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The NICU: Environmental Effects of the Neonatal Intensive Care Unit on Infants and Caregivers

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THE NICU: ENVIRONMENTAL EFFECTS OF THE NEONATAL INTENSIVE
CARE UNIT ON INFANTS AND CAREGIVERS

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A Research Paper

Submitted in Partial Fulfillment of the Requirements for the
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The role of the speech-language pathologist (SLP) providing services in the Neonatal Intensive Care Unit (NICU) is emergent. The American Speech-Language-Hearing Association (ASHA) has comprised a document outlining and approving the current roles and responsibilities of SLPs providing services in the NICU (American Speech-Language-Hearing Association [ASHA], 2004). Prior to the construction of this document, the ASHA Scope of Practice (2001) stated swallowing in addition to communication-based disorders is within the scope of practice for speech-language pathologists (ASHA, 2004). The growing role of the SLP practicing in the NICU lead to the formation a position statement and technical report created by the Ad Hoc Committee on Speech-Language Pathology Practice in 2004 (ASHA, 2004). ASHA requires that speech pathologists working in the NICU to possess the following skills and knowledge bases: evaluation and treatment of communication, feeding, and swallowing; parent/caregiver education and counseling; and staff education and collaboration (ASHA, 2004). The SLP is not limited to the above roles and knowledge base. In addition, an SLP in the NICU shall possess the skills necessary to provide discharge and transition planning, provide follow-up care, educate and supervise SLPs, provide public education and advocacy for serving infants in the NICU, and conduct continued educational research in fetal and neonatal development and function to support efficacy of treatment techniques (ASHA, 2004). The SLP's role, knowledge, and skill base in the NICU may be of greater importance than in other clinical settings due to the premature infant's fragile state.

The more immature the infant, the more vulnerable he or she is to the environment they are exposed to. The premature infant does not have the developmental capacity to endure environmental stresses the way a full term infant might (McGrath, et al., 2002). Blackburn (1998) states two major differences between preterm and full term infants. First, preterm infants are born with immature organ systems. Many of these systems, especially the central nervous system, are still experiencing major development. Second, the last weeks or months of typical gestation are spent in the NICU environment. Transition to extra-uterine life given these limitations make the infant extremely vulnerable and increase the likelihood of needed intensive care. New demands are placed upon the infant following birth. The newborn must make the transition from fetal to neonatal circulation, initiate regular respirations, and achieve postnatal homeostasis (Blackburn, 1998). Given the physiologic limitations of the preterm infant, the physical and psychosocial environment is imperative to continued development and the duration of the infant's stay in the NICU.

The physical and psychological neonatal Intensive care unit (NICU) environment may be the single most important factor in neonatal development. Frequent procedures, handling, and exposure to light and noise may cause physiological stress on infants that increase their length of stay in the NICU and ultimately decrease cognitive development. Not only does this environment directly affect the premature infant, but these children are indirectly affected by the caregiver's stress and ability to provide adequate care. Quality and frequency of caregiver participation in the NICU can play an important role in the

effectiveness of the parental figure following discharge. Supportive roles played by nurses, doctors, and speech-language pathologists (SLPs) are also of great magnitude in the immediate days and months following birth. Research studies targeting the initial and continuing development of premature infants, coupled with information obtained from parents and caregivers from the NICU demonstrate the significance of environmental influences on the development of infants and the mental health of caregivers.

The Physical Environment

Noise

The NICU is filled with technologically advanced machines, health care professionals, and caregivers, all of which directly or indirectly generate noise pollution. The Environmental Protection Agency [EPA], (2011), defines noise pollution is defined as an “unwanted or disturbing sound” (para. 1). The EPA department of Air and Pollution, Noise Effects Handbook states “Studies have demonstrated that there is a direct link between noise and health. Problems that are related to noise and health include: stress related illness, high blood pressure, speech interference, hearing loss, and sleep deprivation” (Environmental Protection Agency [EPA], 2011, para. 2). Sudden and loud noise leads to physiological and behavioral disturbances including sleep disturbance, motor arousals, such as startles, crying, hypoxemia, tachycardia, and increased intracranial pressure (Raman, 1997). Increased intracranial pressure can further contribute to intra-ventricular hemorrhage (Raman, 1997). The longer an infant’s stay in the NICU, the more they are exposed to moderate noise levels. Noise is

one of the most significant contributors adversely effecting infants in the NICU. British safety standards mandate that the mean noise level inside an incubator not exceed 60 dB (Raman, 1997). Raman reported sources of noise consist of staff talking and laughing, telephone ring, placing of bowls and other equipment on the incubator, oxygen cylinder changing, and squeaking door hinges. The mean noise levels outside an infant's incubator range from 55-75 dB which mimic noise pollution recorded in a busy office environment, and alarms used to notify staff have been recorded at a noise level of 85 dB (Raman, 1997). It has also been shown that recordings from inside the incubator pick up muffled, indistinct speech (Raman, 1997).

A study by Laskey and Williams (2009) consisting of 22 low birth weight (LBW) newborns demonstrated that the typical extremely low birth weight neonate was exposed to noise levels averaging 56.44 dB during their stay from 26 to 42 weeks postmenstrual age in the NICU. Noise levels were almost never within the American Academy of Pediatrics recommendations of 5.51% of the time. Bed type and respiratory support systems were among the largest contributors of noise pollution in this study. Laskey and Williams (2009) also noted that younger, sicker newborns required more respiratory support than older, healthier newborns. Most of the newborns involved in this study required mechanical ventilation shortly after birth, eventually replaced with a CPAP, followed by a hood or nasal cannula as the infant's condition improved. Newborns were initially placed in relatively quiet Giraffe incubators that buffer external noise. As the newborns aged, they were placed in older incubators that

also buffer external noise, but generate significantly more internal noise.

Newborns were eventually placed in open beds which fully expose them to the physical environment of the NICU (Lasky & Williams, 2009).

Raman (1997) reported older NICUs constructed before the late 1990s are considered noisy by recommended standards. Many interventions have been put into place to help decrease and monitor noise in the NICU. Staff behavior has changed to accommodate noise recommendations. Talking should be at a considerably low level and laughing should be discouraged. Equipment should not be placed on incubators and opening and closing of portholes in the incubator should be done in a gentle manner. Monitoring equipment should be minimal and manufacturers should be encouraged to reduce the noise levels in their products. During the night a noise policy or “quiet period” should be applied. Audible alarms should be replaced by visual alarms, and all units should be transported gently and with care (Raman, 1997).

A study was designed to measure the effects of a “quiet period” on the NICU environment and its influence on physiological and movement responses (Slevin, Farrington, Duffy, Daly, & Murphy, 2000). The study group consisted of 10 preterm infants who were on assisted ventilation. The infant’s age and weight were also taken into consideration to be included in the study. The environment in which infants were nursed was altered by reducing light, noise, staff activity, and infant handling. The infant’s heart rate, blood pressure, oxygen saturation, and movement responses were recorded during this time and compared with a period of normal activity. Environmental data concluded that there was a 98%

reduction in light, a 4-decibel reduction in noise, and a 58% reduction in duration of alarm events. Staff conversation was reduced by 73%, staff activity by 56%, and infant handling by 100% (Slevin et al., 2000). Physiological data concluded that the infant's median heart rate, systolic blood pressure, and oxygen saturation did not alter significantly, although there a median decrease of systolic blood pressure was noted and a median increase of 3 bpm in heart rate and a median increase of .25% in oxygen saturation (Slevin et al., 2000). Infants were significantly less active during the quiet period with a median value of 14.5 movements per hour versus 84.0 movements per hour during the Normal period (Slevin et al., 2000).

Light

Sources of light in the NICU have increased over the years. Little is known about the effects of light exposure on small infants, but damage to the structure and function of the retina has been documented in animal studies. A randomized study by Raman (1997) demonstrated that sick and vulnerable infants that are exposed to normal light levels in the NICU may develop retinopathy of prematurity. Exposure to sunlight (i.e. being nursed by a window) is also a concern. Vision is especially immature in preterm infants (Blackburn, 1998). Light is usually measured in two dimensions, irradiance (i.e. how much light) and illuminance (i.e. what kind of light) (Blackburn, 1998). Continuous, high-intensity light exposure, lack of systematic, rhythmic diurnal patterns, and potential interaction between NICU lighting and retinopathy of prematurity (ROP) are of concern regarding the development of the premature infant (Blackburn, 1998).

Blackburn (1998) provides the following factors that influence infant light exposure: specific infant characteristics (e.g. weight, age, developmental level), location and position in relation to light fixtures and windows, unit design, and diurnal and seasonal variability in the light environment. Additional factors must be taken into consideration for very low birth weight (VLBW) infants, such as, increased eye opening (eyes may appear slit-like instead of closed tightly), increased pupil size, and decreased reactivity of pupil's response to light (Blackburn, 1998). All of which may increase susceptibility to retinal light exposure.

A study was conducted by Bullough, Rea, and Stevens (1996) to determine the long-term effects of light and electromagnetic fields (EMFs) on pineal function, such as, breast cancer, reproductive irregularities, and/or depression. Illuminance, luminance, and broadband resultant magnetic fields were measured throughout the NICU by Bullough and colleagues (1996) both during the daytime and nighttime. Measurements made were relevant to infants and nurses. Illuminances measured during the daytime and nighttime averaged 184 and 34 lux (1x), respectively, with a maximum illuminance of 747 1x (Bullough et al., 1996). This is much lower than what has been reported in previous studies of illuminance in NICUs. However, peak levels are consistent with levels thought to suppress melatonin. From the perspective of the health of infants in the NICU environment, it appears that they may be regularly exposed to fields significantly higher than those experienced by nurses in the NICU. Little is certain about the biological effects of these field levels on infants, or whether

they play a role in the development of melatonin and other circadian rhythms or have any direct effects on biological functions (Bullough et al., 1996).

In order to regulate light exposure in the NICU, environmental changes must be put into place. Constant light may disturb body rhythm and bright lights may not allow infants to open their eyes to look around. Premature infants that are placed in nurseries with dimmed lights progress more quickly in their sleep-wake patterns (Nair, Gupta, & Jatana, 2003). Light may be reduced by covering isolettes with a blanket. The infant should be hooked up to a multisystem monitor. Eyes should always be covered when using phototherapy lights. During “quiet time” at night, lights need to be dimmed along with noise reduction rules. The infant should not be disturbed unless a procedure or handling is critical. These accommodations will promote a normal sleep schedule and support diurnal variations in hormone and temperature levels (Nair et al., 2003).

Handling

The sense of touch is one of the earliest to develop in early fetal development. In extremely small premature infants, their skin is very fragile requiring gentle care. Studies have indicated that for premature infants less than 30 weeks gestational age, touch may be more stressful rather than soothing (Nair et al., 2003). Infants this young are unable to regulate themselves and handle the same amount of stimuli as a full term infant. However, for older premature infants, touching may be helpful. Infants respond differently to different kinds of touch. How often a premature infant is touched should be dependent on

how he or she responds. It is recommended that application of bland, sterile oil be applied to small preterm infants to help soothe them (Nair et al., 2003).

The preterm infant, once aroused, may have difficulty modulating his or her level of arousal even after the stimuli, such as feeding, changing, and medical procedures are removed. Positioning and handling strategies include enhancing flexion in the arms and trunk and preventing flailing and extensions (Fay, 1988).

By taking these factors into consideration, infant stress may be reduced significantly. Blackburn (1998) states that swaddling and containment provide comfort before and after procedures. Nesting using blankets or commercial positioning devices provides boundaries and reduces infant stress. Kangaroo Mother Care (KMC) is also recommended as a positioning and handling technique for medically fragile infants (Blackburn, 1998). The KMC method developed in 1978 by Rey and Martinez in Bogotá, Columbia, for the home care of low birth weight infants (Nyqvist, 2010). Authors explained that a mother kangaroo was chosen to illustrate the three key components of KMC: warmth, breastmilk, and love. Since then, additional application trends have emerged in clinical practice. The original method included 24-hour a day of mother-infant skin-to-skin care (SSC) in the kangaroo position (KP). This method is often implemented with mother-infant SSC in KP, for up to a few hours intermittently, over a limited period of time. (Nyqvist, 2010). It has been shown to benefit infants and caregivers. If an infant is medically stable, clustering of nursery care activities can promote longer rest periods for the infant. Symington and Pinelli (2006) define clustering of care as the implementation of two or more

developmentally supportive techniques. Blackburn (1998) notes, the very immature infant may be unable to withstand multiple intervention techniques at a given time.

The Psychological Environment

Infant Development

Developmentally supportive care fosters neurobehavioral and physiological organization with individualized care for each infant based on providing ongoing assessment. The goal of this kind of care is to help the infant stabilize at each stage of maturation and to support emerging behaviors and organization while reducing the infant's overall stress. Supportive staff and caregivers must be sensitive to the infant's cues and consider how much sensory input each infant can tolerate. Utilization of infant cues, such as signs of stress, stability, engagement (ability to interact), and disengagement (need to be left alone), and sleep-awake states may help promote neurobehavioral organization. By altering caregiving patterns the infant is better able to conserve energy. Using strategies for handling, positioning and altering caregiving patterns can conserve energy and support developmental organization (Blackburn, 1998). Swaddling, nesting, and kangaroo care may provide the infant with comfort during procedures as well as support motor development, and help promote rest. Developmentally supportive care may potentially reduce the risk of complications such as PVH-IVH and chronic lung disorders. Neurobehavioral organization is also promoted and enhanced (Blackburn, 1998) .

Medical advancements have made it possible to improve the care of high-risk infants. This has resulted in decreased mortality and improved long-term development. Follow-up studies continue to show these infants are at significant risk for physiologic, cognitive, and neuromotor problems, especially if the child is of VLBW. Outcomes for infants generally fall into three categories: a) approximately 50% of infants have minimal developmental problems; b) approximately 10-15% demonstrated significant developmental delays; and c) the remaining infants, 60-65%, have mild to moderate developmental problems including behavioral and learning, and motor or language delays. Cerebral palsy, developmental retardation, neurobehavioral/temperament differences, vision and hearing problems, speech and language problems, and learning and school problems are among other associated developmental problems (Blackburn, 1998).

Some of the neurobehavioral and temperament differences that are seen in preterm infants include less adaptability, greater impulsiveness, more temper tantrums, shorter attention span, increased rigidity, decreased smiling, and emotional affect (Blackburn, 1998). In addition, preterm infants may also demonstrate decreased social competence, increased irritability, more fearfulness, and often require more structure and continuity added to their natural or home environments (Blackburn, 1998). Problems with balance, coordination, and fine motor delays are also concurrently seen in premature infants.

Preterm infants have a high prevalence of long-term cognitive disturbances. A study consisting of 25 eight-year-old children born preterm

obtained from a follow-up longitudinal study concluded that cortical areas in preterm infants were significantly smaller in comparison to term children, predominantly in the sensorimotor areas of the brain (Peterson, Vohr, Staib, Cannistraci, Dolberg, Schneider, et al., 2000). The magnetic resonance imaging (MRI) scans of the preterm infants were compared to MRI scans obtained from a control group containing term children with similar backgrounds. Results from the study reveal abnormalities primarily in the sensorimotor cortex. Concurrently, all lobes of the brain were affected. Cortical gray matter was also reduced more than expected from the overall reduction of brain matter. Cerebral spinal fluid (CSF) in the ventricles was significantly increased in the premature children. In addition, thinning in the posterior corpus callosum was observed (Peterson, et al., 2000). The volume of brain matter in the premature infants significantly correlated with IQ (Intelligent Quotient) measures. The information obtained by Peterson (2000) indicates that “perinatal events produce long-term disturbances in cerebral development and that these disturbances in cerebral development in turn account for cognitive deficits in preterm infants” (p. 1945).

Language deficits are seen in 20% to 40% of premature infants at approximately 2-years of age. Delays in expressive and receptive language are often observed. Depending on coordination and fine motor control, speech disorders are often observed in these children (Blackburn, 1998). Blackburn also states that as these children progress in age, learning and school problems occur in 20% to 65%. The number of children identified as having residual neuro-developmental problems increases as well.

Infants are unable to communicate their basic needs through speech. Raman (1997) suggests that early development is strongly related to the child's interaction with the environment. The infant learns by responding to sensory stimuli. Attempts to remove environmental disturbances that may lead to overstimulation have been made. Many hospital based programs now target suckling stimulation, tactile, auditory, vestibular, and social stimulation. However, short term developmental gains made by these programs have not been attained at a later age. Raman (1997) proposes that hospital based programs must be more individualized to fit the developmental needs of each premature infant. "The aim of the NICU is no longer merely survival or avoidance of severe disability, but rather the preservation of normal brain function" (Raman, 1997, p.418).

Caregiver Stress

A study was conducted by Turan, Basbakkal, and Ozbek (2008) to determine the effect of stress-reducing nursing interventions on the stress levels of mothers and fathers of premature infants in a NICU. Interviews were conducted with parents and they were provided with an educational program about their infant that was approximately 30-minutes long. The study took place within the first week after their infant was admitted to the NICU. Parents in the intervention group were given information at their request and all of their questions were responded to. Parents in the control group received nothing in addition to the routine unit procedures. Stress scores were measured for both groups after their infant's 10th day in the NICU with the Parental Stress Scale

(PSS:NICU). Results concluded the stress scores obtained by the PSS were significantly lower in the treatment group. Stress scores for the fathers in the treatment group were lower, but the difference between the two groups was not statistically significant. Turan and colleagues' research project concluded that parents of children in the NICU experience high levels of stress and that there are interventions which can decrease this overall level of stress. The PSS was used as the primary measurement tool in this study. Information obtained from the PSS demonstrate the stress reducing nursing interventions were the primary cause for the lower stress levels in the intervention groups (Turan et al., 2008).

At first look, the life support equipment in the NICU may cause caregivers shock and anxiety. It is often overwhelming to see incubators as well as the nurses and supportive staff touching and assessing their premature infant. Giving injections to their infant, inserting tubes, intravenous lines and taking blood have been the procedures shown to cause the most parental stress (Turan et al., 2008). When parents learn the function of the interventions and the machines attached to their premature infant, they often no longer perceive it to be stressful (Turan et al., 2008). Caregivers at times are required to give an immediate response to NICU staff or they are provided with new information and feel that they are expected to react positively. Issues that arise are life and death crisis and the future quality of their child's life, all while attempting to monitor and care for their child. Another study by Preyde and Ardal (2003) was discussed by Turan. This study examined the effectiveness of parent-to-parent peer support for mothers of very preterm infants in an NICU. The study consisted of 32

mothers in the intervention group and 28 mothers for the control group. Both groups received services as usual in the NICU with the exception of the intervention group receiving peer support intervention. This support program consisted of educational parental support-group meetings and the parent “buddy program.” The “buddy program” consisted of individual parent-to-parent support, primarily through telephone communication given by a parent who was experienced with the NICU (Turan et al., 2008). Mothers who participated in the “buddy program” reported less stress, state anxiety, and depression than mothers in the control group (Turan et al., 2008). Parents who are given tours of the NICU often report that they are shocked at the size of the very preterm infants, however, feel less stress following a tour (Turan et al., 2008). Healthcare professionals have aimed to reduce the negative effects of the psychological environment since the earliest days of the NICU. Further research should be conducted to determine additional sources of psychological stress among parents and caregivers.

Supportive Staff in the NICU

Caregiver Involvement

Studies of caregiving in the NICU environment demonstrate that much of the caregiving experienced by the preterm infant is related to medical intervention. Generally, little time is spent on social interaction.

In the NICU, parents feel like they are invading the space of professionals (Martin, 2001). Often, caregivers feel lost and out of place in this unfamiliar environment. Some of the experiences caregivers share with their premature

infant and supportive staff during their stay in the NICU will mold their interactions with professionals for many years to come. Martin (2001) provides important characteristics significantly influencing a caregiver's future role as advocate. The NICU environment is often child-centered instead of family-centered. Parents need to be included as a part of the NICU team, assisting in the treatment and decision making process for their child. Often, decisions are made with the welfare of the child first and foremost. Parents' needs are generally put lower on the list of priorities, but they are usually content with their child's needs as the center of focus. However, this may not be the best option in caring for infants and their families as a unit (Martin, 2001).

The NICU environment is occupied with a changing group of professionals. Although continuity is preferred it is not always feasible. Raman (1997) suggests that parents, grandparents, siblings, and close friends of the premature infant should be granted unrestricted access to the NICU, but visitations should not interfere with hospital policies for reduced noise, light, and handling. Instead of seeing protocols hanging from the walls, parent oriented pictures and wall paper may create a more ambient environment to relieve stress and comfort infants and caregivers (Raman, 1997). Parents and caregivers could be provided with educational material in the form of booklets, pamphlets, picture cards, and an album of nursery graduates in order give them hope and insight to the working environment of the NICU.

Increased parental/caregiver involvement may be key in providing greater continuity of care for the infant following their stay in the NICU. Providing

caregivers with a focal person during their time in the NICU may promote question asking and more efficient transfer of information in caring for their infant. Caregivers should always feel included in the decision making process. The more knowledgeable they become during this period, the better they will be able to make informed decisions in the future (Martin, 2001). Caregivers should be applauded by supportive staff in the NICU for their ability to learn to parent in this unique environment. They should also be encouraged to interact with professionals on a regular basis, instead of playing a quiet role on the sideline while professionals make their decisions for them. While in the NICU, the caregiver's role as a primary provider should increase. Caregivers should be feeding, holding, bathing, and changing their infant when the infant is medically stable. It is of utmost importance that support staff includes caregivers as much as possible to participate in major milestones (first bottle, first clothes, first time out of isolette, first bath, etc.) (Martin, 2001). It is likely that both the caregiver and infant will benefit when caregivers undertake more typical parental interactions over their course of stay in the NICU. As an added benefit, the infant experiences more continuity of care and the transition from the NICU to the home is easier for all (Martin, 2001).

The Speech-Language Pathologist's Role

The earliest assessment and intervention provided by the speech-language pathologist may be in the NICU. Over the last two decades, clinical interests in children in the birth-to-age-three population have expanded the speech-language pathologist's (SLPs) role as a care provider or "team member"

in the NICU. Several factors may be responsible, including recent medical advances in the NICU improving the rate of survival for preterm infants.

Intervention as early as birth is supported by federal legislation. The NICU is operated by a medical procedural model. Service providers in this setting strive for not only the preservation of life, but the quality of the life that is saved.

Medical speech-language pathology incorporates policies and procedures of developmentally supportive, family-centered care. Adhering to doctor's orders, reviewing charts, documentation, critical thinking, problem solving, and treatment efficacy are essential to distinguishable service delivery (Ziev, 1999). The role of the SLP in the NICU consists of providing developmentally appropriate, family-centered services (including evaluation and intervention of communication, cognition, feeding, and swallowing problems), as well as educating caregivers and staff.

Oral feeding is the most complex sensorimotor process the newborn infant undertakes (Rogers & Arvedson, 2005). Some of the major components of newborn feeding include sucking, swallowing, and breathing. Oral motor patterns of preterm infants differ significantly from full term infants. Sucking patterns were followed infants born at less than 30 weeks gestation, from when they were first introduced to oral feeding until they reached full oral feeding. A significant correlation was observed between the infant's level of maturity and the infant's sucking ability, feeding performance, and progression of oral feeding (Rogers & Arvedson, 2005). Developmental scales can be used to identify and characterize oral-motor skills of preterm infants at any point in their development (Rogers &

Arvedson, 2005). Although developmental scales assessing oral performance are often implemented by nursing staff, it is also within the SLP's scope of practice to implement feeding and developmental assessment.

According to ASHA's Roles and Responsibilities of Speech-Language Pathologists in the NICU guidelines document (2004), it is within the SLP's scope of practice to "provide public education and advocacy for serving infants and families in the NICU" (ASHA, 2004). ASHA states that this is an essential part of any successful and comprehensive program. Education, however, should not be limited to parents and caregivers. SLPs are required to educate fellow staff members within the NICU as well as the community. It is the SLPs responsibility to advocate for infants and families within the NICU or in the community. SLPs are responsible for providing information to families regarding continued services once the child is discharged. This includes, but is not limited to Early Intervention services and individual practitioners with specialized training specific to the individual child (ASHA, 2004).

The Nurse's Role

Upon entering the NICU, the nurse becomes the infant's primary supportive staff with the most contact with infants and their caregivers. It is the nurse's responsibility to provide caregivers with adequate information regarding their child's health status. They also relay information from doctors and other healthcare professionals. Effective nurse-mother communication is critical in supporting the development of a newborn infant. The neonatal nurse must provide developmental care. Developmental care is family centered care

(Blackburn, 1998). The focus is on promoting parental knowledge through building relationships with parents and caregivers. If this care system is being practiced, parents will be partners in caring for the infant. Parenting is a developmental process that can be facilitated by a nurse (Blackburn, 1998). It is the nurse's role to support and teach caregivers the skills needed to advocate and care for their infant while supporting continued development (Blackburn, 1998).

Helping infants achieve successful bottle or nipple feeding is a primary responsibility of nurses. Premature infants are at a high risk for harm following feedings with immediate consequences such as apnea, bradycardia, hypoxia, fatigue, agitation, and long term effects including delayed oral feeding and increased stay in the NICU (Pickler, 2004). It is important that caregivers be included in feedings, especially breastfeeding mothers. Pickler (2004) discussed the synactive theory of development which is a model based on providing infant care when an infant indicates readiness to receive care through autonomic, motor, behavioral, and attentional responses (Pickler, 2004). The autonomic system includes heart and respiratory rate and rhythm, the motor system includes muscle tone, posture, and coordination (smooth body movement), the behavioral subsystem is related to the infant's level of wakefulness (sleep state to full arousal), and attention refers to the infant's ability to the feeding without becoming restless or agitated (Pickler, 2004). The nurse and/or caregiver must become familiar with the behaviors demonstrated by the infant when attempting to bottle feed. Bottle feedings are difficult for infants who do not possess the

above organization skills. Pickler (2004) suggests that factors contributing to bottle readiness include neurologic maturation, severity of illness, and functioning of the autonomic, motor, and behavioral subsystems (Pickler, 2004).

Nurses in NICUs operate in a challenging environment with the demands of care of the infant and providing family-centered care. There is a need for nursing support to assist parents of ill infants. Nurses are in a position to influence caregiver's abilities to cope with stressors and to become effective parents. Interpersonal communication is one principal tool used to trade information between health professionals, patients, and families (Jones, Woodhouse, & Rowe, 2007). Nurses above all, are a primary source of support for parents during this difficult transition from the NICU to the home. Nurses are the primary educators in teaching parents and caregivers how to care for their premature infant (Jones, et al., 2007).

Conclusion

All of the findings thus far regarding the potentially harmful effects of the physical and psychological environment in the NICU provide caregivers, support staff, and health care professionals with implications that change is a necessity. Further research can provide more concrete information as to what change is most important to support normal developmental growth in premature infants. If the above findings continue to be replicated, incidence and severity of later morbidity may decrease. This has not only implications for infant and caregiver health, but also cost savings, for families and society. Research of the physical environment of the NICU: lighting, noise, and handling, has shown that each of

these factors may significantly impact infant development and lead to a longer stay in the NICU. The psychological environment, caregiver-supportive communication, parental stress, infant development, and caregiver education also have been shown to make a significant difference in infant outcomes following their stay in the NICU.

Collaboration and continuing education of the supportive staff in the NICU (doctors, nurses, SLPs, etc.) are vital in the success of the unit. Infants and their families rely on these professionals for education, help with decision making, and most importantly, quality care. Although there are likely many NICU units with supportive staff that possess these qualities, there is always room for improvement. Staff in the NICU must be observant of any signs that caregivers may demonstrate that indicate they need questions answered or assistance pertaining to their health or the health of their infant. Likewise, it is key that staff members not only support another's decisions, but work together cooperatively to create a first class environment for all who are a part of the NICU.

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