusion for the nursing staff and families of infants when differing practices were used.

When physicians changed service, methods and timing of feedings were frequently changed due to individual practitioner preferences. The frequent change of physicians contributed to inconsistencies in the care of the infants and the confusion and frustration of the families and nurses. Developmentally supportive care for feeding was nonexistent. Implementation of a feeding protocol or pathway was necessary to standardize practice using the best evidence available. The anticipated outcome of this study was decreased LOS. A decreased LOS can improve family bonding, promote family interaction, and support the growth and development of the infant in a developmentally safe environment in the home. The benefit for the healthcare institution is decreased healthcare costs (Lessen, 2011).

The speech therapists at this hospital reported that many of the premature infants discharged from the NICU were seen as outpatients and admitted to the pediatric floor for feeding dysfunction (research site speech therapist, personal communication, May 16, 2013). According to Crosson and Pickler (2005), infant-driven feeding protocols have the

potential to decrease the LOS, reduce hospital readmissions within the first year of life, and improve feeding outcomes for these infants.

Decreases in feeding dysfunction may lead to better outcomes for premature infants. Also, minimizing oral aversion through better self-regulation practices and achievement of developmental milestones may decrease healthcare costs and utilization of valuable resources within the first year of life (Cuevas et al., 2005). The transition to parenthood for first-time parents is challenging and wrought with many decisions and uncertainties. The transition to parenthood for the parents of a premature infant is even more complex. Facing the uncertainty of the survival of their infant along with the doubts of their ability to function as parents isolates them from other first-time parent groups (Watson, 2011).

Parents of premature infants often attribute good parenting skills to the successful feeding of their infant. There is great emphasis placed on parental responsibilities and status as good parents related to caregiving. Therefore, educating parents and allowing them to feed their infant based on readiness cues given by their infant places success or failure on the infant and not on the parent or caregiver. The cues used to evaluate readiness-to-feed are non-nutritive sucking (the willingness to suck on a pacifier), stage of alertness, tone, rooting, and physiologic stability (Ludwig & Waitzman, 2007). The competition between the parents, the parents and the nurse, or the nurses and doctors is eliminated because the onus of successful feeding is placed on the infant and their readiness-to-feed.

The feeding skills and educational information learned while the infant is in the NICU assists parents in assessing the infant's feedings at home and potentially avoids or minimizes feeding difficulties and the repeated hospitalizations associated with preterm infants (Watson, 2011). Following an infant-driven feeding protocol can have a positive impact on LOS and decrease readmission to the hospital within the first year of life, limiting interruption of the family unit (Cuevas et al., 2005).

Assumptions

I made the following assumptions in this study: (a) there would be enough subjects meeting the criteria to make the study meaningful; (b) the nursing staff would follow the protocol and not stray back to previous habits; (c) after the education, the parents would be able to follow the protocol; (d) the medical staff would support the change in practice.

Limitations

There are some identifiable limitations to this study. The sample size was small and may affect the application of the results to the general population of premature infants. Additionally I, as the principal investigator (PI), was the only chart reviewer and data collector. This may have biased the statistical data (Polit, 2010). Despite providing consistency and working to maintain objectivity, as the PI and the data collector, I may have unknowingly desired the data to show a particular outcome.

Summary

There are a variety of feeding practices of premature infants identified in the literature (McCormick et al., 2010). The clinical feeding practices in the study site's

NICU were inconsistent and lacked an evidence-based foundation. There were various practices, none of which were developmentally appropriate. The premature or sick newborn has limited ability to interact or accommodate the environment. Hyper-reactive responses and reduced tolerance to environmental inputs are more likely to occur if the infant's cues are not assessed (Vandenberg, 2007).

An evidence-based feeding protocol may improve the developmental outcomes of the premature infant population. Implementing a protocol can align the goals of the interdisciplinary team with that of the family and the administrative team by improving long-term outcomes and achieving earlier discharge.

Section 2: Background and Context

Concepts, Models and Theories

Though limited, researchers have identified some advantages of infant-driven feeding practices. However, there was not enough evidence available to determine the superiority of demand feeding over scheduled volume-driven feedings. Although some studies demonstrated earlier discharge and fewer days to maximum oral feeds, the evidence was not conclusive. Additionally, there were few studies comparing infant-driven demand feeding to scheduled volume-driven feeding. I completed a thorough review of the literature to identify knowledge gaps and assess the need for additional research.

Historically, most NICUs have not had protocols or guidelines for feeding practices. Crosson and Pickler (2005) reviewed a national survey of head nurses and staff nurses in level II or III nurseries on feeding practices in NICUs. They found less than 50% of the respondents worked in NICUs that had feeding policies for initiation of feedings; 75% surveyed used gestational age and weight for determination of feeding; and 85% used additional behavioral cues, though these were not specifically identified (Crosson & Pickler, 2005).

A review of the literature by McCormick et al. (2010) revealed eight studies over the last three decades that have evaluated demand feeding versus scheduled feedings (Kansas et al., 2004; McCain & Gartside, 2002; Pridham et al., 1999; Pridham et al., 2001; Puckett, Grover, Holt, & Sankaran, 2008). The methodology varied from quasi-randomized controlled trials to randomized controlled trials. They found limited evidence

that feeding on demand decreased the length of hospital stay in preterm infants. Additionally there were no significant findings related to weight gain and days to full feeds.

Crosson and Pickler (2005) completed a review of the literature on infant-driven feedings for premature infants. They revealed seven studies over the previous fifty years. The studies performed in the 1950s were weak due to methodology and sample size issues. The authors found the later studies in the 1980s and 1990s to have replication concerns. They detailed evidence of a trend toward advantages of infant-driven feeding such as demonstration of hunger cues, decreased LOS, and the same or greater weight gain as infants fed on a schedule-driven protocol.

A systematic review of the literature for studies comparing instruments to assess readiness-to-feed versus using no assessment instrument was completed by Crowe, Chang, and Wallace (2012). They found a limited number of instruments available. They included quasi-randomized and randomized trials assessing the benefits of using a tool for the assessment of readiness-to-feed, but they uncovered no studies meeting the inclusion criteria with supportive evidence for the use of a readiness-to-feed tool. There is thus a need for more research in this area.

McCain, Gartside, Greenberg, and Lott (2001) examined the effects of a semi-demand feeding protocol and its effect on days to oral feeding and weight gain. The sample (N=81) was randomly assigned to the control group (n=41) or the experimental group (n=40) for evaluation of a protocol for the transition from gavage to oral feedings. They found infants in the experimental group achieved oral feedings five days earlier

($p < .001$) than the control group. Weight gain was not different between the groups and both gained weight at a satisfactory rate. Because safe feeding is a criterion set forth by the American Academy of Pediatrics (2008) as one of the last milestones to be met before discharge, reaching oral feedings earlier has the potential for earlier discharge and decreased hospital costs.

In a study evaluating the implementation of an oral feeding protocol, Drenckpohl et al. (2009) completed a retrospective chart review of infants delivered less than or equal to 34 weeks gestation. The charts reviewed (N=200) included infants maintained on the old feeding protocol (n=87) and infants on the new protocol (n=78); charts having incomplete data (n=35) were excluded from the study. Infants treated according to the new protocol started oral feedings one week earlier ($p = .05$) and at an earlier gestational age than those on the old protocol ($p=0.38$). The new protocol group had oral stimulation ordered for 15.4% of the infants, whereas for the old protocol group, oral stimulation was only ordered in 2.3% of the infants ($p = .003$). This study showed that gestational age is not the only consideration related to the initiation of oral feedings. There was no difference between groups related to the LOS.

My review of studies completed over the past five decades revealed evaluations of several different aspects related to infant feeding. However, I found that the literature is limited with respect to the impact of infant-driven feedings on LOS. For this reason, further studies are needed to determine the impact infant-driven feeding protocols have on hospital LOS.

Conceptual Model

I chose the logic model as the conceptual model for mapping the process of this project (Figure 1). This model offers a pictorial representation of the project displayed as inputs, processes, outputs, outcomes, and impact. It is an outcome-oriented visual representation of the steps in planning a project that is clear, individualized, and easy to change as the planning progresses. Further, it offers a pictorial representation of a theory of change which allows precise identification of goals and projected outcomes (Centers for Disease Control, Division for Heart Disease and Stroke Prevention, 2008). Benefits of this model include time estimation, easy explanation to stakeholders, and the planning of the project implementation. I also used it for assessment of compliance with the protocol and consistency among the caregivers. I observed the nurses implementing the guidelines and audited the charts for appropriate documentation throughout the process. I kept detailed notes of the findings in a locked cabinet. Use of this model allowed me to frequently evaluate the project and its relationships to ongoing change and progress. This was important to the project implementation, and to achieving the desired outcomes and sustainable change (Kettner, Moroney, & Martin, 2008).

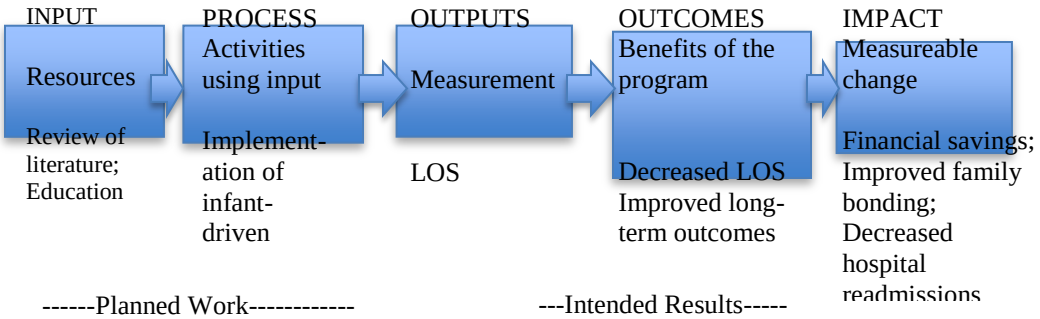

Figure 1. The logic model (Kettner et al., 2008; W. K. Kellogg Foundation, 2004).

Theoretical Framework

For my study, synactive theory (Als, 1982) provided the foundation for developmental care, identified stressors for compromised infants, and documented reactions to stimuli in their environment. Developmental care focused on the provision of an environment for infants that promoted organized behavior and was supportive of the infants' growth and development. My aim was to limit morbidities and provide the best outcomes for the newborns and their families through developmental assessment and measurement of the effect on LOS (Coughlin, Gibbins, & Hoath, 2009). Caregivers at the research site were able to assist the infant in achieving organized behavior including self-regulation through individualized care based on infant cues (Jones, 2012). Readiness for oral feeding was assessed using these cues (Breton & Steinwender, 2008).

Evidence-Based Practice (EBP) Model

I used a systematic process to introduce evidence into practice and to evaluate the practice after implementation. There were many EBP models from which to choose. The organization where the NICU was located for this practice problem used the ACE star model of knowledge transformation (Figure 2) developed by Kathleen Stevens and the staff at the University of Texas Health Science Center (Terry, 2012). The ACE star model uses a circle of stages (a) knowledge discovery, (b) evidence summary, (c) translation into practice, (d) integration into practice, and (e) evaluation (Stevens, 2012). Using this model promoted the smooth integration of the evidence into practice and evaluation of any changes made to current practice. My ongoing use of this implementation model

allowed refinement of the practice changes with evaluation of the outcomes of those changes.

The knowledge discovery phase of the study included my extensive review of the literature. Additionally, I completed verbal polling of similar NICUs but failed to establish common practices. I generated the evidence summary using the results of the comprehensive review of the literature and previous studies that have been completed related to cue-based feeding. An evidence summary relates all findings of new evidence on specific topics, is an important step in the EBP process, and distinguishes EBP from research utilization (Stevens, 2012).

Translation of the evidence into practice provided me the foundation for the creation of clinical pathways, algorithms, and protocols to assist the staff with implementation of newly gained knowledge based on the evidence uncovered (Bliss-Holtz, 2009). According to the promoting action on research implementation in health services model (PARIHS), successful translation of evidence into the practice environment requires a combination of the three core elements: (a) the evidence, (b) the environment (context), and (c) the technique of delivery (facilitation) (White & Dudley-Brown, 2012). Careful analysis of these three elements prior to any change was important so that I could identify potential barriers to the implementation process. Creating evidence-based guidelines connected with the strength of the evidence gave credence and credibility to my project and was vital to garnering staff support of the practice change (Stevens, 2012).

After translating the evidence, I sought to integrate it into practice. I used Lewin's force field analysis theory of change to help with successful integration into practice. According to Lewin's force field analysis theory (as cited in White & Dudley-Brown, 2012, p. 50) change is a dynamic process with competing forces. There are three stages to this theory: (a) unfreezing, in which everyone is preparing for change; (b) moving, when the change has been accepted, and activities are initiated to change; and (c) refreezing when the change becomes a part of the norm. This theory guided the change I made in the feeding process as I sought to involve individuals in the process, build trust, and encourage them to accept change.

The final phase of the ACE star model is the evaluation of the changes. During this phase I reviewed newly implemented practices and evaluated outcomes. The outcome of interest to me was the impact of the infant-driven feeding protocol on the LOS. Based on the evaluation, modifications to the new practice protocols were needed based on the unique environment and population of the unit. The resulting outcome was the delivery of quality care to the premature infants which was based on current evidence (Stevens, 2012).

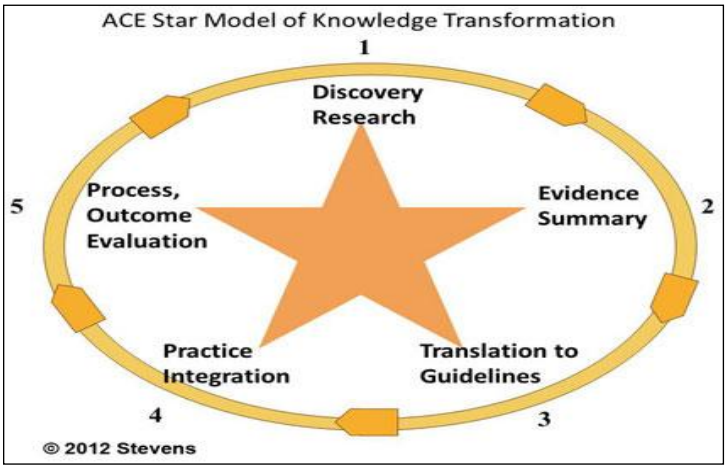

Figure 2. The ACE star model. From "*ACE star model of EBP: Knowledge transformation",* by K. R. Stevens, 2004, Academic Center for Evidence-based Practice. The University of Texas Health Science Center at San Antonio.

Definition of Terms

Developmental delays: Delays in meeting developmental milestones in infants and young children. These delays are within five categories of measurement. They are cognitive, motor, communication, social, emotional, and adaptive (Rosenberg, Ellison, Fast, Robinson, & Lazar, 2013).

Non-nutritive sucking (NNS): This term refers to sucking on a pacifier (Fernandez & Valdebenito, 2007).

Failure to thrive: This term refers to infants and children whose weight or rate of weight gain is less than children in the same age category (National Library of Medicine, 2011).

Continuous positive airway pressure (CPAP): This is a supportive respiratory treatment that assists to keep the distal alveoli in the lungs expanded (National Institute of Health, 2011).

Oral aversion: This term is used when infants and children refuse to eat or eat enough. Oral aversion is most often developed in premature infants but can be seen in children who have experienced negative oral stimuli early in life (Lau, 2007).

Premature infant: An infant born less than 37 weeks gestation (Mayo Clinic Staff, 2011).

Relevance to Nursing Practice

Previous studies over the last few decades have failed to link the feeding method of premature infants to any significant decrease in the LOS (McCormick, 2010). It is hypothesized that following a developmentally sound feeding guideline, as opposed to a traditional volume driven guideline, will result in success with not only short-term learning to feed skills but with successful long-term feeding development (Shaker, 2012). According to Als et al. (2005), neurodevelopmental pathways may be negatively altered in an infant experiencing stressful feedings. Stress occurs when an infant is coaxed or forced to complete an identified volume of feeding according to a schedule despite the lack of demonstration of readiness cues. Stressful feedings have the propensity to lead to not only short-term complications, but long-term feeding inadequacies such as dysphagia and oral aversion (Drenckpohl et al., 2009; Gelfer, McCarthy, & Spruill, 2015; Shaker, 2013). The premature infant is frequently diagnosed with failure to thrive. Failure to

thrive may be a prevalent diagnosis for premature infants as a direct result of undiagnosed feeding disorders and dysphagia in the NICU (Bingham, 2009).

Studies linked improved growth and earlier achievement of the full volume of maintenance feeds, but lacked evidence of a significantly positive or negative influence on the LOS (Crosson & Pickler, 2005; McCormick et al., 2010). There was an infant-driven feeding protocol focused quality improvement project in a large tertiary care center in Houston, Texas. This project showed a propensity toward a decreased LOS of 1.7 days. This study also demonstrated a decrease in occupational therapy consults when the infant-driven feeding protocol was followed (Gelfer et al., 2015). This is the only reported study showing a significant effect on LOS related to the feeding protocol. According to Crosson and Pickler (2005), infant-driven feeding protocols have the potential to decrease the LOS, reduce hospital readmissions within the first year of life, and improve feeding outcomes for these infants.

The nurses are the primary caregivers feeding the premature infants while hospitalized. The nurses are very experienced, though not much thought is given to the appropriate method of feeding an infant (Gelfer et al., 2015; Shaker, 2013). The goals are usually to feed the total volume prescribed as quickly as possible so they can move on to their next patient. This is understandable in a busy NICU. Frequently these infants will have episodes of de-compensation during feedings. These episodes may consist of tachypnea, spillage of formula from the mouth, color change, bradycardia, and aspiration (Shaker & Woida, 2007). Adopting an infant-driven feeding protocol with a

developmental assessment prior to feeding is imperative for the safety of the infant and improving the infant's long-term outcomes.

Local Background and Context

This study took place in a suburban teaching university medical center. The unit is a level III NICU housed in a children's hospital within a hospital, and part of a level III regional perinatal center. This intensive care unit has an average daily census of 21. Diagnoses range from extreme prematurity to any neonate at risk for health complications. There are approximately 60 registered nurse (RN) team members. There are no patient care assistants or assistive personnel. All care rendered to the infants is by the RNs. There are also nine neonatologists, one nurse practitioner, and two physician assistants.

I attended medical rounds in the NICU and found many reported discrepancies on the methods of feeding and the quality in the feeding. The feeding was reported by the nurses as nippled well or nippled poorly without much discussion as to what that meant. There were many inconsistencies and setbacks with feedings that seemed to delay discharges. This was not only frustrating to the physicians and nurses, but to the families as well. Additionally, the speech therapists reported that many of the premature infants discharged from this NICU were seen as outpatients and admitted to the pediatric floor for feeding dysfunction soon after discharge (research site speech therapist, personal communication, May 16, 2013).

I asked the nursing staff, "What does nippled poor or nippled well mean?" The most common answer for nippled well was that the infant finished the feeding. The most

common answer for nippled poor was that the infant didn't finish the feeding. There was no information about readiness-to-feed signs, alertness, suck-swallow-breathe coordination, or interaction mentioned throughout those conversations. This led to the realization that there was a problem that needed investigation.

Role of the DNP Student

I completed this project in the NICU where I am currently the Clinical Nurse Specialist (CNS). I have been employed in this institution for the last 31 years in various roles. I am currently responsible for all of the education, orientation, performance improvement, guideline development, and policies and procedures among other duties. I have an excellent working relationship with the leadership team. I have a lengthy professional relationship with many of the nurses.

I was the principal investigator for this project. The speech therapists assisted with the education of the nursing staff. The leadership team helped with reinforcement of the protocols through observation of behaviors and assessing compliance with the guidelines.

The motivation for this project came from years of watching premature infants struggle through physiologic instability to complete a feeding. There was no awareness that this could cause the infant harm. We did not have the knowledge or the evidence to support a change in our feeding routine.

New Jersey has a statewide collaborative with approximately 14 NICUs as members. One of my colleagues presented a poster on a feeding initiative in their NICU. It peaked my interest because there was not a developmentally feeding practice within

my NICU. There were differences in techniques and lack of meaningful documentation. The inconsistencies and lack of clarity were frustrating to families, nurses, and physicians. We needed evidence-based practices that were consistent, supported the families, and improved the developmental outcomes of the infants.

I was acutely aware of the potential for bias in this project. I had an enormous amount of time invested in this and wanted to make a difference with this protocol. I was the principal investigator, the educator, and the only data collector. Throughout the process, I had a strong self-awareness to resisting any type of unfair influence or prejudice that might affect the outcomes.

Summary

After the review of the evidence, planning of the project began. I used the logic model to map out the steps in the planning process. The theory underpinning this project was Als' synactive theory, which is the foundation for developmental care. The evidence based model chosen was the ace star model. This model supported translation of the evidence into practice allowing for continual evaluation of all the steps. The following section will discuss the details of the project.

Section 3: Collection and Analysis of Evidence

Introduction

Lengthy hospitalizations are thought to have negative consequences on newborns and families (American Academy of Pediatrics, 2008). One of the causes of delays in discharge for premature infants is a lack of developmentally appropriate, consistent feeding techniques (Shaker, 2013; Thoyre, Shaker, & Pridham, 2005). A developmentally-based feeding protocol may assist infants in developing the skills necessary to feed safely and have a stress free feeding experience. A positive feeding experience may lead to a decreased LOS and decreased morbidity through the first year of life. Additionally, a shortened hospital stay for the premature newborn may decrease adverse effects on family bonding for the infant and parents. In this section I will discuss topics related to my project's method, population, data collection, data analysis, and evaluation of the findings.

Practice Focused Question

As the clinical nurse specialist in a busy NICU, I had the opportunity to assist the staff with the care of their patients. In doing so, I would bottle feed many of the premature infants. While reviewing trends in the feeding, I noticed many inconsistencies in the outcomes documented by the nurses on the same infants. Some documented that the infant tolerated all feedings well, while others evaluated the feedings as poor. These definitions were extremely subjective and gave no guidelines for successful feedings.

In a meeting with the speech therapists to discuss the feeding method in the unit, specifically the differences in the assessments of the infants' feeding, they spoke of

additional issues. They noted the anecdotal increase in outpatient visits and readmissions to the hospital for feeding related issues. They also observed that many of their consults were for patients previously in this NICU.

I discussed these issues with the manager and medical director of the unit. Together, we designed a protocol to standardize the feeding process. I introduced an assessment of readiness-to-feed, an evaluation of the quality of the feeding, and the use of different caregiver technique scales (Appendix A; Ludwig & Waitzman, 2007). Using the method of supporting oral feeding in fragile infants (SOFFI), I developed a protocol (Appendix B) and provided education to the interdisciplinary team (Philbin & Ross, 2011). The SOFFI method of feeding premature infants utilizes physiological assessment to make decisions that assist the infant in learning how to feed, and to experience feeding with enjoyment and satisfaction (Shaker, 2013).

My project question was founded in this evidence-based clinical practice problem. The literature I reviewed cited various methods of feeding premature infants, but no method was shown to be superior to the other. I formulated the project question using the brief report method, which includes preparing focused questions, and ensuring accuracy, clarity, and inclusion of essential elements. This method utilizes statements targeting the population, the intervention, the comparison, and the outcome (PICO) (Elkins, 2010). The PICO format for the clinical practice question in this university medical center was:

- P: All infants born between 27 to 32 weeks gestation or with a birth weight of 1000 grams to 1700 grams, hospitalized in a suburban, 21 bed, level III neonatal intensive care unit.

- I: Infant-driven feeding.
- C: Scheduled feeding.
- O: Impact on LOS.

Based on the PICO criteria, my evidence-based project question was: Will premature infants fed according to an infant-driven protocol have a shorter LOS than infants fed according to traditional, volume-driven, scheduled feedings?

The speech therapy team and I provided the education for the nursing staff. The follow-up education was incorporated into the yearly competencies for all staff. The intention was to provide a developmental approach to feeding to assist the infant in attaining a successful feeding while maintaining physiologic stability. Sustainable change was important. Therefore, follow-up education was provided along with continuous communication regarding infant-driven feedings. The project question focused on the impact of the developmentally based feeding protocol on LOS.

Sources of Evidence

This study took place in a suburban teaching university medical center in the Northeastern United States. The unit is a level III NICU housed in a children's hospital within a hospital, and part of a level III regional perinatal center. This intensive care unit has an average daily census of 21. Diagnoses ranged from extreme prematurity to any neonate at risk for health complications. There are approximately 60 registered nurse (RN) team members. There are no patient care assistants or assistive personnel. All care rendered to the infants is by the RNs. There are also nine neonatologists, one nurse practitioner, and two physician assistants.

I completed a retrospective chart review pre- and post-implementation of an infant-driven feeding protocol. Inclusion criteria for this study were: (a) infants born between 27 and 32 weeks gestation or with birth weights between 1000 and 1700 grams, and (b) receiving oral nutrition only (gavage or nipple). Exclusion criteria included infants with: (a) neurological disorders, gastrointestinal disorders, or major congenital anomalies, (b) breastfed infants, and (c) any infant with a discrepancy between the gestational age by maternal history and the Ballard score for physical and neurological assessment of gestational age.

The population sample was a convenience sample I acquired through a list of infants generated by a password-protected database. There were two groups for comparison. The pre-intervention group (n=15) included infants in the NICU meeting inclusion criteria between January 2013 and April 2013. This time frame was chosen to allow a suitable number of subjects, but to limit effects of any conversations about the infant-driven feeding protocols immediately preceding the protocol implementation. After the protocol was implemented and infants were discharged, I reviewed the charts of the infants in the post-protocol implementation group (n=14). The time frame for this group was October 2013-December 2013. I then compared the two groups.

After obtaining IRB approval from the study site (Appendix C) and Walden University (Appendix D), I obtained a list of discharged infants using a password-protected electronic database. I reviewed the electronic medical records after discharge for all infants meeting the inclusion criteria. I used a password-protected computer for all infant data entry and stored written data collection worksheets in a locked cabinet. I

transferred data to a Microsoft Excel spreadsheet for the purpose of analysis (Appendix E). I assigned the subjects numbers and letters, and the only identification was according to which group they belonged. All written records were shredded at the completion of the study, and I kept all identifying information confidential and de-identified for the purpose of this study. There were no ethical risk factors for human subjects.

Analysis and Synthesis

The sample size for this study was 29. There were 14 infants in the protocol-driven demand group, seven female, and six male. There were 15 infants in the traditional volume-driven group, eight female, and seven male.

I completed analysis of the data using Statistical Package for the Social Sciences (SPSS) software. The descriptive statistics included the measures of central tendencies for all the variables (Table 1).

Table 1

Descriptive Statistics Entire Data Set

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Birth weight (grams)	29	789	945	1734	1346.38	235.379	55403.387
GA at birth	29	7.00	26.71	33.71	30.5869	2.24220	5.027
Length of Stay	29	56	14	70	41.52	15.032	225.973
Valid N (listwise)	29						

Descriptive statistics for each group, by variable, for purposes of comparison included the measures of central tendencies including the range, mean, standard deviation and variance of the two feeding groups related to LOS (Table 2). The LOS was lower for infants who were in the protocol-driven, demand-feeding group as compared with the

traditional volume-driven feeding group (37.07 days - 45.67 days). This is a difference of 8.6 days.

Table 2

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Birth weight (grams)	Protocol-driven demand feeding	14	1450.71	217.770	58.201
	Traditional volume-driven feeding	15	1249.00	213.833	55.211
GA at birth	Protocol-driven demand feeding	14	31.6521	1.85500	.49577
	Traditional volume-driven feeding	15	29.5927	2.16005	.55772
Length of Stay	Protocol-driven demand feeding	14	37.07	13.848	3.701
	Traditional volume-driven feeding	15	45.67	15.351	3.964

The Test of Normality, Kolmogorov-Smirnov, and Shapiro Wilk's Test (Table 3) were non-significant indicating that the data were normal.

Table 3

Tests of Normality for Entire Dataset

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Birth weight (grams)	.149	29	.101	.951	29	.196
GA at birth	.114	29	.200*	.934	29	.069
DOL at discharge	.165	29	.042	.938	29	.090
Weight (grams) at discharge	.185	29	.012	.918	29	.027
Length of Stay	.142	29	.138	.960	29	.320

*. This is a lower bound of the true significance.

The graphical representation (Figure 3) demonstrates the difference in LOS between the two groups. The small circles outside the box plots represent the outliers and the middle line inside the box plots represents the median. The box plot demonstrates the difference in length of stay between the two groups.

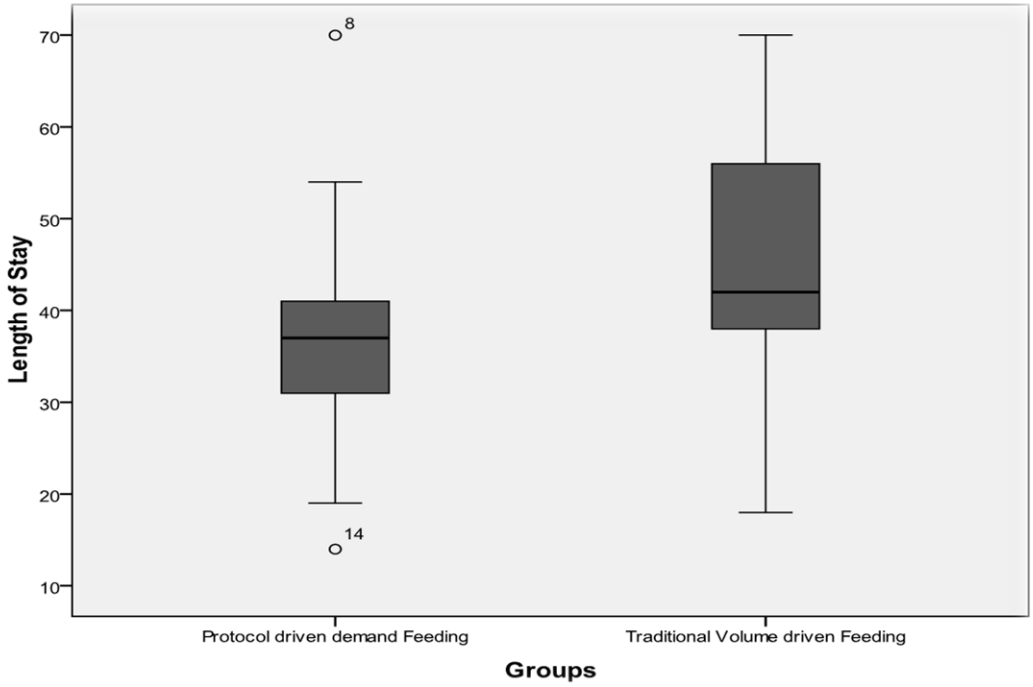

Figure 3. Length of stay comparison. This box plot represents the difference in the LOS between the protocol group and the traditional group.

The Tests of Normality, Kolmogorov-Smirnov, and Shapiro Wilk's Test comparing the groups (Table 4) resulted as non-significant for most of the variables, including LOS, confirming the data is normal.

Table 4

Test of Normality Groups

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Birth weight (grams)	Protocol-driven demand feeding	.147	14	.200*	.937	14	.384
	Traditional volume-driven feeding	.203	15	.095	.863	15	.026
GA at birth	Protocol-driven demand feeding	.164	14	.200*	.889	14	.079
	Traditional volume-driven feeding	.149	15	.200*	.932	15	.292
Length of Stay	Protocol-driven demand feeding	.174	14	.200*	.936	14	.369
	Traditional volume-driven feeding	.128	15	.200*	.967	15	.814

*. This is a lower bound of the true significance.

According to the descriptive statistics, the means of LOS for the protocol-driven demand-feeding group were lower than the traditional volume-driven feeding group (from 37.07 days to 45.67 days), a difference of 8.6 days. However *t*-test results (Table 5) showed that LOS was not statistically significant (P=0.126).

Table 5

Homogeneity of Variance, Levine's Test, Independent t-test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Birth weight (grams)	Equal variances assumed	.234	.632	2.516	27	.018	201.714	80.171	37.218	366.211
	Equal variances not assumed			2.514	26.784	.018	201.714	80.223	37.048	366.380
GA at birth	Equal variances assumed	.437	.514	2.745	27	.011	2.05948	.75026	.52007	3.59888
	Equal variances not assumed			2.760	26.827	.010	2.05948	.74622	.52790	3.59105
Length of Stay	Equal variances assumed	.894	.353	-1.579	27	.126	-8.595	5.443	-19.763	2.573
	Equal variances not assumed			-1.585	26.973	.125	-8.595	5.423	-19.723	2.532

The ANOVA was non-significant for LOS; F(1,27)=2.494; P=0.126. There was no difference between the 2 groups based on the LOS (Table 6).

Table 6

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Length of Stay	Between Groups	534.979	1	534.979	2.494	.126
	Within Groups	5792.262	27	214.528		
	Total	6327.241	28			

Re-examination of the data in the box plot for LOS (Figure 1) revealed outliers in the protocol driven demand-feeding group. In particular there is an extreme outlier (observation 8). The true impact of the intervention may not be demonstrated due to the inclusion of this outlier. Review of the exclusion criteria revealed the extreme outlier with the LOS of 70 days met the exclusion criteria and should not have been included in the study. The intervention effect may not have been realized due to the inclusion of this subject. Therefore, the extreme outlier in the protocol demand-feeding group was adjusted in two different ways and data were analyzed again for LOS.

First, the extreme outlier in the protocol driven demand-feeding group was substituted with the mean LOS for the protocol driven demand-feeding group. The original value for the LOS was 70 days and it was substituted with the mean=34.54 days. The resulting difference in the means of LOS was 11.13 days (Table 7).

Table 7

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
LOS	Protocol driven group	14	34.5386	10.09658	2.69842
	Traditional volume driven group	15	45.6667	15.35144	3.96372

The t-test (Table 8) was statistically significant for LOS (P=0.03). There was a significant difference between the 2 groups based on LOS. This supported the assumption that the change in feeding methods had an impact on the LOS.

Table 8

Independent Samples t-test After Inserting Mean For the Outlier

		Levene's Test for Equality of Variances		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
LOS	Equal variances assumed	3.500	.072	-2.288	27	.030	-11.12810	4.86343	-21.10703	-1.14916
	Equal variances not assumed			-2.321	24.351	.029	-11.12810	4.79506	-21.01707	-1.23913

After adjusting for the outlier (LOS=70 Days), the ANOVA was statistically significant for LOS; F(1,27)=5.235; P=0.03. There was a difference between the 2 groups based on LOS (Table 9).

Table 9

ANOVA After Adjusting for the Outlier

Length Of Stay					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	896.733	1	896.733	5.235	.030
Within Groups	4624.564	27	171.280		
Total	5521.297	28			

Second, the observation with the outlier was removed from the dataset (Table 10). The difference in the means of LOS was 11.13 days.

Table 10

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
LOS	Protocol driven group	13	34.54	10.509	2.915
	Traditional volume driven group	15	45.67	15.351	3.964

The t-test was again statistically significant for LOS (P=0.037). There was a significant difference between the 2 groups based on LOS (Table 11).

Table 11

Independent Samples t-test After Eliminating the Outlier

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
LOS	Equal variances assumed	2.705	.112	-2.202	26	.037	-11.128	5.054	-21.516	-.740
	Equal variances not assumed			-2.262	24.780	.033	-11.128	4.920	-21.266	-.991

After eliminating the outlier from the dataset (LOS=70 Days), the ANOVA was statistically significant for LOS; F(1,26)=4.849; P=0.037 (Table 12).

Table 12

ANOVA After Outlier Elimination

Length Of Stay					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	862.436	1	862.436	4.849	.037
Within Groups	4624.564	26	177.868		
Total	5487.000	27			

Project Evaluation Plan

I completed the project evaluation plan through examination of the process of implementing an infant-driven feeding protocol and the impact it might have on the LOS. Decreasing the LOS would be significant to the administrative stakeholders due to money saving initiatives and improved quality care. The success of this project represented a major change in the feeding method of the infants, a reduction in the LOS, and a decrease of the hospital costs per premature infant. For a change in practice to occur and be sustained, the nurses must be engaged and support the change (Burnes & Cooke, 2012).

I developed an infant-driven feeding protocol based on current findings in the literature and best practices in local NICUs. The speech therapists and I educated the team members on the changes in the policy, the feeding method, and appropriate feeding techniques. We provided the education through multiple venues to incorporate preferences for learning and accommodate various types of learners. I assigned self-study modules for completion through the hospital e-learning system. Speech therapists presented power point lectures and demonstrated feedings at the bedside. The leadership team gave team members support at the bedside through articles, hands-on instruction, visual examples of the rating scale, and documentation of the process. The comparison of the LOS of two similar groups of infants fed with different methods determined the impact of the change

Section 4: Findings and Recommendations

Introduction

Feeding is a skill in preterm infants that must be learned because they are not born ready to feed. It is a complex process involving multiple behaviors and neurodevelopmental support. The lack of a supportive environment can lead to long-term failure creating oral aversion, physiologic instability, and neurological shut down (Shaker, 2012; Shaker & Woida, 2007). Therefore, creating a positive environment with minimal stressors and neurobehavioral symmetry may assist the preterm infant in achieving success and decrease the long-term negative outcomes for the infant and family. Allowing the infant to dictate when and how they feed by assessing their behavioral and physiologic status enables them to learn how to feed and not just to be fed.

The purpose of this study was to evaluate the impact of an infant-driven feeding protocol on the LOS for premature infants. Advances in technology have improved outcomes in premature infants. Infants are surviving at an earlier gestational age, and this presents numerous challenges to the healthcare system and families (Centers for Disease Control and Prevention, 2012). Creating a developmentally appropriate plan of care for these infants can decrease some of the morbidity in long-term outcomes (Als et al., 2005).

Findings and Implications

I examined two groups of preterm infants. The protocol-driven group and the traditional volume-driven group. The infant-driven feeding protocol established the

method of feeding for the protocol-driven group. Through a readiness-to-feed assessment the decision was made to bottle-feed or not-bottle feed the infant. The traditional volume driven group was fed on a schedule with a pre-determined amount and was bottle-fed based on gestational age not a readiness-to-feed assessment. I compared the infants' LOS in the protocol-driven group with the infants' LOS in the traditional volume-driven group. The results of this study answered my evidence-based project question: Will premature infants fed according to an infant-driven protocol have a shorter LOS than infants fed according to traditional, volume-driven, scheduled feedings? According to my initial analysis of the data, the answer to this question was "no." There was not a significant effect on the LOS. However after careful examination of the subjects, I discovered that one of the subjects, an outlier with an LOS of 70 days, did not meet the inclusion criteria for the study. This subject was diagnosed with a gastrointestinal disorder, and therefore, should have been excluded. I then ran the data analysis for two different scenarios. First I substituted the mean LOS of the protocol group for the outlier of 70 days. Secondly, I eliminated the outlier and performed the data analysis again. In both of these analyses, the answer to the study question was "yes." There was a significant decrease in the LOS (11.13 days) of the premature infants who were fed on demand according to the infant's cues for readiness-to-feed.

The AAP established a list of discharge criteria that infants must meet to be discharged from the hospital. Included in that list of discharge criteria is the ability to coordinate their suck-swallow-breathe motion and gain weight consistently (American Academy of Pediatrics, 2008). Although those criteria may be met, meeting them does

not address the functionality of the feeding methods for the infant. As I have previously stated throughout this study, the functionality and the accomplishment of the infant learning to feed is as important as--if not more important than--being fed a specific volume at each feeding (Shaker, 2013).

Many formula companies have historically manufactured high flow nipples to maximize an infant's feeding potential without expending vast amounts of energy. When an infant was sucking but the volume was not decreasing, the NICU nurse changed to a high flow nipple to expedite the feeding. However, when the control of the flow of the fluid is removed from the infant, a dangerous situation is created. The infant becomes stressed, struggling to suck–swallow-breathe all while fluid is free flowing into their mouths. The loss of control and overfilling of the mouth can lead to extreme stress and physiologic instability. This stress and instability lead to an unpleasant feeding experience, predisposing the infant to long-term negative feeding and avoidance behaviors demonstrated throughout feedings (Drenckpohl et al., 2009).

Adverse long-term outcomes and morbidities that occur with a preterm infant are not always avoidable. However, taking the time to allow an infant to learn to feed properly in an encouraging, self-regulated environment may reduce complications such as readmission to the hospital for failure to thrive, the negative association the premature infant experiences with feedings, and oral aversions (Shaker, 2012). Therefore, implementation of an infant-driven feeding protocol should improve the infant's ability to feed and decrease the LOS.

Experienced NICU nurses are proficient in the feeding techniques to get an infant to eat. They may use techniques they have become accustomed to over the years. Fast flow nipples, chin and cheek support, and manipulating the nipple and bottle are all methods that historically have been used to attain successful feeding (Shaker, 2013). Regretfully, this may not be the way to successfully feed a preterm infant. Developmental practices should be used in the NICU to achieve the best universal outcomes for the preterm infant and not isolated circumstances such as feeding.

Caregivers must feed infants in a positive fashion avoiding stress-producing techniques. Adopting an infant feeding program based on readiness cues from the infant can promote a positive experience for the infant, thereby avoiding negative feeding behaviors. Negative learned behaviors can adversely affect the growth and maturation of the neuro-pathways in the preterm infant's brain causing difficulty with feeding capabilities for life (Drenckpohl et al., 2009; Shaker, 2013).

Change in practice can lead to emotional upheaval and challenges to nurses' foundation of practice. Nonetheless, nurses working in healthcare environments are in an ever-changing atmosphere, and must learn to adapt to change on a daily basis (Bowers, 2011). Nurses need to embrace change and implement practices that, although different, have been shown to assist the infant and family in reaching their best potential.

When implementing sustainable change, it is important to assess the resistances that may arise and have a plan to manage them. The implementation of the infant-driven feeding protocol was a challenge in an environment with many seasoned NICU nurses who seemed insulted when I addressed the subject of feeding. The speech therapists were

actively involved in this feeding protocol, and the nurses were resentful wondering what--if anything-- the therapists knew about feeding. Formulating a better analysis of the resistances would have helped me facilitate the nurses' acceptance of the new protocol (Bowers, 2011). However, it has now been a year since the implementation, and although there are still resisters, more are following the new protocol. Nurses, as leaders, have the responsibility to change practices based on current evidence. If there is no evidence available, the questioning of why or why not can lead us to projects intended to improve quality.

There is little research available comparing an infant-driven feeding protocol's impact on a preterm infant's LOS (Crosson & Pickler, 2005). This study demonstrates that the infants fed according to a protocol based on the infant's readiness cues can decrease the LOS of the infant. A decreased LOS presents a great opportunity for healthcare systems and families. A decreased LOS saves dollars for the hospital and improves outcomes for the infant (Lessen, 2011).

Once the infant is in a home environment, the opportunities for the infant to develop in an appropriately nurturing environment are numerous compared to the busy surroundings of the NICU. Nurturing from the family provides an environment for positive growth and development of infants who have been negatively over-stimulated since birth. Clinicians have a responsibility to provide the best possible care to lead to positive outcomes for their patients.

Recommendations

Future research is needed to confirm the outcomes of this study. Additional studies could include the method of feeding related to long-term outcomes, the length of time to attainment of full maintenance feedings, and family interaction and bonding. Another opportunity for research would be to evaluate a change in nurse satisfaction or engagement when using this method as opposed to the traditional way of feeding an infant.

Expanding the depth of this study is critical. The future of healthcare and the impact on society demands it. Instituting developmentally-based protocols for all aspects of premature care can decrease morbidities that drain the healthcare system and families of valuable financial resources (Als, 1982; Als & McAnulty, 2011; Cuevas et al., 2005). Improving outcomes for these infants not only decreases financial strain on the families but the emotional strain as well.

This study demonstrated how the implementation of an infant-driven feeding protocol decreased the average LOS of premature babies by 11.13 days. This decreased LOS has great potential to assist healthcare facilities in decreasing costs, thus aiding their financial solvency. The average cost of a baby in the NICU is approximately $3000 per day. Decreasing the ALOS by 11.13 days has the potential to save this hospital $33,000 per infant annually. There are approximately 400 infants admitted to this NICU annually. If the LOS were decreased by 11.13 days for just 100 of those infants, the savings for this hospital would be over $3 million. The decrease in LOS is also financially significant for those with no insurance, or with government policies with limited reimbursement rates.

Additionally, the potential reductions in feeding dysfunction may lead to better outcomes for premature infants. Decreased oral aversion through better self-regulation practices and achievement of developmental milestones may reduce healthcare costs and utilization of valuable resources within the first year of life. Hospital readmissions may be reduced with appropriate developmental feeding programs (Cuevas et al., 2005).

Furthermore, the transition to parenthood is challenging and wrought with many decisions and uncertainties. Parents of premature infants are segregated from parents with full-term infants and are faced with even more complex and complicated situations. Facing the uncertainty of the survival of their infant, along with the doubts of their ability to function as parents, isolates them from other first-time parent groups (Watson, 2011). Decreasing the LOS gives the family unit additional time to be home and bond as a family. The developmental environment for a premature infant is better controlled at home, and the parents can regain their status as normal parents.

In contrast to studies reported in the literature, this study demonstrated a significant decrease in the LOS. I concluded that the implementation of a developmentally sound infant-driven feeding protocol based on the infant's readiness cues had a significant impact on the premature infants' LOS. The infants who were fed according to the protocol were discharged an average of 11.13 days earlier than those fed by the traditional volume-scheduled methods.

One of the favorable aspects of this infant-driven feeding protocol is giving the control of the feeding to the infant instead of the caregiver. The assessment of readiness cues is based on synactive theory (Als, 1982). Synactive theory promotes development

and fine tuning of the self-regulation abilities of the infant, in turn, allowing the infant to learn to control its intake also referred to as pacing (Gelfer et al., 2015). This practice allows the infant rest periods and control of volume that decreases the negativity, apnea, bradycardia, and respiratory compromise of the infant. The infant learns to control how much fluid enters the mouth and achieve the suck-swallow-breathe coordination necessary to produce a successful feeding.

Moreover, utilizing a demand-driven protocol assists the infant to notify the caregiver of their readiness-to-feed, the ability to control their feeding, and limiting stressful behaviors learned by the infant during feedings. Scheduled volume-driven feedings often become sources of stress. These adverse events often develop a negative feeding experience for the infant (Law-Morstatt, Judd, Snyder, Baier, & Dhanireddy, 2003). If feeding is associated with negativity, these infants are often plagued with years of feeding difficulty, growth retardation, and readmissions to the hospital.

Projects Strengths and Limitations

Strengths

My goal was to evaluate the impact of an infant-driven feeding protocol on the hospital LOS. The data analysis demonstrated that the infants in the post-implementation group had a significant decreased LOS of an average of 11.3 days over the traditionally volume fed infants. The results of this project support the transition to a cue-based infant-driven feeding protocol in the NICU and warrants continuation of the program.

The RN team members had to be trained on the infant-driven feeding protocol. The education took place over several weeks and was delivered by two different methods.

There was a lecture component given by the speech therapists and a self-learning module assigned to all NICU nurses through our on-line learning system. Therefore, all of the team members received the same education.

Limitations

I identified several limitations to this project. Although all of the education for the nurses was the same, understanding and retention of the information was not tested which could have led to inconsistencies in following the protocol and performing the feeding skills.

I did not measure compliance with the protocol. Random audits were completed through observation. However, I could not guarantee that the RNs followed the protocol when not being observed.

This NICU has a vast number of seasoned nurses working for years in this NICU. I had some difficulty convincing them that old practices not supported by evidence may need to change. The new protocol was a tremendous change in practice, and it was difficult to gain complete buy-in from them. Change is a complex process and involves different stages. According to Lewin's theory of planned change (TPC), there are three stages of change. Unfreezing is the first stage and consists of the preparation for the change. Creating the urgency, analyzing the need for change and preparing the stakeholders for the change are important steps for successful implementation. In this phase the driving forces need to be strengthened and the opposing forces need to be weakened (Bowers, 2011). The planning stage for this project was somewhat rushed and

planning for the resistors should have been more efficient. Utilizing a more effective plan and including additional team champions may have decreased the resistance to change.

Another limitation was that I was the only data collector. This may promote bias in the collection of data (Polit, 2010). However, a single data collector may be viewed as a strength for consistency of data collection.

The sample size was small. A small sample size can affect the generalizability of the results of this study to the general population of premature infants. This study was time limited due to the project timeline for school. It would be helpful to have a greater sample size, therefore, allowing the results to be able to be applied to the general population.

In conclusion, the literature supports the need for this project and future studies examining the short and long-term effects of a developmentally based feeding protocol to assist the infant to learn how to feed and not just be fed. Few studies examined LOS and none showed a significant change in LOS based on the different feeding methods. Future studies should examine the long-term effects of a feeding protocol throughout the first year of life. Developmentally-sound feeding routines and guidelines may potentially reduce healthcare costs by decreasing the LOS, readmissions, and morbidity associated with traditional feeding regimens.

Section 5: Dissemination Plan

Introduction

Part of being a scholar is disseminating the findings of your work to a greater audience. My plan is to disseminate this information in an executive summary. The purpose of an executive summary is to summarize a lengthy report into a short document that allows for quick review of all the information. I will distribute the following summary to all of the stakeholders of this project. Additionally, I am considering publication in a professional journal. I have also been invited to share my findings with colleagues at the institutions 11th annual nursing research conference.

Executive Summary

The cost of healthcare is on the rise in the United States. The economic impact of preterm births is fast approaching $27 billion. Prolonged hospital stays are common for preterm infants because of physiologic immaturity and the impact of the environment on their growth and development. Healthcare professionals must find a solution to decrease costs while supporting the developmental growth and maturity of the preterm infant. Additionally, morbidities leading to readmission in the first year of life should be prevented whenever possible. Decreasing the length of stay (LOS) can have a huge impact on costs, family bonding, and parenting. Formulating clinical guidelines based on current scientific evidence improves healthcare delivery. An infant driven feeding protocol may lead to healthier infants with financial savings to support better programs (Kornhauser & Schneiderman, n.d.).

One of the obstacles in discharging a premature infant is the ability to safely and efficiently bottle feed. The time to accomplish this task can be quite lengthy and unpredictable. The purpose of this project was to investigate if the implementation of an infant-driven feeding protocol focused on the quality of the feeding and not the volume fed would decrease the LOS. Additionally, when infants learn to feed with positive experiences, they respond favorably, and long-term morbidities may decrease.

I educated the RN team members and physicians about the SOFFI methods of feeding, the assessment scales, and the new guidelines for feeding and implementation of the protocol.

I completed a retrospective chart review pre- and post-implementation of the infant-driven feeding protocol. The protocol consisted of a feeding readiness assessment based on the infant-driven feeding scales (Ludwig & Waitzman, 2007).

I completed data analysis using SPSS. My initial analysis showed a decrease in the LOS by 8.6 days, but it was not statistically significant (P=0.126). I re-examined the data for inaccuracies and discovered an outlier in the protocol-driven group with a LOS of 70 days. After careful evaluation, I determined that the outlier met exclusion criteria and eliminated it. After SPSS analysis excluding the outlier, I found that the LOS was decreased by 11.13 days with statistical significance (P=0.037).

The average cost of a baby in the NICU is approximately $3000 per day. Decreasing the ALOS by 11.13 days has the potential to save this hospital $33,000 per infant annually. There are approximately 400 infants admitted to this NICU annually. If the LOS were decreased by 11.13 days just for 100 of those infants, the savings for this

hospital would be over $3 million. The decrease in LOS is also financially significant for those with no insurance, or with government policies with limited reimbursement rates.

The implementation of the infant-driven feeding protocol affords future opportunities for change in the NICU. Although many of the RNs were initially resistant to the change and not entirely convinced of the benefits of the protocol, they made many inquiries about what else we can do to improve the care of our patients after I shared the results with them. It is important to continue these efforts to ensure delivery of quality care to all of the patients and families. The financial savings can be put toward future programs that improve quality and decrease long-term morbidities.

Analysis of Self

This DNP project has positively impacted me as a scholar, practitioner, and project developer. Nurses are practicing in a healthcare environment of constant change, new practices, advanced technology, and demands of excellence from administrative leadership and the communities they serve. It is a challenging environment for the bedside nurse to work a long busy day and still leave with a feeling of accomplishment and pride. Healthcare professionals are extremely busy and do not always have the resource of time to implement change.

Throughout the process of this project, I have struggled with many obstacles within myself. As I near the end of this journey, I have noted many changes in me related to my experiences, including finding a stronger voice as a scholar and leader. A scholar has insight that promotes advances in their field, interpreting what has been realized and seeks new origins or methods of practice. A scholar remains open minded and has a sense

of integrity and imparts their knowledge to others. The succession of change mandates strong leadership, mentoring, vision, and order (Tolk, 2012). The ability to inspire and motivate change with good communication, honesty, and integrity can assist the workforce to reach a new level of excellence. Leadership must encourage the questioning of existing practices and support the changes in the workplace culture. I have gained successful tools that enable me to lead with confidence, direct with courage, and communicate with transparency.

As I approached this project, I hoped to gain new knowledge to disseminate among nurses caring for preterm infants. The data I collected and the results I obtained showed promising effects of an infant-driven feeding protocol on the LOS. I reviewed the literature and implemented a developmentally based protocol for feeding premature infants in turn decreasing the LOS. I would like to explore further the effect an infant-driven feeding protocol might have on long-term outcomes such as feeding dysphagia, failure to thrive, and oral aversion.

Although I consider myself a novice researcher, I have the confidence to approach a new project to improve the outcomes of the preterm infants. I can disseminate this information to other professionals so they too can learn and make changes at the bedside that will improve quality, utilizing methods that are financially supportive and best for the patient and family. As a project developer, I have gained the ability to bring change to nursing practice at the bedside. Through this process, I now recognize the need for setting goals, identifying barriers to success, and planning to alleviate those barriers. Communication is imperative for a successful project, and listening is a skill I have

developed. I have learned to accept the positive and negative responses about my approach, methods, and activities. Utilizing transformational leadership principals supports the self-efficacy of the participants, increasing their desire to be part of the process and the outcome (Salanova, Lorente, Chambel, & Martínez, 2011). Including them in the process and the practice change allows for the possibility of that change working and becoming sustainable.

Summary and Conclusions

The importance of an infant's ability to feed is evident in the AAP guidelines for discharge (American Academy of Pediatrics, 2008). Successful feeding is one of the final criteria that must be met. However, feeding is a complicated task that must be learned by the premature infant. A premature infant learns how to feed when the environment is quiet with limited stimulation, they demonstrate physiologic stability, and can coordinate the suck-swallow-breathe reflex. This study showed that a deliberate and focused neurobehavioral assessment that looks for cues from the infant aids the infant to accomplish successful feedings earlier than the traditionally scheduled volume-fed infant.

This study focused on the implementation of an infant-driven feeding protocol based on neurobehavioral assessments and the impact it would have on the LOS. The purpose or importance of reducing the LOS is multifocal. A reduced LOS has the potential to decrease costs by millions of dollars, improve patient outcomes, improve family bonding, and decrease admissions to the hospital in the first year of life (Cuevas et al., 2005). The positive impact of these findings can encourage healthcare providers to investigate other evidence-based methods of taking care of this population.

This project demonstrates how using evidence-based protocols have tremendous impact on patient outcomes. Healthcare is a domain that is continuously changing, and change is a difficult concept fraught with uncertainty. This project demonstrates how changing behaviors based on evidence can produce better outcomes and healthcare practices for premature infants. Furthermore, the change that was implemented reaches far beyond the benefits for the hospital and the healthcare system at large. Developing an individualized feeding protocol based on scientific evidence demonstrated how current practices are not always best practices. Utilizing the evidence to make positive changes in healthcare practices is imperative for an improved, healthier future for families, society, and healthcare organizations. This study demonstrates that the way we have always done things may not be the way we should continue to do them.

The nursing profession, along with the interdisciplinary team, has the responsibility to provide safe quality care while striving for the best possible outcomes. The implementation of an infant-driven feeding protocol has the potential to deliver that care with a positive impact financially, but more importantly, socially for the infant and the family bonding process. As a result of this project, the standard of feeding practice in the institution of study has become infant-driven.

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Appendix A1: Infant-driven Feeding Scales

Feeding Readiness Scale	
1.	Drowsy, alert or fussy prior to care. Rooting and/or hands to mouth/takes pacifier. Good tone
2.	Drowsy or alert once handled. Some rooting or takes pacifier. Adequate tone
3.	Briefly alert with care. No hunger behaviors. No change in tone.
4.	Sleeping throughout care. No hunger cues. No change in tone.
5.	Needs increased O2 with care. Apnea and/or bradycardia and/or tachypnea over baseline with care.

Note. From "Changing feeding documentation to reflect infant-driven feeding practice," by S. Ludwig and K. Waitzman, 2007, *Newborn and Infant Nursing Reviews*, (7) 3, p. 155-160.

Appendix A2: Infant-driven Feeding Scale

Quality of Nippling Scale

1. Nipples with a strong coordinated suck throughout the feed
2. Nipples with a strong coordinated suck initially but fatigues with progression
3. Nipples with consistent suck but has difficulty coordinating swallow, some loss of liquid or difficulty in pacing. Benefits with external pacing
4. Nipples with a weak/inconsistent suck, little to no rhythm, may require some rest breaks
5. Unable to coordinate suck- swallow-breathe pattern despite pacing, may result in frequent or significant A/Bs or large amounts of liquid loss and/or tachypnea significantly greater than baseline feeding

Note. From "Changing feeding documentation to reflect infant-driven feeding practice," by S. Ludwig and K. Waitzman, 2007, *Newborn and Infant Nursing Reviews*, (7) 3, p. 155-160. Copyright 2007 by Ludwig and Waitzman. Reprinted with permission.

Appendix A3: Infant-driven Feeding Scale

	Caregiver Technique
A	External pacing
B	Moderate side-lying position
C	Chin support
D	Cheek support
E	Oral stimulation

Note. From "Changing feeding documentation to reflect infant-driven feeding practice," by S. Ludwig and K. Waitzman, 2007, *Newborn and Infant Nursing Reviews*, (7) 3, p. 155-160. Copyright 2007 by Ludwig and Waitzman. Reprinted with permission.

Appendix B: Infant-driven Protocol Guideline

Guideline

Infant-driven Feeding Protocol

- Readiness-to-feed assessments will begin on all infants at 32 weeks post conceptual age (PCA). The infant will **NOT** be nipple fed until 33 weeks PCA. The scoring in the 32-33 week PCA is for information only. The score given to the infant will be documented in the feeding section of the nurse's flow sheet. **Never nipple feed infants less than 33 weeks PCA.**
- When the infant is 33 weeks and scoring a 1 or 2 on the readiness-to-feed scale, obtain a physician's order to feed according to the infant-driven feeding protocol. The infant may then attempt nipple feeding. If the infant displays physiologic instability at any point (increased RR, poor tone, desaturations, or bradycardia), attempts should be made to return the infant to a state of physiologic stability. This may be accomplished by swaddling and holding the infant quietly. Non-nutritive sucking with a pacifier should be offered. Limit the noise surrounding the infant and dim the lights.
- Once the infant returns to physiologic stability, the nurse may offer the bottle. The nurse must continually assess the participation of the infant noting good tone and suck-swallow-breathe patterns. If the infant displays instability in the second attempt, stop and gavage the remainder of the feeding.
- Efficiency of the feeding must be assessed. This includes minimal spillage of milk from the mouth, no gulping sounds, and the sucking motion extracts milk from the bottle.
- Assessment of the feeding continues assessing stability, participation, efficiency and self-pacing.
- Do not under any circumstances manipulate the bottle or nipple to gain more fluid from the bottle, awaken the infant that has fallen asleep, or has decreased tone. At that point the remainder of the feeding should be gavaged.
- Ask the physician for a speech consult when:
    - An infant at 35 weeks has not shown readiness-to-feed.
    - The infant has neurological or anatomic disorders that may affect feeding.
    - The infant has chronic illness including but not limited to respiratory disease (chronic lung, BPD) or cardiac disease.

Appendix C1: Community Partner IRB Approval

March 06, 2014

Lori L. Messer RNC, MSN, NNP
NICU

FULL APPROVAL

Dear Ms. Messer:

This is to advise you that the above referenced Study has been presented to
the following action has been taken subject to the conditions and explanation

IRB Study # 201402171J
Protocol Title: Infant Driven Feeding vs. Scheduled Feeding and the Effi
Hospitalized Premature Infants: An Evidence Based Practice Project

IRB CPA#: New Appl
Study Status: Exempt
IRB ACTION: Approved 45 CFR 46.101(4)
Description: IRB grants Exempt Approval for the following period:
Approval Date: 03/03/2014
Expiration Date: 03/02/2019
Full Board Notification Date: 03/11/2014
Pre-Meeting Action: Approved as Exempt
Approval includes:

- Chart Review application approved as submitted for 5-years. Data Cc
- **Approved to collect data from up to 50 Charts. This number may Review and Approval.**

Condition(s): This exemption is good for five years as long as the protocol are followed. Once the study has been completed you are r IRB by providing the appropriate paperwork.

See page 2 for additional conditions of this approval.

Appendix C2: Community Partner IRB Approval

IRB approvals are provided to Principal Investigators subject to the following conditions:

The IRB regards the Principal Investigator as the individual responsible for the conduct of research trials at his/her site and all associated research facilities. Specific responsibilities of the Principal Investigator include ensuring the following:

- supervision of all research activity at the approved site(s) and facility(ies) in accordance with IRB, policies and procedures, and all state and federal regulations pertaining to the conduct of human subject research;
- conduct of research according to the research protocol as approved by the IRB;
- use of the most recently IRB-approved informed consent form;
- provision of a IRB-approved consent form in the participant's first language to all non-English speaking participants according to policy on Informed Consent for non-English speaking participants;
- prospective approval by the IRB of changes in research activity including protocol amendments and/or consent form revisions prior to implementation, changes in Principal Investigator, change in research site, and addition of research facilities to a previously approved site;
- prompt reporting to the IRB of the completion of research;
- prospective approval by the IRB of all advertisements and recruiting materials prior to use;
- prompt reporting to the IRB of serious adverse events, major protocol deviations/violations, and other unanticipated problems involving risks to participants or others which meets the definition of reportable events. Please refer to IRB Policy, Actions for Approved Protocols – Reporting of Unanticipated Problems and Safety Information;
- prompt reporting to the IRB of significant findings or information during the course of research which may relate to a participant's willingness to continue participation in the research;
- all participants are aware that the research is investigational;
- maintenance of adequate records in accordance with federal, state, and local regulations;
- maintenance of open communication with participants regarding participant requests for additional information or concerns about the research;
- each individual listed as study personnel in this application has received and maintains the mandatory human research protections education (CITI); and
- compliance with all requirements specified in the IRB Policies and Procedures.

The Institutional Review Board is a duly constituted IRB in accordance with the requirements of the Federal Food, Drug, and Cosmetic Act as specified in 21 CFR Part 56, the requirements of the ICH Guideline for Good Clinical Practice, and in accordance with the ethical principles outlined in the Belmont Report. As Chairman of the IRB, I hereby certify that this action of the IRB was taken in accordance with these regulations for the protection of human subjects.

Respectfully yours,

IRB Chairperson
Institutional Review Board

Appendix D: Walden University IRB Approval

From: IRB <IRB@waldenu.edu>
Date: April 3, 2014 at 10:23:46 AM EDT
To: "Lori Messer
Cc: dnp <dnp@waldenu.edu>
Subject: Notification of Approval to Conduct Research-Lori Messer

Dear Ms. Messer,

This email confirms receipt of the IRB approval for the community research partner and also serves as your notification that Walden University has approved BOTH your dissertation proposal and your application to the Institutional Review Board. As such, you are approved by Walden University to conduct research.

Please contact the Office of Student Research Administration at dnp@waldenu.edu if you have any questions.

Congratulations!

Associate Director, Office of Research Ethics and Compliance

IRB Chair, Walden University

Appendix E: Data Collection Worksheet

Data Collection Form

Unique ID #	Gender	Birth weight (grams)	GA at birth	GA at first nipple feed	DOL of first nipple feed	GA at full nipple feeds	DOL of full nipple feeds	Weight (grams) when nippling full feeds	GA at discharge	DOL at discharge	Weight (grams) at discharge	LOS	Comments

Appendix F: Permission to use Infant-Driven Feeding Scales©

January 14, 2014

Susan Ludwig and Kara Ann Waitzman grant permission to the NICU at Jersey Shore University Medical Center, New Jersey, to use the Infant-Driven Feeding Scales© (IDFS). We also grant permission for the IDFS to be automated in computer format/for electronic medical record. We do ask that your feeding policy and your documentation state they were 'reprinted with permission from Susan Ludwig and Kara Ann Waitzman' and include the copyright symbol wherever they may be used.

The IDFS are intended to be used as they appear in the September 07 issue of Newborn and Infant Nursing Reviews unless otherwise indicated. Updated versions are being studied currently, and you will be kept up to date about this progress via the contact information you provided.

We have found that implementation of the IDFS has been most successful in NICUs that made unit-wide education a priority. Education which includes changing the culture of feeding, implementation of the IDFS, and the entire scope of infant-driven feeding® practice is vital to successful practice change.

Best of luck to you and please feel free to contact us via email with any questions!

Sincerely,

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