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Cue-Based Feeding to Support Oral Feeding Success for Preterm Infants in a Neonatal Intensive Care Unit

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by

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TABLE OF CONTENTS

CHAPTER PAGE

TYPICAL DEVELOPMENT 2

CONCEPTUAL PERSPECTIVE 2

ANATOMY/NEUROLOGIC MATURATION 2

TRADITIONAL FEEDING 3

CONSEQUENCES 5

CUE-BASED FEEDING 8

GAVAGE TO ORAL FEEDING 8

BOTTLE NIPPLE 8

FEEDING SCHEDULE 9

ORAL FEEDING READINESS 10

PACING 11

ENGAGEMENT IN FEEDING 11

ORAL MOTOR FUNCTIONING 12

SWALLOW COORDINATION 13

PHYSIOLOGIC STABILITY 14

SUPPORTING RESEARCH 15

EDUCATING PARENTS 19

CONCLUSION 21

REFERENCES 23

VITA 25

One in every eight babies born in the United States is born premature (Shaker, 2012). That is more than half a million infants per year in the United States alone. Though survival rates of preterm infants have increased over the last decade, the number of infants at risk for nutritional, growth, motor and sensory issues have increased. Preterm babies are admitted to the Neonatal Intensive Care Unit (NICU) after birth where they are cared for by a variety of nurses with a variety of nursing styles. The growing concern has been facilitating and encouraging the infants' competencies without added stress of the preterm care environment, particularly with regard to feeding as this is the most common cause of prolonged hospitalization in the NICU (Shaker, 2012). The traditional volume-driven model can add unnecessary stress to the infant, slow the progression of successful oral feedings, create an overall negative oral feeding experience and lead to more feeding problems later in life. Cue-Based feeding is an infant-driven model that encourages individual, consistent, safe, functional, nurturing and developmentally appropriate feeding to reduce stress for the infant and feeder as well as promote positive oral feeding experiences and feeding development (Ludwig & Waitman, 2007). Finally, educating parents on using cue-based feeding can support parent-infant attachment, reduce stress on both the parent and infant and improve overall intake as well as maintain consistency across feedings to promote successful progression of oral feedings even after hospital discharge (Shaker, 2013a).

Typical Development

Conceptual Perspective

The synactive theory of development provides a basis for the cue-based feeding model for preterm infants. This theory suggests that preterm infants interact with and adapt to their environment through the integration of the autonomic, motor, behavioral and attentional subsystems. The core of this theory is the infant's ability to self-regulate the integration of the subsystems. The synactive theory suggests that the caregivers/parents of preterm infants can assist the infant in self-regulation by providing care contingent upon the infant's behaviors, thus the need for a cue-based feeding model (Pickler, 2004).

The autonomic subsystem includes the organization of the heart and respiratory system. The infant must gain control of the autonomic functioning first because the ability to achieve and maintain control of the other subsystems depends on the functioning of the autonomic mechanisms. During oral feeding, this system endures a lot of stress due to poor organization of the suck/swallow/breathe (Pickler, 2004).

The motor subsystem includes the infant's ability to achieve and maintain tone, posture and smooth body movement. An infant with poor organization of the motor subsystem may have difficulty maintaining energy for oral feeding because he is constantly trying to stabilize muscle tone or maintain posture and therefore burns energy for feeding very quickly (Pickler, 2004).

The behavioral subsystem includes the infant's ability to transition from a sleep state to full arousal and the pattern of behavioral state transitions. This is important for oral feeding because it has been found that an infant that is quiet and alert to start a

feeding typically demonstrates improved bottle feeding outcomes. However, bottle feeding can be difficult for the infant and can cause the infant to become restless or agitated when he is not completely capable of regulating his behavioral subsystem (Pickler, 2004).

Anatomy and Neurologic Maturation

The oral cavity, pharynx, larynx and esophagus begin to develop at four to eight weeks gestation and continue after birth. At nine weeks, the oral cavity, pharynx and esophagus are three distinct anatomic regions that can function separately, but are not yet functional for swallowing (Delaney & Arvedson, 2008). A root response begins to develop at 28 weeks though it is immature at this time (Morris & Gardener, 2011). Swallowing and sucking have been observed in utero as early as 13-18 weeks gestation, however, the coordination of the two does not usually occur before 32-34 weeks gestation. Coordination of the suck/swallow/breathe does not occur until 37 weeks gestation and is often immature until closer to 40 weeks (Pickler, 2004). It is common for infants to demonstrate disorganization of the suck/swallow/breathe past 40 weeks, especially for those that are born preterm. Preterm infants typically experience more difficulty with the development of oral feeding skills and therefore need more support to facilitate safe and successful oral feeding development (Delaney & Arvedson, 2008).

Traditional Feeding

It is common in a NICU to hear nurses talk about oral feeding in numbers. Phrases such as “he has to be able to take a full bottle before going home” or “we got him to take 30cc this session” have driven oral feeding for years. The experience of

bottle-feeding 30cc is not discussed. This has been a common practice in the past and unfortunately is still commonly seen in today's NICUs. This traditional approach is volume driven rather than infant driven. Some professionals see feeding as an easy routine task, rather than a highly skilled intervention piece that is crucial for development of oral feeding skills and to promote positive oral experiences (Shaker, 2013a). This volume driven model often encourages preterm infants to eat even when they are indicating they are not behaviorally or physiologically ready or are just too fatigued (Shaker, 2012).

The focus is empting the bottle with little regard to information the infant is trying to communicate to the feeder. A volume driven feeder often feeds past the infant's signs indicating to stop the feeding. The feeder may feed past signs of mild physiologic instability, swallow-breathe incoordination and disengagement in oral feeding. Volume-driven strategies include removing the blanket and feeding the infant un-swaddled which does not support the flexion that preterm infants are often unable to maintain on their own. Nurses will commonly select a nipple with an increased flow rate that is often too fast for preterm infants to coordinate the suck/swallow/breathe safely (Shaker, 2013b). The potential for silent aspiration is higher for this population and chin/cheek support is commonly observed in a volume-driven model, which can increase the flow rate and make the flow even more difficult for the infant to manage (Shaker, 2009). The infant's head may not be completely supported which can lead to the infants head and neck tilted back making it more difficult for the infant to successfully close the airway during the swallow to prevent penetration or aspiration (Shaker, 2013b). Prodding such as pulling the nipple in and out, twisting or turning the nipple, jiggling the nipple,

squeezing the infant's cheeks, and moving the infant's jaw up and down have been common practices to force the infant to keep eating. Though all of these tactics were intended to encourage intake it actually can force liquid into the infants mouth when they are not expecting it, therefore, not supporting a positive oral feeding experience and putting them at increased risk of aspiration (Thoyre, Shaker, & Pridham, 2005).

This approach does not support positive oral feeding experiences for the infant and can have many negative effects. Negative oral feeding experiences in which the infant's communication is ignored can create maladaptive feeding behaviors, learned feeding refusal and long-term feeding aversions (Shaker, 2013b).

Consequences

A volume-driven model does not support the infant or provide a positive oral experience. Negative oral experiences can cause the infant to develop compensatory strategies that can adversely affect success at oral feeding. One example is if an infant is having difficulty coordinating the suck/swallow/breathe the infant may compensate by shutting down or move to a lower sleep state, which is accompanied by decreased postural control, especially in the oral cavity. This would appear as if the infant was having difficulty maintaining the fluid in his mouth and therefore letting the liquid fall out of his mouth. A volume-driven nurse would often provide chin/cheek to "help" decrease the liquid escaping the oral cavity. This results in a large uncontrolled bolus moving passively toward the infant's airway compromising oxygenation. As the infant attempts to protect his airway, coordination of feeding behaviors is typically lost and the infant's physiologic stability is compromised causing apnea, cessation of breathing, or bradycardic, drop in heart rate below 60 beats per minute, events. An accumulation of

negative events such as physiologic instability may provide negative feedback and lead to feeding refusal or oral aversion behaviors (Shaker, 2009).

Since success at oral feeding is typically judged by an infant's oral consumption amount rather than full assessment of suck/swallow/breathe coordination, preterm infants are often discharged home prior to 38 weeks postmenstrual age (PMA) with oral feeding skills still developing. Research has shown that within the first two weeks post-discharge from the NICU fifteen percent of preterm infants are re-hospitalized with feeding difficulties (Pickler, Reyna, Griffin, Lewis, &Thompson, 2012).

Feeding difficulties are still reported for preterm infants at 1.5-3.5 years of age. A questionnaire was sent out to parents of all children of very low birth weight or of gestational age (GA) of less than 32 weeks born between July 1994 and July 1996 and admitted to the NICU of Flinders Medical Centre. The questionnaire consisted of 48 items addressing feeding history and parents' perceptions and concerns about their child's current eating behaviors, growth and health (Cerro, Zeunert, Simmer, & Daniels, 2001).

Questionnaires for 95 children were returned and analyzed. Of the questionnaires returned, the mean GA was 29.2, mean birth weight of 1243 grams (2.74 lbs) and mean stay in the NICU of 9.4 weeks. The median corrected age of the returned questionnaires was 31 months with a range of 19-43 months. Supplemental oxygen was required for 16 infants for a range of 3.3-2.8 (mean of 19) weeks. Four infants required home gavage, feeding through a nasogastric or orogastric feeding tube, for a range of 7.8-41.0 (mean of 14.4) weeks, with one child continuing to receive gavage feeding. Overall, 73% of parents specified feeding related problems. The two

most common problems reported were vomiting (33%) and gastroesophageal reflux (32%) requiring medication. Other problems reported were poor weight gain, diarrhea and colic (Cerro et al., 2001).

Seventy-eight percent of parents reported concern about the quality of food intake and 45% wished to change their child's current eating behaviors. Fifty-eight percent of parents reported food refusal with 69% using coaxing, 22% using bribes or threats, 51% using food reward and 34% using non-food reward to increase intake. These alarming numbers suggest that more parent education may be required to decrease the prevalence of food refusal through creating positive oral feeding experiences starting at a young age (Cerro et al., 2001).

A similar study of preterm infants was conducted at six years of age to determine the prevalence of eating problems in extremely preterm children. Two hundred and twenty-three children born at or before twenty-five weeks and 6 days gestation and parents of 148 classmates of typically developing children were analyzed at six years of age. Parents were asked to complete an eating questionnaire that included nineteen items addressing food refusal, faddy eaters, oral hypersensitivity, oral motor problems and behavioral problems around mealtime (Samara, Johnson, Lamberts, Marlow, & Wolke, 2009).

Questionnaires revealed that 34.9% of extremely preterm infants had total eating difficulty with 33.5% reporting oral motor difficulty, 17% reporting refusal-faddy problems, 23.7% reporting behavioral problems and 23.5% reporting problems with hypersensitivity. Overall, the extremely preterm group had more total eating difficulties, oral motor problems, refusal-faddy problems, behavioral difficulties and problems with

hypersensitivity than the compared classmates. In addition, attained growth in terms of weight, height, head circumference and mid-arm circumference was significantly poorer in the extremely preterm children in normal range than that in comparison classmates as well as a lower BMI (Samara et al., 2009).

Negative feeding experiences can be the cause of maladaptive feeding behaviors creating long-term affects on successful oral feeding. Using an infant driven model supports infant participation and successful development of oral feeding skills as well as decreases the chances of feeding problems later in post-discharge (Shaker, 2013b).

Cue-Based Feeding

Research suggests an infant's state of health and oral feeding experience are the two main factors that effect an infant's progression of oral feed (Thoyre et al., 2005). Cue-based feeding supports these factors and moves away from the volume driven approach to a more infant driven model. This model of feeding requires the infant to communicate with the feeder regarding hunger cues to begin the oral feeding and signs of stress once the feeding is underway (Morris & Gardner, 2011). Focusing on the infant means supporting the infant's efforts to achieve adequate oral feeding skills, regardless of volume. This method supports the infant in learning to feed safely and successfully (Shaker, 2009).

Gavage to Oral Feeding

Prior to the transition from gavage to oral feeding and before every oral feeding session, the infant should demonstrate signs of oral feeding readiness. Such cues

include an alert state, cardiorespiratory stability and hunger cues such as nonnutritive sucking, rooting, mouthing or bringing hands-to-mouth (Morris & Gardner, 2011).

Bottle Nipple

Once the infant has demonstrated all signs of oral feeding readiness, a bottle nipple must be selected to begin oral feeding. Selected an appropriate bottle nipple for the infant is very important because the flow rate can affect respiration, feeding ability and swallowing safety. Though a faster flowing nipple may reduce feeding time, it can increase the difficulty of coordinating the suck/swallow/breathe. Using a faster flowing nipple, the infant is required to spend more time swallowing due to more liquid being presented at one time and therefore decreasing the time the infant spends breathing. Prolonged decreased ventilation due to immature coordination and a faster flowing nipple can increase the likelihood of apneas, bradycardias and an overall negative oral feeding experience (Shaker, 1999).

Kelli Jackman (2013), conducted a study to determine and compare flow rates of twenty-five disposable and commercially available bottle nipples. The results indicated that disposable nipples, often used in a NICU have more variable flow rates between different nipples and between trials of the same nipple. Commercially available nipples tend to have a slower flow rate than disposable nipples. Finally, the study found that the nipples that claimed to be “slow flow” actually have a variety of flow rates; indicating the term “slow flow” is not a commercially regulated term. The study found that true slow flow nipples were the Playtex Ventaire, Similac slow flow and Dr. Brown preemie. These slower flowing nipples may be more appropriate for premature infants that are at high-risk of feeding difficulty (Jackman, 2013).

Feeding Schedule

Oral feedings should be limited to 20-30 minutes per session. This includes time spent re-engaging, burping or resting the infant. After 30 minutes, the infant is burning more calories than he is taking in and therefore successful weight gain can be affected. Feedings should occur every two to three hours from the start of one feeding to the beginning of the next feeding. The time interval is important to maintain to facilitate the sensation of hunger, sensation of a full stomach at the end of the feeding, digestion and promotion of the next feeding cycle (Delaney & Arvedson, 2008).

Oral Feeding Readiness

Prior to each oral feeding session, the infant should demonstrate a flexed body position, bringing hands to midline for oral feeding. Think about the way adults eat. They sit up straight with their head, neck and trunk aligned and with their hands at midline bringing food to their mouth. The same concept holds true for infants; however, premature infants are often not able to support the flexed body position on their own. Therefore, to support flexion the feeder should swaddle the infant with the infant's hands up toward their face at midline. Once the infant has demonstrated all signs of oral feeding readiness and is swaddled to support flexion, oral feeding can begin (Thoyre et al., 2005).

Once oral feeding is underway, the feeder should assess the infant's feeding skills such as ability to remain engaged in the feeding, to organize oral-motor functioning, to coordinate swallowing and breathing and to maintain physiologic stability, as well as observe and respond to any stress cues. Stress cues are an infant's way of communicating to the feeder that something is not going well. Stress cues include

coughing, pulling away from the nipple, arching back, turning head, stop sign hand, raising eyebrows, nasal flaring, stridor, increased work of breathing, splayed fingers, facial grimacing, gagging, gulping, drooling, thrusting tongue, color change, apnea, bradycardia, oxygen desaturation and yelping. If these stress cues occur a feeder using the cue-based feeding model would respond to those stress cues and provide external pacing or a rest break depending on the severity of the observed stress cue (Thoyre et al., 2005)

Pacing

External pacing provides the infant with a smaller bolus size and decreased flow rate to allow the infant to better manage the flow rate and coordinate the suck/swallow/breathe (Morris & Gardner, 2011). A study conducted by Law-Morstatt, Judd, Snyder, Baier and Dhanireddy (2003), indicated that external pacing as a treatment technique can decrease bradycardic incidences during feedings and aid in development of a more efficient suck pattern. In addition, the length of hospital stay for infants that were provided pacing was usually 1.5 weeks shorter than the group which pacing not provided (Law-Morstatt, Judd, Snyder, Baier, Dhanireddy, 2003). Pacing for observed stress cues during the feeding is one of the biggest roles as a feeder using cue-based feeding, however, assessing the infant's feeding skills is also very important. These skills are adequate indicators of oral feeding, rather than the traditional approach of reporting on the volume intake (Thoyre et al., 2005).

Engagement in Feeding

The ability to remain engaged in the feeding implies the infant is able to demonstrate sufficient energy for feeding, maintaining an awake and focused state

throughout the entire feeding. Premature infants often have difficulty remaining engaged therefore improvement in this skill is one of the first steps to successful oral feeding. Premature infants may begin the feeding quiet and alert, however, as the feeding continues the infant may become fatigued and appear drowsy or sleepy. Using cue-based feeding, a feeder should attempt to re-engage the infant in the feeding, give the infant a break or discontinue oral feeding at that time (Thoyre et al., 2005).

Oral-Motor Functioning

The infant's oral-motor organization should be assessed at the onset of the feeding and once the feeding is underway. At onset, a skilled feeder would open his mouth and descend his tongue promptly when his lips are stroked with the bottle nipple. Some infants require additional stroking of the lips, repositioning or even rest. An infant that holds his tongue at the hard palate despite stroking of the lips might be trying to stabilize the head and neck muscles or compensate for excessive breathing effort. Once the infant opens his mouth and descends his tongue to receive the bottle nipple, the feeder should assess the infant's ability to initiate sucking. A skilled feeder initiates an organized and rhythmic suck pattern immediately after accepting the nipple and continues an organized suck once feeding is underway. The suck pattern may change across the feeding, however, a smooth and rhythmic sucking pattern should be constantly observed. An infant that has some disorganized sucking once feeding is underway typically has difficulty coordinating breathing with sucking rather than difficulty organizing oral-motor structures for sucking. An infant that has difficulty organizing oral-motor structures for sucking will have disorganized sucking from the onset of the feeding. Disorganization seen at onsets consists of difficulty to latch on to the nipple,

chewing on the nipple or demonstrating a more nonnutritive or weak-sucking pattern. Weak sucking can be identified by the feeders sense that the nipple could be easily removed from the infant's mouth or that the infant has a very loose hold on the nipple. Next, the feeder assesses the infant's ability to engage in and tolerate long sucking bursts. A more mature infant is expected to engage in long sucking bursts without difficulty, but premature infants often engage in long sucking bursts that exceed their ability to maintain physiologic stability. This should be assessed and pacing or breaks should be provided as necessary to decrease the likelihood of physiologic instability. Finally, the feeder should listen for tongue clicking which indicates that the infant is having difficulty maintaining a cupped tongue on the nipple. This is often observed when an infant is fatigued or would benefit from more postural support (Thoyre et al., 2005).

Swallow Coordination

The next area of assessment is the infant's ability to coordinate the suck/swallow/breathe. Assessment is conducted by listening for the sound of swallowing and breathing as well as observing the infant's ability to manage the fluid. The easiest item to assess in this area is loss of fluid. The instances of fluid loss should be noted such as if it occurs when the infant appears fatigued, during long sucking bursts or is associated with a stress cue. If the amount of fluid on the infant's tongue is more than the infant can manage the infant will often weaken suction on the nipple to allow some of the fluid to run out of the mouth. If weak sucking associated with drooling is observed or if drooling frequently occurs it may be an indication that the flow is too fast and the infant may benefit from an external pacing or a slower flowing bottle nipple.

Another instance in which external pacing or a slower flowing nipple may be beneficial is when the infant is observed to have multiple swallows. Multiple swallows is typically an infants attempt to protect his airway from fluid entering while completing the swallow, however, an infant that is requiring multiple swallows to clear the liquid is not regulating the flow rate of the liquid well (Thoyre et al., 2005).

The feeder should listen closely for changes in breathing, gurgling or congestion. These sounds could indicate that fluid is flowing into the nasopharyngeal area or pooling in the hypopharynx during the swallow. During the swallow the vocal folds should close and reopen when the swallow is complete, making the swallow often felt by the feeder, but not heard. Sounds such as high pitched yelping or stridor can indicate that the vocal folds are opening to soon following the swallow allowing air to pass between the partially closed vocal folds. Gulping or loud, hard swallows indicates the infant is sucking rapidly or that air was swallowed with the fluid. All of these sounds are indications that something is not going well for the infant while trying to coordinate the suck/swallow/breathe and external pacing as well as rest breaks should be provided. These events can often lead to de-saturations, apnea or bradycardic episodes and should be monitored very closely. Coughing or choking is an obvious indication of possible aspiration and a break should instantly be provided (Thoyre et al., 2005).

Physiologic Stability

The next area to assess and respond to given cues is the infant's ability to maintain physiologic stability without excessive work of breathing. This area of assessment is very important especially at the beginning of the feeding and as the

infant becomes fatigued. Balancing sucking and respirations can be difficult for preterm infants as they often have brief, shallow breaths during suck bursts and therefore only partially recover from diminished ventilation that occurs during longer sucking bursts. Both preterm and full-term infants typically engage in more long sucking bursts at the beginning of the feeding which often lead to physiological changes such as desaturation, apnea and bradycardia (Thoyre et al., 2005).

The feeder should assess the infant's breathing pattern and determine if a regular pattern of quiet and adequate breaths are being taken during each suck burst. If the infant does not appear to be taking quiet, adequate breaths then external pacing should be provided to ensure the infant is maintaining adequate respiration to maintain physiologic stability. The feeder should closely observe the infant for stress cues, color changes or changes in physiologic stability and respond accordingly. External pacing should be provided following stress cues to hopefully decrease the likelihood of a change in physiologic stability. If a change in physiologic stability is observed, the feeder should immediately remove the bottle nipple and give the infant a break from feeding (Thoyre et al., 2005).

Supporting Research

In 2004, Kirk, Alder and King conducted research of 51 premature infants <37 weeks of PMA to determine if cue based feeding resulted in earlier achievement of full oral feedings. The control group consisted of twenty-three preterm infants that were advanced on feedings based on the discretion of the attending physician. The remaining 28 infants made up the study group and were advanced on feedings by demonstrating signs of behavioral readiness. These infants began with one oral feeding

per twelve-hour shift. Once the infant was able to successfully take more than 75% of the required volume in less than 30 minutes without significant signs of stress such as change in color, change in state of alertness, changes in breathing pattern, abnormalities in swallowing, apnea, bradycardia, or desaturations, and demonstrates appropriate weight gain for forty-eight-hours the infant can then advance to two oral feedings per shift. Once milestones are reached for two oral feedings per shift the infant advances to ad libitum with a maximum of every four hours. If the infant is asleep or not expressing interest in the oral feeding within four hours, the feeding is gavaged. When the infant had appropriate weight gain for 48 hours without the need nasogastric (NG) feeding tube, the NG tube was removed (Kirk, Alder & King, 2007).

Researchers found that the infants that were advanced on oral feeding based on signs of behavioral readiness obtained full oral feeding six days earlier PMA than infants that were advanced based on the discretion of the doctors. In addition, the infants in the study group had better weight gain than infants in the control group (Kirk et al., 2007).

In 2005, researchers White-Traut, Berbaum, Lessen, McFarlin and Cardenas conducted a study regarding alertness levels, behavioral readiness cues for feeding and feeding efficiency in twenty-one infants 29-35 weeks gestation. The purpose of this study was to examine the relationship between an infant's alert behavioral states, behavior readiness cues for feeding and overall feeding efficiency (White-Traut, Berbaum, Lessen, McFarlin, & Cardenas, 2005).

Researchers randomly assigned infants into a control group consisting of ten infants and the experimental group with eleven infants. Researchers observed and

collected data from three oral feedings. Infants in both groups received routine nursery care including transitioning from gavage to nipple feeding when the infant was 1500 grams or 32 weeks PCA. All infants' baseline vitals and weight were documented prior to each oral feeding session. The experiment group received auditory tactile visual vestibular (ATVV) intervention for 15 minutes prior to all three observed oral feedings. For all infants, researchers recorded pre-feeding periods to determine infant's behavioral state and feeding readiness cues. Infant's behavior state was identified as one of the following seven categories; active sleep, quiet sleep, drowsy, active alert, quiet alert, crying and the indeterminate state. Feeding readiness cues included mouthing, hand-to-mouth, hand swipes at mouth, sucking on hand and sucking on tongue. Finally, feeding efficiency was determined by nipple-feeding volume intake and duration of feeding (White-Traut et al., 2005).

Results for behavioral states over three feedings are as follows; 19% quiet sleep, 44.4% active sleep, 9.5% drowsy, 8% quiet alert, 12.7% active alert, 3.2% crying and 3.2% indeterminate. The control group was typically in the active sleep state and infants in the experimental group had more quiet sleep and alertness. The total number of feeding readiness cues ranged between 0-14 for each infant. The control group had a mean of 5.8 and the experimental group had a mean of 8.6. Volume intake ranged from 17 to 59mL, the control group having a mean of 33.9mL and the experimental group with a mean of 32.2mL. Mean duration of feeding for the control group was 11.73 minutes and the experimental group was 15.8. These values total a mean feeding efficiency of 3.24 for the control group and 2.33 for the experimental group (White-Traut et al., 2005).

The results of this study indicate that alert behavior states prior to feeding are not associated with the number of feeding readiness cues or efficiency of oral feeding. However, this study did determine oral feeding readiness cues such as mouthing, hand-to-mouth, hand swipes at mouth, sucking on hand and sucking on tongue were good indicators of overall oral feeding efficiency. This research study supports the idea of using cue-based feeding to support overall successful oral feeding (White-Traut et al., 2005).

Finally completing a thorough assessment during cue-based feeding as described above can predict post-discharge feeding skills and therefore decrease the chances of re-hospitalization. Two studies analyzed data of preterm infant's feeding skills two weeks post-discharge from the NICU to determine if feeding skills pre-discharge adequately predict post-discharge feeding skills. The first study was a non-experimental study assessing feeding readiness in 95 preterm infants including 22 infants who were included in a follow up study 2-weeks post-discharge. The second study was an experimental study of transition from gavage to oral feeding using four feeding approaches. This study was conducted using 109 preterm infants that included 63 infants who were retained for a follow-up of feeding skills 2-week post-discharge. Both studies took place in the same level III NICU and were approved by the institutional review board (Pickler et al., 2012).

The Early Feeding Skills Assessment (EFSA) was used to measure the infants feeding skills pre- and post-discharge. This assessment tool measures feeding skills of preterm infants through 52 weeks post-conceptual age. Twenty-nine areas are assessed by observation including oral feeding readiness, oral feeding skills,

coordinated swallowing, physiologic stability and oral feeding tolerance (Pickler et al., 2012).

The results of this study indicated the infant's EFSA score pre-discharge was predictive of the EFSA 2-weeks post-discharge for both study groups. Using such a tool in the NICU to evaluate an infant's feeding skills beyond volume intake can help identify infants at risk for poor feeding in the early discharge period. Identifying at risk infants before discharge could allow for additional parental preparation as well as follow up via telephone or other mechanism during the first few days or weeks post-discharge. Identification, additional preparation and follow up could potentially decrease or avoid re-hospitalization for failure to gain weight and parental anxiety toward feeding (Pickler et al., 2012).

Educating Parents

A primary goal of professionals in the NICU is empowering the infants' parents to care for their preterm infant. The idea of having a preterm infant in the NICU can lead to parental anxiety, depression and the sense of a loss of autonomy. Parents may experience difficulty bonding with their infant and NICU staff leading them to perceive themselves as the outsiders. Feeding is one of the earliest opportunities to support the infant and parent connection, however, consistency and continuity among staff is important. Lack of consistency and continuity can create more stress for the infant and the child as well as hinder the parent and infant relationship (Shaker, 2013a).

Professional caregivers should set the expectations of a successful feeding to the quality of the feeding rather than the quantity of the feeding. Parents will modify

their idea of a successful feeding by consistent reports from professionals about successful feedings in terms of quality rather than intake amounts (Shaker, 2013a).

Parents learn and develop their own internal working model about feeding by observing professional caregivers in the NICU. Consistent, infant-driven feeding among caregivers will provide the parents with the support and confidence to feed their preterm infant. When bottle feeding is first introduced a professional caregiver should sit down with the parents during a feeding time and allow the parents to observe a feeding while the caregiver talks the parents through cue-based feeding. An anticipatory guidance model can be used to teach successful cue-based feeding which teaches the parents to identify the infants' behaviors or cues and then to use those cues to guide their response during the feeding. The caregiver should identify the behaviors and cues with the parents, help interpret the cues, identify a possible reason for the behavior and then select an intervention method to help the infant self-regulate. An example would be "Let's see what Tommy tells us during the feeding. See how he did not open his mouth when I stroked his lips with the bottle nipple. He might be telling us that he has to burp, needs a longer break for breathing or that he needs help re-engaging in the feeding. Let's see what happens if we sit him up and burp him and then reoffer the bottle nipple by stroking his lips, then if he doesn't root for the bottle nipple we will unswaddle him and try to re-engage him in the feeding and see if then he will root for the bottle nipple." This method explains what the nurse is doing and why, the infant's behavior because of the nurse's action, possible reasons for the behavior and an intervention plan to promote a successful oral feeding experience. This example of teaching should be

provided throughout the entire feeding session for several feedings until the parents are confortable trying the feeding with professional guidance (Shaker, 2013a).

The next phase of educating parents is guiding the parents while they feed their infant. The professional caregiver observes and provides guided participation to reinforce interventions and to help the parents assess the infant's response to the intervention. An example of this would be "I saw that you tipped the bottle down to give Tommy a break from sucking. That is exactly what he needed. How did you know Tommy needed a break?" This type of reinforcement builds the parent's confidence and makes them feel as they are actually understanding what their infant is communicating to them. When the parents feel as though they understand what the infant is communicating and how to support the infant's needs, a trusting relationship between the parent and infant begins to develop. This relationship is important to facilitate and empower the parents in caring for their infant (Shaker, 2013a).

These examples of teaching should be provided until the parents are confident and successful cue-based feeders. Educating parents is not only beneficial to promote successful oral feeding development but it also supports infant and parent bonding and consistency when the infant is discharged from the NICU (Shaker, 2013a).

Conclusion

Bottle-feeding has been viewed as an easy routine task in the NICU and is often delegated to inexperienced staff such as a new nurse, healthcare technician or even a volunteer. During the period when most preterm infants are learning to orally feed in the NICU, they are also developing motor and sensory neuropathways. Stressful experiences such as physiologic instability or decrease oral motor coordination can

establish altered sensory-motor pathways in the brain that compromise the ability and desire to feed in the NICU and after discharge (Shaker, 2013a). It is critical to understand that at this time, preterm infants are establishing their learned experiences with feeding and therefore every feeding experience must be as positive as possible (Shaker, 2009).

Cue-based feeding supports development while working towards meeting the goals of successful oral feeding, weight gain and discharge. It is a model of feeding that is driven by the infant's behaviors and individual needs to facilitate development of successful and positive oral feeding skills (Morris & Gardner, 2011). Research suggests that using a cue-based feeding model allows a professional in a NICU to assess the infant's current feeding skills to accurately predict post-discharge feeding skills. This can help to decrease the likelihood of re-hospitalization or learned avoidance behaviors during feeding by ensuring the infant is ready for discharge and proper parental education has been provided (Pickler et al., 2012). Thorough parental education on cue-based feeding can aid in maintaining consistency following discharge and making feeding a healthy and happy bonding time for parent and infant as well as facilitate development of successful oral feeding skills post-discharge (Shaker, 2013a).

REFERENCES

Cerro, N., Zeunert, S., Simmer, K., & Daniels, L. (2002). Eating behaviour of children 1.5-3.5 years born preterm: Parents' perceptions. *J. Paediatr. Child Health*, 38, 72-78.

Delaney, A. L., & Arvedson, J. C. (2008). Development of swallowing and feeding prenatal through first year of life. *Developmental Disabilities Research Reviews,* 14, 105-117. doi:10.1002/ddrr.16

Jackman, K. T. (2013). Go with the flow: Choosing a feeding system for infants in the neonatal intensive care unit and beyond based on flow performance. *Newborn & Nursing Reviews,* 13, 31-34. doi:10.1053/j.nainr.2012.12.003

Kirk, A., Alder, S., & King, J. (2007). Cue-based oral feeding clinical pathway results in earlier attainment of full oral feeding in premature infants. *Journal of Perinatology*, 27, 572-578.

Law-Morstatt, L., Judd, D. M., Snyder, P., Baier, R. J., & Dhanireddy, R. (2003). Pacing as a treatment technique for transitional sucking patterns. *Journal of Perinatology,* 23, 483-488.

Ludwig, S. M., & Waitzman, K. A. (2007). Changing feeding documentation to reflect infant-driven feeding practice. *Newborn and Infant Nursing Reviews,* 7(3), 155-160. doi:10.1053/j.nainr.2007.06.007

Morris, A. C., & Gardner S. L. (2011). Cue-based feeding: Evidence-based practice. *Nurse Currents*, 5(2), 1-8.

Pickler, R. H. (2004). A model of feeding readiness for preterm infants. *Neonatal Intensive Care,* 17(4), 31-36.

Pickler, R. H., Reyna, B. A., Griffin, J. B., Lewis, M., & Thompson, A. M. (2012). Changes in oral feeding in preterm infants 2 weeks after hospital discharge. *Newborn & Infant Nursing Reviews*, 12(4), 202-206.

Samara, M., Johnson, S., Lamberts, K., Marlow, N., & Wolke, D. (2010). Eating problems at age 6 years in a whole population sample of extremely preterm children. *Developmental Medicine & Child Neurology*, 52, e16-e22. doi:10.1111/j.1469-8749.2009.03512.x

Shaker, C. S. (1999). Nipple feeding preterm infants: An individualized, developmentally supportive approach. *Neonatal Network,* 18(3), 15-22.

Shaker, C. S. (2009). Improving feeding outcomes in the NICU: Moving from the volume-driven to infant-driven feeding. *ASHA Journal*, 68-74.

Shaker, C. S. (2012). Feed me only when I'm cueing: Moving away from a volume-driven culture in the NICU. *Neonatal Intensive Care,* 25(3), 27-32.

Shaker, C. S. (2013a). Cue-based co-regulated feeding in the neonatal intensive care unit: Supporting parents in learning to feed their preterm infant. *Newborn & Infant Nursing Reviews,* 13, 51-55. doi:10.1053/j.nainr.2012.12.009

Shaker, C.S. (2013b). Cue-based feeding in the NICU: Using the infant's communication as a guide. *Neonatal Network,* 32(6), 404-408. doi:10.1891/0730-0832.32.6.404

Thoyre, S. M., Shaker, C. S., & Pridham, K. F. (2005). The early feeding skills assessment for preterm infants. *Neonatal Network*, 24(3), 7-16.

White-Traut, R. C., Berbaum, M. L., Lessen, B., McFarlin, B., & Cardenas, L. (2005). Feeding readiness in preterm infants. *MCN*, 30(1), 52-59.

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