

Evaluation of Cue-Based Oral Feeding Protocols for Preterm Infants in
the Neonatal Intensive Care Unit (NICU)

Cindy L. Selig, DNP, APRN, RNC-OB, CPLC

Lori Baas Rubarth, PhD, APRN, NNP-BC

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Abstract

PURPOSE: The purpose of this study was to evaluate the use of two feeding protocols. Both feeding protocols included the implementation of oral stimulation, the use of feeding readiness cues, and a quality of nipping scale. Infants were evaluated prior to and after implementation of the oral stimulation program and the feeding protocols.

SUBJECTS: A convenience sample of 1155 preterm infants less than 37 weeks gestation were included in the study.

DESIGN: Quasi-experimental, retrospective, quantitative.

METHODS: Data were collected from chart reviews of infants from a pre-intervention group that did not receive the feeding protocol and a post-intervention group that received oral stimulation and a cue-based feeding protocol.

MAIN OUTCOME MEASURES: Gestational age at first nipple feed, gestational age at full nipple feedings, and gestational age at discharge.

PRINCIPLE RESULTS: T-tests were performed on the entire group of preterm infants comparing the pre-intervention group with the post-intervention group. T-tests were also performed on groups of preterm infants of varying gestational ages. As a total group of preterm infants there were no statistically significant differences in the outcome measures. In the post-intervention group of infants under 26 weeks gestation, the first oral feeding occurred seven days earlier than in the pre-intervention group, resulting in a statistically significant finding ($p=0.05$). In this same group, there were clinically significant results. Infants achieved full oral feedings nine days earlier, and they were discharged eight days earlier than infants who did not receive oral stimulation or the feeding protocols. Only infants under 26 weeks gestation who received oral stimulation achieved full feeds and was discharged earlier than infants who did not receive oral stimulation.

CONCLUSION: Our cue-based feeding protocol and oral stimulation program improved the time it takes for extremely preterm infants to reach full feedings which can impact their readiness for discharge. Being discharged earlier will decrease the cost of care in the NICU. Feeding readiness protocols also provide guidance in assessing preterm infants.

A Comparison of Cue-Based Oral Feeding Protocols for Preterm Infants in
the Neonatal Intensive Care Unit (NICU)

Prematurity remains a problem in the United States with a preterm birth rate that remains greater than 12% (Maternal, Infant and Child Health, 2012). According to Blosky et al. (2010), hospital length of stay (LOS) and cost are higher for preterm infants. The mean charges for hospitalization for preterm infants are \$103,000 versus \$7,000 for a full term infant. The average LOS for the preterm infant was 16.1 days compared to 2.3 days for the full term infant. Overall cost of hospitalization increases as gestational ages decreases. The cost of hospitalization would decrease if the LOS would decrease (Blosky et al., 2010).

There are many problems that the premature infant experiences while a patient in the NICU. Oral feedings is one of the most difficult tasks for the preterm infant to master. For a premature infant to be discharged home, they must be gaining weight, nipple feeding or breastfeeding well, maintaining their temperature outside of an isolette, and have a stable respiratory/cardiovascular status (no apnea/bradycardia). The ability to oral feed adequately to gain weight depends on the infant's sucking maturity as well as the infant's physical ability.

Determining oral feeding readiness of the premature infant can be challenging for both parents and neonatal nurses. Infants are required to coordinate sucking, swallowing, and breathing to oral feed successfully. Attempting to nipple feed preterm infants is often done before they are ready physiologically or behaviorally (Lessen, 2011). This causes stress for the infant and the oral feeding will not be successful. Infants must be able to take in adequate nutrition from oral feedings to support their rapid growth. Increasing oral feeding success with adequate infant assessment of feeding readiness can ensure a more timely discharge from the hospital.

Background & Significance

Initiation of oral feeds involves assessing a preterm infant's behavioral cues and physiological stability (Lessen, 2011). Many nurses and families have difficulty learning to feed the preterm infant due to the inability to read the infant's behavioral cues. Infant cues are an infant's own body language and parents who are able to identify these cues are able to form a positive parent-infant attachment. Nurses can help the families of preterm infants by promoting the confidence necessary to feed their infant by teaching them the feeding cues, and when to slow down or stop the feeding. The infant is able to develop maturational skills to advance oral feeding skills which are dependent upon many physical, behavioral and environmental factors. Early feeding skills imply the infant can physically maintain a flexed position for feeding with good muscle tone (Thoyre, Shaker, & Pridham, 2005). When an infant demonstrates autonomic stability and the physical ability to nipple feed, they are usually in a state of alertness or quiet awake and able to focus on initiation of a feeding trial. The feeding cues include good muscle tone, stable respiratory rate, alert and fussy prior to feedings, rooting, and bringing fist to mouth for sucking. When the infant displays normal respiratory rate without any episodes of apnea or bradycardia when handled, the nurse/feeder continues to assess for infants oral sucking and coordination of suck, swallow and breathing. The behavioral stress cues are head bobbing, color change, multiple swallowing attempts, grunting, coughing, and choking. These are evidence of feeding difficulties (Ludwig, & Waitzman, 2007; Thoyre, Shaker, & Pridham, 2005).

Preterm infants are exposed to numerous environmental and physiological stressors and must learn to adapt to those stressors. Currently most NICUs are arranged to provide less environmental stimuli which otherwise may be overwhelming to a developing premature infant. Excessive noise, lights, stimuli, and care providers contribute to stress and further disorganization

in the preterm infant development (Jones, 2012). The initiation of oral feedings is historically based on the standard practice of weight and gestational age of the infant. The physician writes the order to start nipple feedings based on the infant's weight and/or gestational age. Yet nurses at the bedside are more competent at assessing when the preterm infant may be ready to nipple feed because they observe the infant during each feeding episode.

Als (1986) described signs of disorganized behavior for preterm infants. Their ability to thumb suck may not be developed until 28 – 31 weeks gestation. The ability to suck starts with no suction and develops into a rhythmic expression with the suction becomes stronger with bursts, pauses, and increased amplitude (Lau, Alagurusamy, Schanler, Smith, & Shulman, 2000).

Oral stimulation is another method that has been used to improve sucking skills for preterm infants (Fucile, Gisel, & Lau, 2005; Lasby & Dressler-Mund, 2011). Oral stimulation is used to assist preterm infants to oral feed and develop stronger sucking skills. Oral stimulation is used prior to oral feedings to help infants develop their readiness to feed. Oral Stimulation has resulted in better oral feeding performance and is becoming more common in the NICU (Arvedson, Clark, Lazarus, Schooling, & Frymark, 2010; Fucile et al., 2005). Infants who received oral stimulation for 15 minutes, twice a day, for ten days prior to starting oral feedings demonstrated greater suction and a more mature suck (Fucile, 2012).

Nurses can determine if the infant is ready to nipple or breast feed by offering non-nutritive sucking (NNS) experiences. NNS involves providing pacifiers to improve infant's sucking ability prior to the time of the initial feed to avoid the risk of aspiration or pneumonia due to poor suck-swallow coordination. Non-nutritive sucking has been studied as an intervention to improve digestion, increase oxygenation, and promote a quieter, more restful state of behavior. NNS also encouraged readiness for nipple feeding (Pickler, 2004). NNS is associated with improved oral

feedings with decreasing time to full oral feedings (Arvedson et al., 2010).

The preterm infant's ability to coordinate sucking, swallowing, and breathing (SSB) are not fully developed until 34 – 37 weeks gestation. The immature SSB coordination puts them at risk for choking or developing respiratory problems, apnea, aspiration, or pneumonia (Boiron, Da Nobrega, Roux, & Saliba, 2009; Thoyre, Shaker, & Pridham, 2005). Preterm infants have difficulty maintaining engagement throughout early oral feedings which can lead to less efficient feeding and prolonged feeding skill development (Pickler, 2004). It is necessary for infants to exhibit feeding readiness behaviors such as hand to mouth, sucking, and rooting before actual oral feeding commences.

Nipple feeding is a task that an infant must accomplish before being discharged home. It is necessary for the infant to achieve physiologic stability prior to discharge. An infant who is unable to regulate physiologic stability may have decreased oxygen saturation or heart rate before, during, or after feedings. Some of the physiologic distress signals include hiccups, facial grimaces, or changes in heart and respiratory rate (Gamerl, 2013). The infant's gestational age and medical condition has a considerable influence in determining an infant's readiness to nipple feed. As the infant's physiologic stability is achieved, the infant's SSB coordination also matures.

The nurse provides guidance to the parent during feeding by helping them recognize their infant cues. They learn about the infant's unique behavior during feeds and are then able to apply appropriate interventions to make the oral feeding a success. When parents are able to modify care according to the infant's behavioral cues, the infant's hospital stay is shortened, the infant starts nipple feedings earlier, and the parent-infant interaction is improved (Fucile et al., 2005, Law-Morstatt, Judd, Snyder, Baier, & Ramasubbareddy, 2003).

Infants benefit from nutrition care plans developed by the interdisciplinary team with expertise of the medical/nursing providers, neonatal dietician, lactation consultant, and the parents (Wessel, 2011). When a team is working toward a common goal, the interprofessional collaboration promotes patient safety and quality of care (Galt & Paschal, 2011). The consistent language and use of common tools enhance communication among team members and promote better outcomes for infant feedings. The interdisciplinary team at these two facilities identified variances in practice with some nurses using infant feeding pathways, some nurses relying on physician/NNP orders to begin feedings, and some nurses using volume-driven feeding practices. All team members should promote the use of cue-based feeding protocols (Gamerl, 2013; Ludwig, & Waitzman, 2007). The preterm infant's discharge will be delayed if they are not competent taking oral feedings.

Problem Statement

A priority consideration for the preterm infant is the ability to oral feed prior to discharge. The nurse should be able to assess for infant feeding readiness by identification of feeding cues. The goal is to provide safe and developmentally appropriate care utilizing cue-based feeding protocols for preterm infants for adequate weight gain. Evidence-based feeding protocols could ultimately provide effective cost savings by decreasing the length of stay for NICU infants.

Rationale

The rationale for this study was to evaluate the relationship of cue-based feeding protocols on the gestational age at first nipple feeding, gestational age at full nipple feedings, and gestational age at discharge from the hospital. The study evaluated the following research question:

Does oral stimulation and use of a cue-based feeding readiness protocol impact the gestational age at first nipple feeding, gestational age at full nipple feedings, and

gestational age at discharge from the NICU?

Hypothesis

Infants who receive oral stimulation twice a day and are assessed and fed with a cue-based feeding protocol will begin nipple feeding earlier, achieve full nipple feedings earlier, and will have earlier discharge than infants who do not receive these interventions.

Definitions of Key Terms

Cue-based feeding = feeding an infant based on the infant's physical and behavioral responses.

First nipple feed = first time the infant receives a feeding by bottle or at the breast.

Full nipple feeds = taking all feedings by breast or bottle in a 24 hour period (eight oral feedings). The infant will be taking full feedings within 30 minutes with no episodes of apnea, bradycardia, or desaturation ($spO_2 \geq 85\%$).

Gestational Age = period of time between conception and birth.

Oral feeding = nipple feedings that occur with the infant placed at the breast or bottle.

Oral stimulation = providing gentle tap or stroking of infant's mouth, lips, or tongue before the infant is taking a bottle feeding or being put to breast.

Purpose Statement

The purpose of this study was to evaluate the use of two feeding readiness protocols at two different NICUs within the Alegant-Creighton health care system. The two protocols included the implementation of oral stimulation and cue-based feeding assessments.

Methodology

Design, Setting, and Sample

The study design was a quasi-experimental, retrospective quantitative design using data

from a pre-intervention group that did not receive the feeding protocol and a post-intervention group that received the oral stimulation and cue-based feeding protocol. The two Midwest NICU facilities were level three units which ranged in size from 24-36 beds each.

The convenience sample was 1155 preterm infants less than 37 weeks admitted to the NICU from January 2008 until April 2013. The pre-intervention infants (n = 503) were born prior to implementation of the oral stimulation program and feeding protocol. The post-intervention infants (n=652) received oral stimulation and were assessed with the cue-based feeding protocol (Table 1).

Instruments/Tools/Measures

The oral stimulation protocols and cue-based feeding protocols were implemented at both facilities at different times. The oral stimulation protocols were similar and both protocols were adapted from the work of Fucile et al. (2005) and Lessen (2011). Hospital A created and implemented the Oral Feeding Process Tool (Figure 1) to determine preterm infant feeding readiness. This tool incorporated three different feeding scales and an Oral Stimulation Protocol (Table 2). The Infant-Driven Feeding Scales by Ludwig & Waitzman (2007) included the Feeding Readiness Scale (Figure 3), the Quality of Nippling Scale (Figure 4), and the Caregiver Technique Scale (Figure 5). Hospital B used a variation of the three Infant-Driven Feeding Scales within their Feeding Pathway (Figure 6).

Data Collection Procedure

Initially, the medical record was reviewed for the specific criteria being studied as well as demographic information. Demographic information included gender, gestational age at birth, birth weight. Exclusion criteria included:

- 1) Any infant with any congenital birth defect.

- 2) Infant with genetic birth defect i.e. down syndrome/ or other genetic syndrome.
- 3) Hypoxic Ischemic Encephalopathy or asphyxia.
- 4) Known neurological disorder.
- 5) Any infant with oxygen that is high flow

The Oral Feeding Process Tool (Figure 1) or the Feeding Pathway (Figure 6) was used prior to each infant assessment to determine when the infant was ready to nipple feed. If the infant did not meet the criteria for nipple feeding, then the infant was gavage feed and reassessed in 24 hours. These infants were provided with oral stimulation even if they were not nipple feeding. The oral stimulation continued for five minutes every twelve hours and if the infant did not score a one or two on the Feeding Readiness Scale (Figure 3), the infant continued to be gavage feed. Once the infant achieved a score of one or two on the Feeding Readiness Scale, the infant was offered oral feeding for a minimum of 30 minutes at breast or bottle with the nurse assessing the quality of nipping ability. The infant cannot be fed safely with a score greater than two on the Feeding Readiness Scale.

The Quality of Nipping Scale (Figure 4) was used by the nurses to assess how well the infant nipple fed. The scores on this scale ranged from one to five, with a score of one being a strong coordinated suck throughout the feeding and a score of five being an uncoordinated suck-swallow-breathe response.

The Caregiver Technique Scale (Figure 5) was the third component of the Infant-Driven Scales which described supportive methods used to facilitate early bottle feeding of the preterm infant (Ludwig & Waitzman, 2007). This scale was comprised of 1) external pacing, 2) modified side lying position, 3) chin support, 4) cheek support, and 5) oral stimulation exercises. Both facilities used these caregiver feeding techniques.

Hospital A would start using the Oral Feeding Process Tool when an infant became 29 weeks corrected gestational age (CGA). This included the oral stimulation protocol. Hospital B only used the Feeding Pathway on infants greater than 33 weeks gestation but started oral stimulation when the infant started showing feeding cues.

The outcome measures identified in the medical records were 1) CGA at first nipple feeding, 2) CGA at full nipple feedings, and 3) CGA at discharge. All data were entered into an excel spread sheet by year. The data had no patient identifiers and all data were reported as group data. The data were identified as pre-intervention or post-intervention, and also identified by hospital. The IRB Committee and facility managers approved the study.

Statistical Analysis

The data was analyzed with the IBM SPSS Statistics 21 computer analysis program. Descriptive statistics and independent sample t-test were used with a *p* value of 0.05.

Results

The preterm infant had a mean gestational age at birth of 33 weeks with the range from 22 5/7 weeks to 36 6/7 weeks gestation. The mean birth weight was 2001 grams. The length of stay (LOS) ranged from 2 to 142 days with the mean of 26 days. The average discharge weight was 2467 and ranged between 1894 to 4238 grams (Table 3).

Comparisons of the data between both hospitals found no difference in full feeds and CGA at discharge, but the first facility began nipple feedings three days earlier than the second facility. There was no significant impact on the time to reach full feeds or the CGA at discharge. The sample consisted of 544 females and 611 males.

An independent t-test was conducted on all preterm infants born between 22.7 and 37 weeks gestation (n=1155). In comparing the pre-intervention and post-intervention groups, there

was no statistical difference between the groups.

An independent t-test was conducted on just the preterm infants less than 27 weeks gestation at birth (n=33). In comparing the pre-intervention and post-intervention groups, there was a statistically significant decrease in the CGA at first feeding in this group. The post-intervention infants initiated nipple feedings seven days earlier than the pre-intervention group. Though not statistically significant, the post-intervention group was able to advance to full feedings nine days earlier and were discharged from the NICU eight days earlier than the pre-intervention group (Table 4).

Discussion

The purpose of this study was to evaluate the use of oral stimulation and cue-based oral feeding protocols between two different NICUs to determine if there were any differences in outcomes of infants comparing pre-intervention and post-intervention care. The results found that infants less than 27 weeks gestation at birth benefit with the use of both oral stimulation and assessment with a cue-based feeding protocol. The hypothesis that infants would begin to nipple feed earlier, achieve full nipple feedings earlier, and have earlier discharge from the hospital than infants who did not received these interventions was found to be valid only for those infants less than 27 weeks gestation. The findings are clinically significant but do not show statistical significance.

In previous studies, the use of specific stimulation of the cheek, gums, tongue, and lips prior to oral feeding improved suck, swallow and breathing coordination in infants 26 to 29 weeks gestation at birth (Fucile, Gisel, & Lau, 2002; Fucile et al., 2005; Boiron, Da Nobrega, Roux, & Saliba, (2009); Lessen, 2011). The studies by Fucile (2012), Fucile et al. (2005), and Arvedson (2005) suggested that oral stimulation programs demonstrated positive effects on sucking, which

resulted in earlier first oral feeding and accelerated the process to attain full oral feedings. These findings are consistent with the results for the preterm infants less than 27 weeks in this study.

The initiation of the oral stimulation protocols varied between the hospitals with one starting at 29 weeks CGA and the other starting according to infant cues and physiologic stability. The first was done by the nurses and the second initiated by speech therapists. Both protocols utilized the five minute stimulation twice per day compared to prior studies by Fucile, Gisel, & Lau (2002) where the oral stimulation went for 15 minutes twice per day and Lessen (2011) conducted five minute stimulation once per day. The longer time periods of oral stimulation may tire preterm infants; therefore, this provides good rationale for the use of oral stimulation in conjunction with cue-based feeding protocols. The infants need to be continually evaluated for behavioral and physiologic stability. When infants display fatigue, stress cues, or apnea/bradycardia, they require time to recover. Then when the infant stabilizes, the health care provider may continue oral stimulation for the designated time frame based on NICU policy.

Boiron's (2009) research findings supported the use of cheek and chin support and external pacing strategies (Law-Morstatt, L., Judd, D. M., Snyder, P., Baier, R. & Ramasubbareddy, D., 2003). Side-lying position is another option for developmental feeding support described by Thoyre, Shaker and Pridham (2005). The oral support was provided in conjunction with the Caregiver Technique Scale by Ludwig and Waitzman (2007) during the post-intervention period. Together these pathways offer guidelines for consistent assessment and intervention for feeding the preterm infant.

Parental involvement in oral stimulation and understanding of the feeding cues provides avenues for family-centered care. Lessen (2011) described educating parents on these interventions promoted feeding progression. Both hospital protocols included parents as partners

in the assessment and feeding of their infants. Parents were educated on the oral stimulation protocol and feeding techniques. These strategies can impact the length of stay for preterm infants when parents understand infant feeding cues, infant positioning, and pacing techniques.

The study results are consistent with the clinical findings of Kirk et al. (2007). His research indicated that a cue-based oral feeding pathway advanced the preterm infants to full demand feedings faster, and resulted in effective weight gain and sucking effectiveness. The infant needs to demonstrate physiologic stability, behavioral readiness to feed, and feeding cues to advance to full feedings. When nursing staff implement the tools regularly, preterm infant outcomes can improve with earlier discharge home and cost savings for the NICU.

Individualized assessments and cue-based feeding protocols incorporate the science and art of nursing into bedside care. Pickler (2004) described a model for cue-based feeding protocols to promote optimal feedings for preterm infants with safety and efficiency. Ludwig and Waltzman (2007) developed the infant-driven feeding readiness scales which were used as the primary tools in these NICUs. The scale provides the foundation for bedside nurses in assessing and safely beginning oral feedings. A 35 week gestation intrauterine growth restricted infant may require different feeding approaches than a 26 week gestation infant. By individualizing each feeding according to the infant cues the infant is safely fed (Gamerl, 2013). The study results demonstrated no significant advantages for using oral stimulation in infants greater than 33 weeks gestation at birth.

Oral feedings are essential and considered routine by parents and other healthcare providers within the NICU. Ongoing education and competency validation are needed in the NICU to advance feedings for preterm infants. Volume-driven feeding orders do not demonstrate best practices or consider infant cue-based feeding assessments.

Infants with more experience nipping their feedings may be discharged earlier (Pickler, Best, & Crosson, 2009). But infant discharge outcomes may also be impacted by other factors that are not related to infant oral feeding abilities. Therefore, the CGA at discharge may not be totally affected by the use of cue-based feeding protocols.

Implications for Practice

Oral stimulation and cue-based feeding assessments appear to benefit the preterm infant's ability to suck more efficiently, initiate earlier oral feedings, and improve the time to reach full oral feedings. All health care providers and parents using these protocols consistently would benefit the preterm infant.

The cue-based feeding protocols and oral stimulation program were only clinically significant for improving the time it takes to reach full feedings in the infants less than 27 weeks gestation at birth. Yet the earlier time to reach full feedings by nine days could impact preterm infant's length of hospital stay. The financial cost savings for a seven day earlier discharge from the hospital for the very low birth weight infant could result in approximately \$49,000 savings. The shortened hospital stay and quicker advancement to full nipple feedings can result in a substantial cost savings for a NICU.

Limitations of the Study

The Ludwig and Waitzman cue-based feeding protocols have not been tested for reliability and validity. This tool is being used in many NICUs around the country. All cue-based feeding protocols need to be validated to promote safe feeding practices. When tools are utilized which are not tested the preterm infants are placed at risk. The multiple health care providers bring various work experiences into the NICU. Prior nursing practices focused on volume-driven feedings for preterm infants that may contribute to infant aspiration or other harmful outcomes.

When preterm infants are fed without assessing for feeding cues and awake/alert cycles, the health care providers or parent places the infant at risk. A well-validated tool used by all healthcare providers would assure preterm infant safety.

The limitation of the small sample size (n=33) in the less than 27 week gestation infants may be too small to determine statistical significance for the time it takes the infant to reach full feeds and be discharged. The use of oral stimulation and feeding cues were evaluated together during the data collection for this study. Additional studies separating these two variables are needed.

The minor variation between the two facility protocols may have been a limitation. The questionable consistency with the implementation and application of the use of the protocols among the nursing staff may have impacted study results. Newly hired nurses may have been oriented or trained in different ways to implement the protocols. Yearly competencies could help to control the variations of the use of the cue-based feeding protocols. Also the speech therapists at one facility provided oral stimulation to some preterm infants dependent on their developmental and clinical cues during the pre-intervention period, which may have skewed the results.

The pre- and post-intervention time periods were about three years apart. Many changes in ventilator care and feedings for preterm infants occurred during this time. Infants are requiring less time on the ventilator than in previous years. Many infants are extubated in the delivery room and the use of CPAP has increased. New feeding practices include the earlier initiation of total parental nutrition and trophic feedings. These changes may have contributed to earlier feedings and decreased length of stay.

Recommendations for Future Research

Validation and reliability testing of the tools need to be conducted. Consistency of

education and implementation of the protocols would assure reliability of the instruments.

Separation of the oral stimulation protocol from the cue-based feeding pathway protocol would be beneficial for research purposes. Conducting the research as a randomized controlled trial would improve the validity and the generalizability of the study. Increasing the sample size of infants born less than 27 weeks gestation may confirm the clinical significance of the study results.

Conclusions

Cue-based feeding protocols provide consistency among care providers in determining when is the most appropriate time to initiate and continue oral feedings for the preterm infant. The protocols provide a tangible tool for the bedside nurse to determine when and how to safely begin oral feedings. Offering the infants oral stimulation may facilitate feeding readiness. The protocols can guide the healthcare providers in advancing feedings and can ultimately impact the infants' length of stay. Collaboration and communication among all care providers will enhance safe feeding practices in the NICU. The protocols promote quality and patient safety related to preterm infant feedings.

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References

- Als, J. (1986). A synactive model of neonatal behavioral organization: framework for the assessment of neurobehavioral development in the premature infant and for support of infants and parents in the neonatal intensive care environment. *Physical Occupational Therapy Pediatric*, 6, 3-53.
- Arvedson, J., Clark, H., Lazarus, C., Schooling, T., & Frymark, T. (2010). Evidence-based systematic review: Effects of oral motor interventions on feeding and swallowing in preterm infants. *American Journal of Speech-Language Pathology*, 19(4), 321-340.
- Bingham, P., M., Ashikaga, T., & Abbasi, S. (2012). Relationship of neonatal oral motor assessment scale to feeding performance of premature infants. *Journal of Neonatal Nursing*, 18(1), 30-36. doi:10.1016/j.jnn.2010.09.004
- Blosky, M.A., Zhengmin, Q., Wood, G.C., Betoni, J., Black, L., Wary, A., Materr, H., Stewart, W., (2010). Premature birth, initial hospital length of stay, and cost. *Clinical Medicine & Research*, 8, 184, 1-22. doi:103121/cmr.2010.943.
- Boiron, M., Da Nobrega, L., Roux, S., & Saliba, E. (2009). Pharyngeal swallowing rhythm in response to oral sensorimotor programs in preterm infants. *Journal of Neonatal Nursing*, 15(4), 123-128.
- Donabedian, A. (1987). Some basic issues in evaluating the quality of health care. In L.T. Rinke (Ed.) *Outcome Measure in Home Care*, (Vol I, pp. 3-28). New York: National League of Nursing.
- Fucile, S., Gisel, E., & Lau, C. (2002). Oral stimulation accelerates the transition from tube to oral feeding in preterm infants. [published erratum appears in J PEDIATR 2002 nov; 141(5):743]. *Journal of Pediatrics*, 141(2), 230-236.

- Fucile, S., Gisel, E. G., & Lau, C. (2005). Effect of an oral stimulation program on sucking skill maturation of preterm infants. *Developmental Medicine & Child Neurology*, 47(3), 158-162.
- Fucile, S., McFarland, D.H., Gisel, E.G., & Lau, C. (2012). Oral and non-oral sensorimotor interventions facilitate suck-swallow-respiration functions and their coordination in preterm infants. *Early Human Development*, 88, 345-350.
- Galt, K. A., Paschal, K.A. (2011). *Foundations in Patient Safety for Health Professionals*, Sudbury, MA: Jones and Bartlett Publishers.
- Gamerl, B. (2013). When it comes to establishing an infant-driven feeding program, communication and patience are key. *ADVANCE*, 22 (8), 14-15.
- Jones, L., R. (2012). Oral feeding readiness in the neonatal intensive care unit. *Neonatal Network*, 31(3), 148-155.
- Kirk, A.T., Alder, S.C., & King, J.D. (2007). Cue-based oral feeding clinical pathway results in earlier attainment of full oral feeding in premature infants. *Journal of Perinatology*, 27, 572-578. doi:10.1038/sj.jp.7211791
- Lasby, K., & Dressler-Mund, D. (2011). Making the literature palatable at the bedside: Reference poster promotes oral feeding best practice. *Advances in Neonatal Care (Elsevier Science)*, 11(1), 17-24. doi:10.1097/ANC.0b013e318206e1b4
- Lau, C., Alagurusamy, R., Schanler, R. Smith, E. & Shulman, R. (2007). Characterization of the developmental stages of sucking in preterm infants during bottle feeding. *Acta Paediatrica*, 89, (7), 846-852. doi:10.1111/j.1651-2227.20000.tb00393.x
- Lau, C., & Smith, E. O. (2012). Interventions to improve the oral feeding performance of preterm infants. *Acta Paediatrica.*, 101(20), e269-e274. doi:O.1111/j.1651-2227.2012.02662.x

- Law-Morstatt, L., Judd, D. M., Snyder, P., Baier, R. & Ramasubbareddy, D. (2003). Pacing as a treatment technique for transitional sucking patterns. *Journal of Perinatology*, 23, 483-488. doi:10.1038/sj.jp.7210976
- Lessen, B., S. (2011). Effect of the premature infant oral motor intervention on feeding progression and length of stay in preterm infants. *Advances in Neonatal Care (Elsevier Science)*, 11(2), 129-139. doi:10.1097/ANC.0b013e3182115a2a
- Ludwig, S., & Waitzman, K. A. (2007). Changing feeding documentation to reflect infant driven feeding practice. *Newborn & Infant Nursing Reviews*, 3, 155-160.
- Maternal, Infant and Child Health. (2012). *Leading Health Indicators*. Retrieved from <http://www.healthypeople.gov/2020/LHI/micHealth.aspx>
- Medoff-Cooper, B. (2005). Nutritive sucking research: From clinical questions to research answers. *Journal of Perinatal & Neonatal Nursing*, 19, 265-272.
- Medoff-Cooper, B., Verklan, T., & Carlson, S. (1993). The development of sucking patterns and physiologic correlates in very-low-birth-weight infants. *Nursing Research*, 42(2), 100-105.
- Pickler, R. H., Best, A., & Crosson, D. (2009). The effect of feeding experience on clinical outcomes in preterm infants. *Journal of Perinatology*, 29, 124-129.
- Pickler, R. H. (2004). A model of feeding readiness for preterm infants. *Neonatal Intensive Care*, 17(4), 31-36.
- Thoyre, S. M., Shaker, C.S., & Pridham, K.F. (2005). The early feeding skills assessment for preterm infants. *Neonatal Network*, 24, 7-16.
- Wessel, J. (2011). Nutrition and the late preterm infant. *NICU Current*, 2, 1-6.

Appendix A
Oral Stimulation Protocol

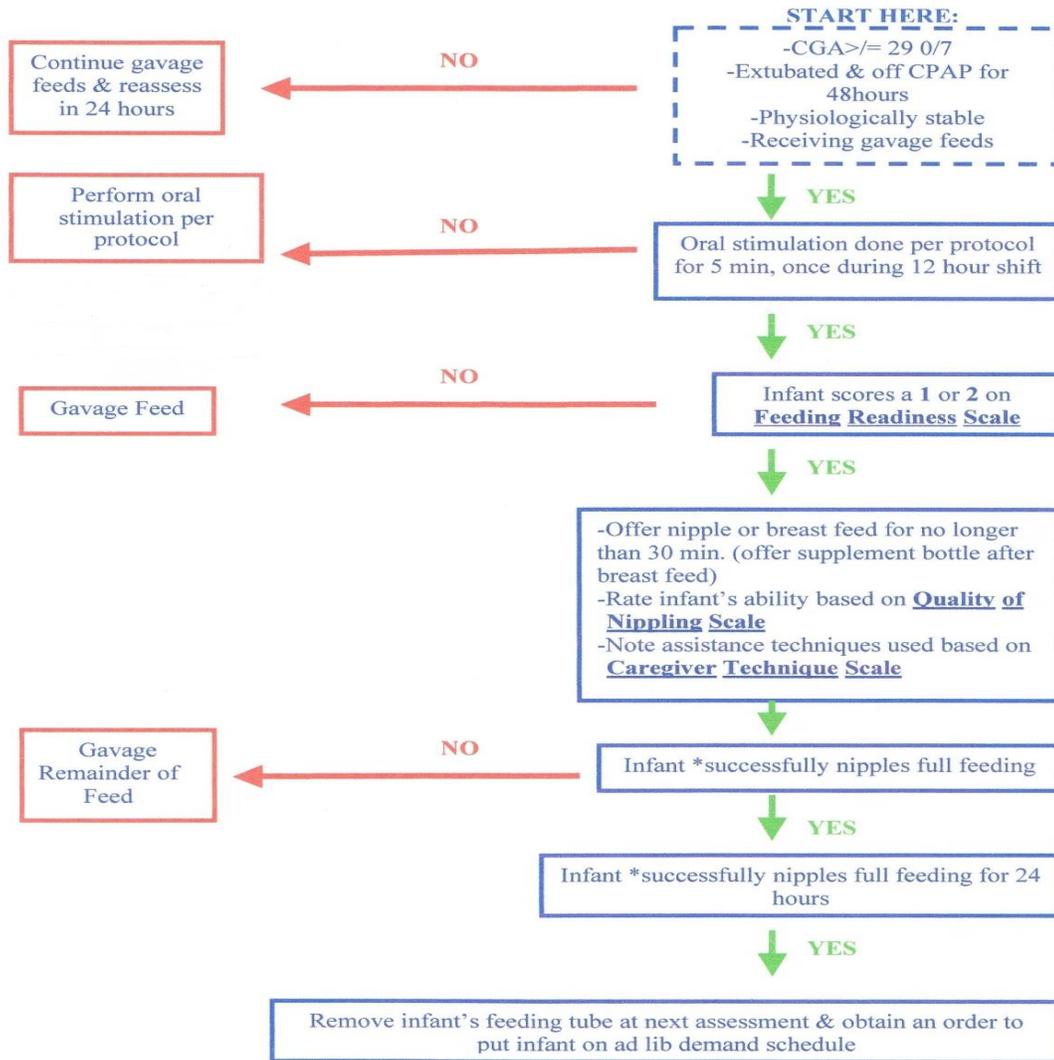
1. Put on latex free gloves.
2. Gently tap infant's lips with index finger, going around the infant's mouth in a circular motion.
3. When the infant opens his/her mouth, put your index finger on the tip of their tongue.
4. Tap the infant's tongue with your index finger, being careful not to put your finger too far into the infant's mouth-for 1 minute.
5. Stroke the infant's tongue with your index finger by pushing down and pulling your finger back towards you-for 1 minute.
6. Stroke the roof of the infant's mouth, being careful not to put your finger too far into the infant's mouth-for 1 minute.
7. Let the infant suck on your gloved finger or pacifier-for 2 minutes.

*Oral Stimulation Protocol followed once every 12-hour shift

There was no established validity and/or reliability of this protocol

Appendix B
Oral Feeding Process Tool

INITIATING & ADVANCING ORAL FEEDINGS PROCESS TOOL
USE PRIOR TO EVERY INFANT ASSESSMENT TO DETERMINE WHEN INFANT IS READY TO NIPPLE FEED
Creighton University Medical Center Neonatal Intensive Care Unit



*Successful nipple feeding: Infant nipples full feeding within 30min, with no episodes of apnea, bradycardia, or desaturation (spO₂<85%)

Appendix C
Infant-Driven Feeding Scales

A. Feeding Readiness Scale:

1. Drowsy, alert, or fussy before care
Rooting and/or bringing of hands to mouth/taking of pacifier
Good tone (presupposes autonomic stability)
2. Drowsy or alert once handled
Some rooting or taking of pacifier
Adequate tone
3. Briefly alert with care
No hunger behaviors
No change in tone
4. Sleeps throughout care
No hunger cues
No change in tone
5. Needs increased oxygen with care
Apnea and /or bradycardia with care
Tachypnea greater than baseline with care

B. Quality of Nippling Scale

1. Nipples with a strong coordinated suck throughout 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 from 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 with feeding

C. Caregiver Technique Scale

1. External pacing
2. Modified side lying
3. Chin support
4. Cheek support
5. Oral stimulation

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Appendix D
Bergan Mercy Feeding Pathway

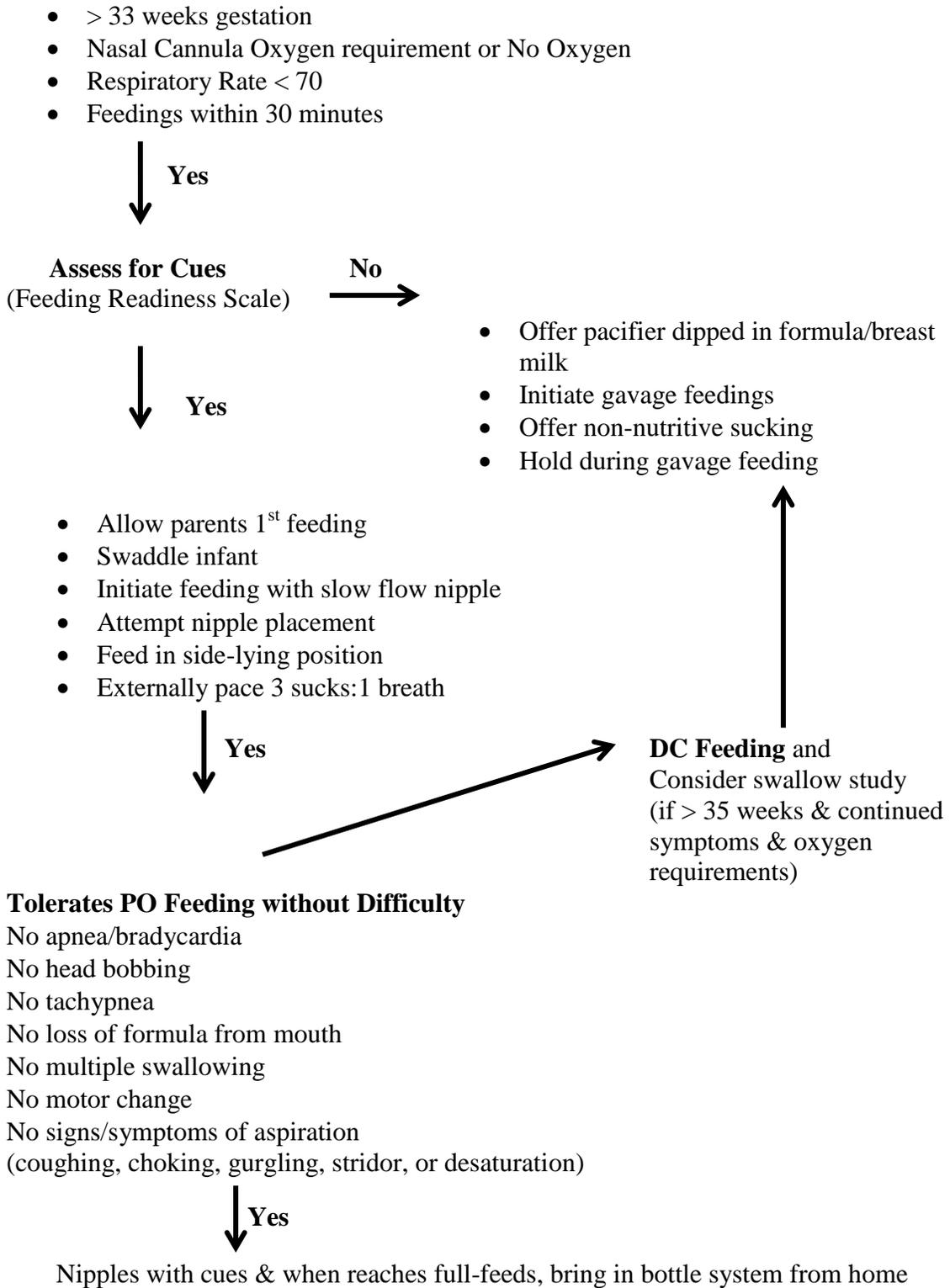


Table 1

Sample distribution

Groupings	Hospital A	Hospital B	Combined
Pre-intervention	158	345	503
Post-intervention	146	506	652
Total:	304	851	Grand Total: 1155

Table 2

Oral Stimulation Protocol

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1. Put on latex free gloves
 2. Gently tap infant's lips with index finger, going around the infant's mouth in a circular motion.
 3. When the infant opens his/her mouth, put your index finger on the tip of their tongue.
 4. Tap the infant's tongue with your index finger, being careful not to put your finger too far into the infant's mouth-for 1 minute.
 5. Stroke the infant's tongue with your index finger by pushing down and pulling your finger back towards you-for 1 minute.
 6. Stroke the roof of the infant's mouth, being careful not to put your finger too far into the infant's mouth-for 1 minute.
 7. Let the infant suck on your gloved finger or pacifier-for 2 minutes.

*Oral Stimulation Protocol followed once every 12-hour shift
There was no established validity and/or reliability of this protocol

Table 3

Preterm Infant Characteristics (n = 1155)

Infant Characteristic	Minimal	Maximum	Mean
Gestational age at Birth	22.71	36.86	33.06
Birth Weight	440	4560	2000.90
Length of Stay	2	142	26.25
Weight at Discharge	1894	4238	2466.57

Table 4

Means and T-test for Infants Less than 27 weeks Gestation at Birth

	Number of Infants	Means	Std. Deviation	t-test for Equality of Means	Difference in Days
CGA at First Feed				2.039*	7 days
Pre	21	34.96	1.46		35 0/7 days
Post	12	33.84	1.61		33 6/7 days
CGA at Full Feed				1.613	9 days
Pre	21	38.06	1.98		38 0/7 days
Post	12	36.74	2.70		36 5/7 days
CGA at Discharge				1.457	8 days
Pre	21	40.47	2.26		40 3/7 days
Post	12	39.29	2.21		39 2/7 days

* = statistical significance at the 0.05 level

CGA = corrected gestational age