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Improving Nurses’ Provision of Neuroprotective Care in the NICU: A Quality Improvement Project

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A Quality Improvement Project

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Chapter 1:

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Infants born prematurely (less than 37 weeks' gestation) require specialized medical and nursing care to survive. Most of these babies require some form of respiratory, cardiovascular, thermal, and nutritional support as their bodies are not yet physiologically mature enough to handle these basic functions on their own. These supports include basic care such as diaper changes and feeding as well as life-saving interventions which include ventilation, intravenous nutrition, thermal regulation, and vasoactive medications. Depending on their gestational age or their diagnoses, they may require higher levels of support, such as nitric oxide gas delivered via a ventilator (Lai et al, 2018) or active hypothermia for a hypoxic ischemic event (Lemyre & Chau, 2018). This care is given in the neonatal intensive care unit (NICU)and no matter the diagnoses or the treatments, these patients also require care to be given in such a way as to protect their developing brain and nervous system.

Infants admitted to the neonatal intensive care unit (NICU) are at increased risk for long-term poor health outcomes including developmental delays, musculoskeletal issues, and/or behavioral and mental health conditions (Lockridge, 2018). According to the March of Dimes Foundation, approximately 10% of all births occur prior to 37 weeks gestational age (MarchofDimes.org, 2021) translating to a cost of $26.2 billion in the United States (Cheah, 2019). In 2017, in California alone, there were almost 472,000 live births with an 8.7% rate of preterm births, translating to approximately 41,000 premature infants (Ely &Driscoll, 2019).

In utero, the environment is ideal for the developing fetus as there is consistent regulation of temperature, noise, and light; likewise, nutrition and oxygenation are passively provided, and appropriate positioning is ensured. These factors allow the fetus to mature and grow in a controlled, deliberate, and sequential manner that is neurologically and developmentally supportive. Preterm birth interrupts this maturation process, forcing physical and neurological development to occur in a disordered way and in an unnatural environment, placing the newborn under severe physiological and neurological stress (Lockridge, 2018). Preterm infants, those born before 37 weeks gestational age, may not have the ability to filter incoming stimuli such as noise, touch, or pain as the neurological system is not developed sufficiently; this lack of neurologic development or maturity is especially important when these infants become stressed (Maguire et al., 2008). Stress responses in preterm infants include bradycardia, oxygen desaturation (hypoxemia), low blood glucose, temperature instability, vomiting, or apnea - all of which are harmful to these patients who do not have physiologic reserves to counter their own stress reactions (Maguire et al., 2008).

The brain develops based on sensory input and a fetus has minimal sensory stimulation, so the brain is not sufficiently mature to tolerate stimuli until nearly term gestational age (Konkel, 2018). When an infant is born prematurely, the brain is unprepared to receive the amount of stimulation that occurs, particularly in the NICU environment (Spilker et al, 2016). This leaves the immature brain in a vulnerable position as it does not have the capacity to effectively filter or process stimuli such as loud noise, bright light, pain, or cold, and the baby becomes overwhelmed (Konkel, 2018). This places not only the infant's neurological development at risk, but also the physical health and development of the infant as they can have negative physiologic and developmental responses to stimuli because of their lack of coping mechanisms. These negative responses impact their cardiovascular and respiratory function, placing the infant at risk for hypoxia which, again, places the brain at risk. It becomes a vicious circle from which the infant cannot escape without significant intervention (Cong et al, 2017). According to Montagna and Nosarti (2016), there is compelling evidence to suggest that these infants are at significantly increased risk for socio-emotional psychopathology, including autism spectrum disorders (ASD), attention-deficit hyperactivity disorder (ADHD), eating disorders, anxiety, depression, and bipolar affective disorder both in childhood and into adulthood.

To combat these negative physiologic and developmental responses, neuroprotective care aims to protect the neonate's developing brain by providing supportive interventions in a variety of areas. These interventions include modifying environmental factors, such as light and noise levels; improving physical contact factors, such as positioning and handling, feeding practices, or parental touch; and providing interventions in a deliberate and appropriate way (Macho, 2017; Millette, et al., 2017a). Historically, neuroprotective positioning and feeding interventions were referred to as developmental positioning and cue-based feeding. The most current literature suggests that neuroprotective care is the appropriate label for these interventions.

A fetus has obtained full term status after the 37th week of gestation. Cohen and Sayeed (2011) reveal that it is generally accepted that 23 weeks gestational age is the point of fetal viability and Ecker et al reaffirm that (2019). This means that staff in NICUs care for patients born as young as 23 weeks gestational age and continue to care for them as they progress towards a gestational age that is near full term or beyond, in some cases. Additionally, full term infants with congenital anomalies or difficulty adjusting to extrauterine life are commonly admitted to NICU settings. Given the complexity of diagnoses and often lengthy hospitalizations, there is significant development that occurs between birth and discharge from the NICU. As primary caregivers, NICU nurses must possess (and use) highly developed critical thinking and care provision skills to help these patients' brains to develop appropriately.

Mefford's Theory of Health Promotion for Premature Infants

In 2004, Linda C. Mefford proposed a theory of health promotion for preterm infants. Mefford framed her application of the theory in environmental factors. In Mefford's theory, a preterm birth disrupts the ideal environment in which a fetus develops, thus throwing the developmental process into chaos (2004). She notes three environments in which the infant must participate and in which nurses must help to mitigate any negative effects (Mefford, 2004).

The first environment is the perceptual environment. This is the external environment of sensory input - specifically light, noise, and temperature. This environment is one which can easily overwhelm an infant who lacks the neurologic capability to filter incoming stimuli. In this environment, energy is consumed to maintain temperature, and sleep is interrupted, so there is limited energy left over for growth and development.

The second environment is the operational environment. This is identified as the environment of microorganisms, gravity, and radiation. The effects of microorganisms on the neonate are obvious, as infection is potentially life-threatening to this population due to their immature immune systems and inadequate ability to respond to infection. The force of gravity is mitigated in utero as the fetus is surrounded by fluid and remains in a flexed posture. After birth, the underdeveloped musculoskeletal system does not have the strength to fight gravity and will tend to be hyperextended, leading to abnormal posture and movement patterns. Exposure to radiation is increased as NICU patients receive x-rays for several diagnostic purposes.

The final environment is the conceptual environment. This includes the cognitive and emotional demands placed on the infant who has an immature central nervous system. The stress that occurs with a premature infant having to learn to eat, to breathe on her own, or to communicate overstimulation is a major challenge for these infants. Additionally, NICU families are also impacted by these environmental challenges as they must learn how to interact with an infant with low tolerance to stimulation.

Mefford's theory grew from Levine's conservation model and incorporates Levine's value for wholeness (Levine, 1967). Mefford identifies threats to the infant's wholeness in four areas: energy balance, structural integrity, personal integrity, and social integrity. Neuroprotective positioning and feeding practices combat all these threats to wholeness. For example, neuroprotective positioning improves energy balance by providing the infant with a comfortable nest and boundaries which are like the intrauterine environment. This intervention prevents the infant from flailing or kicking their extremities to find their boundaries; this promotes sleep and growth and can also decrease oxygen needs (Altimier et al, 2013). Neuroprotective feeding practices (Infant Driven Feeding or IDF) influence energy expenditure by placing the infant in charge of when they are bottle fed. Nurses must carefully evaluate an infant's readiness to feed and determine when it is appropriate to attempt bottle feeding, and just as importantly, or even more importantly, when to stop bottle feeding. Because bottle feeding is an energy consuming activity, nurses must be adept at minimizing the energy expended during feeding by using a protocol such as the IDF program.

Neuroprotective positioning aids in maintaining structural integrity by ensuring the skeleton and musculature have the best chance to develop appropriately by keeping the body and extremities flexed, contained, and aligned in midline. These interventions promote normal musculoskeletal development and potentially eliminate the need for physical therapy to deal with the negative outcomes of poor positioning; these outcomes include right or left sided head preference, plagiocephaly, and abducted shoulders and/or hips (Painter et al., 2019). Neuroprotective feeding practices minimize threats to structural integrity by preventing or minimizing oral aversion which can have lifelong effects.

Mefford describes wholeness in terms of personal integrity as "neurodevelopmental competence" (Mefford, 2004, p. 261). The promotion of personal integrity emphasizes modulating the environment to protect the infant's neurologic and sensory systems, and it is the essence of neuroprotective care. Neuroprotective positioning and feeding promote personal integrity as they honor the patient as a person, not just a set of diagnoses or issues, and allows the provider to offer care that is individualized for that patient's specific needs. Additionally, it provides an environment that minimizes stressful encounters and promotes trust, both of which are critical to a newborn infant, regardless of their gestation or condition. The foundation for the infant's personality is built in the NICU and is impacted by the care they receive there.

Social integrity refers to the infant's position within the family and the threat to the infant's social integrity is caused by the disruption to the family system because of their preterm birth or NICU admission. Mefford's theory emphasizes the importance of helping the parents deal with this crisis and assisting them with integrating the infant into their family. Nurses should tailor their care to facilitate attachment and promote parental comfort and competence. Neuroprotective positioning and feeding practices model behaviors that are beneficial to the infants, and the infants' responses to those neuroprotective care interventions demonstrate to the parents the importance of reading the infant's cues and intervening appropriately to maintain wholeness. Neuroprotective care promotes social integrity as it mitigates the risk of excessive insults that could lead to further impairment of the family unit which could affect their lifelong interactions in society.

Mefford's theory is useful as it relates specifically to the NICU environment and patient population and thus will serve as a guiding force for this project. The value in using this theory lies in that it explains how neuroprotective care is used as a protective measure for NICU patients, especially premature infants. Nurses should frame their care decisions based on the long-term needs and outcomes of their patients. Both theorists, Levine (1967) and Mefford (2004), include cognition and mental health in their models, speaking to the importance of care that is supportive to the central nervous system and meets the emotional needs of the patient and their caregivers. In the NICU, patients are at increased risk for deficits in both areas, making it vital for nurses to offer neuroprotective care to counteract at least some of the risks for these patients.

Neuroprotective Care Perspectives

Neuroprotective care, in various iterations, has been around for a long time. In 2009, Coughlin et al, developed core measures for developmentally supportive care in the NICU. They cite inconsistent language within developmental care theories and protocols and no clear, consistent evaluative method for developmental care as barriers to universal adaptation of developmental care practices. They emphasized making the NICU patient-centered with a focus on long-term outcomes as the basis for prioritizing care. Their core measures include protected sleep; pain and stress management; positioning, feeding, and skin care interventions; family-centered care; and creating a healing physical environment. These core measures also serve to combat variability in care between NICUs and even between staff members within a NICU. Their core measure specific to positioning and feeding advocates for 1) flexion and alignment during all cares, 2) evaluation of position with each interaction to support symmetric development, 3) non-nutritive sucking with gavage feeding, 4) utilizing feeding readiness cues, and 5) a strong support for breastfeeding and feeding breast milk whenever available. All these measures are meant to support the infant's developing brain by offering safe, stable, comfortable, and supportive care.

Coughlin (2017) equates the provision of neuroprotective care with assisting patients with their activities of daily living. Her guideline for care includes maintaining age-appropriate postural alignment to support optimal neuromotor development by promoting the infant's comfort, safety, and physiologic stability. Coughlin also notes that feeding experiences must be free of pain and stress, and should be nurturing and comforting experiences; additionally, feedings must be organized and carried out with the specific infant in mind. For example, attempting to bottle feed an infant less than 33 weeks gestational age may do more harm than good by creating a negative experience with feeding, one that is frightening; this can build a neurologic association between feeding and fear, which can then lead to long-term feeding problems such as oral aversion. However, offering ample skin-to-skin time between infant and mother may actually allow for earlier transition to oral feeding, particularly breastfeeding. The difference between these two experiences is that with the skin-to-skin time, the infant determines their readiness to feed as they are exposed to the scent, sound, and feel of their mother rather than having a bottle forced on them. They decide when to eat and are free to nuzzle or suckle as they see fit. Allowing the infant to make the decision has been shown to decrease the transition time to full oral feeding (Coughlin, 2017; Watson & McGuire, 2016). Shaker (2017a) adds that even one negative feeding experience can affect the brain's synaptic pruning and reinforcement processes. A practice that focuses on allowing the infant to decide may decrease the risk for even one negative feeding experience.

The Newborn Individualized Developmental Care and Assessment Program (NIDCAP) is a comprehensive developmental care protocol in which care is based on the individual cues of each infant, and family members are seen as active members of the baby's care team (Als & McAnulty, 2011; Maguire et al., 2008). Due to the variability between each nurse's interpretation of infant cues, an inability for some parents to be at the infant's bedside every day or for long periods of time, and the constantly active NICU environment, NIDCAP's main tool, Kangaroo Mother Care (KMC), is not a consistently available option (Maguire et al. 2008).

According to this program, infants are to be held skin-to-skin as much as possible. The goal, according to Als (2011), is to create an incubator-free NICU. Various interpretations of this program have been accepted and practiced by neonatal care teams, especially nurses. A meta-analysis of outcomes of this program revealed some potential flaws, including small sample sizes in evaluative studies, no long-term follow up data, and no fiscally driven evaluation (Jacobs, et al., 2002).

Maguire et al. (2008) proposed to study the same patient demographic but to use a more generalized developmental care approach that was not reliant on KMC as a substitute for the incubator, but rather used nesting aids to position infants. They posited that using a more consistent, practiced approach would ensure better outcomes (including long-term outcomes) overall and would be more fiscally responsible from a system perspective. Their results showed that there were no significant differences between outcomes using either developmental care approach. Regardless of the differences between approaches, these studies underscored the importance of providing neuroprotective care to NICU patients to ensure the best possible long-term outcomes.

Altimier & Phillips (2013) described seven neuroprotective core measures for developmental care in NICU patients. Their third core measure, positioning and handling, covered not only the positions in which infants are placed, but also the way in which they are placed there. In utero, the fetus is bounded by the amniotic sac and uterine wall. When an infant is born prematurely, if those boundaries are not provided with positioning aids, the infant will be at much higher risk for musculoskeletal weakness or physiological dysfunction due to improper neuronal development and muscle weakness (Altimier & Phillips, 2013).

Additionally, they note that gravity has a significant effect on the infant's ability to self-position as they do not inherently have the strength to fight gravitational pull. This leads to a flat, unflexed position with the head turned to one side or the other. The ramifications of this type of position are potentially lifelong, especially if musculoskeletal weakness, proprioceptive input, and unmanaged stress (physical and mental) go unaddressed. In addition, the infant will burn more calories trying to manage these deficits, leaving fewer available for growth and development (Altimier & Phillips, 2013).

Lockridge's (2018) findings reflect the same outcomes with the additional note that positional boundaries allow infants to achieve rapid eye movement sleep, which is necessary for neurosensory, auditory, and visual maturation. Altimier & Phillips (2013) also note that positional boundaries, when used appropriately, allow infants to learn to self-soothe leading to a less fussy, more relaxed infant. Maguire et al (2008) found that positional boundaries had no effect on number of days on respiratory support, even when the infant was ≤32 weeks gestational age. They acknowledge that their follow up was incomplete with their subjects. They included 179 infants in their study but did not specify how many infants they were able to follow to at least two years of age.

Another element of neuroprotective care is Infant Driven Feeding; in the past, this has also been referred to as cue-based feeding. However, according to infantdrivenfeeding.com (2018), there are differences between cue-based feeding and the true Infant Driven Feeding protocol. In cue-based feeding, the cues are subjective, and the process is more unit-based than universally defined in the literature. Infant Driven Feeding is rooted in evidence and provides clearly defined feeding scales for readiness, methods, and quality of feeding (Ludwig &

Waitzman, 2013). It outlines when oral feeding should be initiated and even specifies supplementation needs based on breastfeeding time. By contrast, cue-based feeding is really focused more on an overall concept (that of letting the infant decide when and how much to eat rather than being volume-driven by orders from providers) with no objective scales or evaluative pieces (Flanagan, 2017).

Whetten (2016) reminds us that feeding is complex and should be interactive. It is also a developmental task and should be respected as such. The ability to suck, swallow, and breathe in a coordinated manner is a skill that usually comes after 33 weeks gestational age (Altimier et al, 2013). Shaker (2017a, 2017b) further builds on that premise in her two-part co-regulated feeding learning activity for speech language therapists who practice in the NICU. Shaker's teaching advocates for changing the NICU feeding paradigm from volume-driven to patient-driven. The goal is to change feeding from something done to the patient to something done with the patient, always keeping safety, family inclusion, and patient engagement in mind. Safety includes allowing rest periods when the patient shows signs of fatigue; the use of flow appropriate nipples; positioning to assist with handling the flow of the feeding; and including parents in the education and feeding practices. By respecting feeding as a team sport, with the infant as the captain, neural development can occur without making negative associations with feeding, thus decreasing the risk for oral aversion or future eating disorders.

This is in stark contrast to the volume-driven paradigm which has been the NICU standard of practice for many years (Coughlin, 2017). One of the most serious issues with the volume-driven method of feeding is that it puts the infant at increased risk for aspiration. Aspiration can lead to pneumonia, pain associated with feeding, fear associated with feeding, and oral aversion. Oral aversion can have life-long repercussions for infants, including eating disorders, and failure to thrive (Shaker, 2017a).

Chapter 2: Literature Review and Critique

As noted above, there is a significant research base for neuroprotective care in the NICU. However, available evidence-based resources seem to include conflicting results thus underscoring the need for additional research into this important topic. Using the keywords "NICU," "developmental," and "neuroprotective" with a date range of 2016-2021, a search of the CINAHL database yielded no results, however, "NICU" and "developmental" yielded five results. A search of the PubMed database using the keywords "NICU," "developmental," and "neuroprotective" with date range 2016-2021 yielded 259 results. The citations ranged from opinion pieces to book chapters and the recommendations included many different interventions. Many of the citations focused on therapies and interventions related to neurological injury, such as hypoxic ischemic events, so were not relevant for this project. However, there were several articles addressing neuroprotective positioning and feeding practices.

The Infant Positioning Assessment Tool (IPAT) (Koninklijke Philips, 2018) is a tool used to assess a premature infant's position. It consists of six items with cumulative scores ranging from zero to twelve. Scores are generated by observation of specific anatomical areas, including shoulders, hands, hips, knees/ankles/feet, head, and neck. Each of the six areas receives a score of zero, one, or two based on certain criteria. For example, if shoulders are retracted, flat on the bed, the score would be zero. Conversely, if the shoulders are softly rounded, the score would be two. As a general rule, scores below eight indicate that the infant needs containment, flexion, and body alignment, usually with the assistance of properly used positioning aids. The validity and reliability of the tool was established in 2010 by Coughlin, et al. It has been cited in numerous developmental studies as a recommended tool for positioning assessment in the NICU (Charafeddine et al., 2018; Jeanson, 2013; Spilker et al., 2016;Painter et al., 2019; Masri et al., 2018).

Painter, et al (2019) laid the groundwork for this project with their own study which measured the effectiveness of positioning NICU infants in a developmentally supportive way. In their study, they looked at length of stay (LOS) and weight gain to determine what, if any, impact positioning had on the developing premature infant. They found that there was a clinically significant difference in weight gain and overall muscle tone, based on Dr. Dubowitz's Hammersmith Neonatal Neurological Assessment Tool (1998), in their intervention group at discharge. These are important findings as they demonstrate that given appropriate positioning, infants can conserve calories and use them for growth and baseline metabolic functions, allowing them to be in a more relaxed state and to grow at an appropriate rate. Their results were mixed as their intervention group had increased weight gain and muscle tone, but their LOS increased, though not in a statistically significant way. This may be attributed to the small sample size of the study (*n*=27). Though they used a relatively small convenience sample, their findings were consistent across the intervention group. Their control group was culled from a retrospective chart review and both groups' inclusion criteria were gestational age of $\leq$34 weeks with no physical anomalies.

Jeanson (2013) found that the IPAT was useful as an assessment tool as well as an educational tool. In her study, she established baseline IPAT scores and then offered an educational intervention to staff. She then used the IPAT to assess infant positioning at one- and four-months post-education. IPAT scores did not change in a statistically significant way, though there was improvement in scores.

Spilker et al (2016) also used the IPAT as both an assessment tool and an educational device. In their study, a team of staff nurses were recruited to be positioning champions and to assist in the education of their colleagues. This team also performed the IPAT scoring. The team was able to achieve a statistically significant improvement in scores pre- and post-education. However, the researchers note that the improvement was small, and scores did not reach the target level of 10-12. Additionally, there was no follow up scoring, so it is unknown if there was sustainability after the study ended.

Charafeddine, et al., (2018) developed an educational project specifically addressing infant positioning in the NICU using the IPAT. In their educational program, they recruited current staff nurses to be champions for the project. These champions provided hip-to-hip real time education to their peers and evaluated IPAT scoring practices, demonstrating an interrater reliability of 0.80. They performed two Plan-Do-Study-Act cycles of evaluation during their project to identify barriers to nursing compliance and to refine and improve the educational materials. Their results did not meet their target of achieving mean scores of 9 on the IPAT (maximum score of 12); however, their change was significant as their mean scores went from 3.4 to 7.3 within 18 months. They acknowledge that the length of time it took to show significant change speaks to the difficulties involved in changing behaviors.

Masri et al (2018) also used the IPAT to test effectiveness of an educational program regarding infant positioning. Their research team included nurses as well as medical residents which is a shift from other studies of this kind. Their rationale was that the residents, after assessing patients, also positioned them prior to leaving the bedside, therefore, they needed to be included in the educational intervention. This team was able to increase mean IPAT-based scores from 3.4 to 8.1 which was statistically as well as clinically significant (Masri et al., 2018).

Settle and Francis (2019) determined that there is a distinct need for empirical studies to determine the efficacy of Infant-Driven Feeding. They found that there was inadequate information from studies; rather, there were a few quality improvement projects that addressed the effects of Infant-Driven Feeding methods on length of stay and achievement of full oral feeding, but no randomized or quasi-experimental studies. Though this project includes Infant-Driven Feeding as an educational piece for nurses, its aim is not to evaluate Infant-Driven Feeding as a practice. However, as Infant-Driven Feeding is becoming the standard of practice in many NICUs, largely based on the claim that it is neuroprotective in nature, future randomized controlled study-based research is important (Settle & Francis, 2019).

Chrupcala, Edwards, & Spatz (2015) carried out an ongoing quality improvement project with Infant-Driven Feeding. Their finding of an average decrease in length of stay of 6.63 days is significant based on the national average of $5,770.00 per day cost for NICU care (MarchofDimes.org, 2011). This translates to a projected savings of $38,000.00 per patient. Their study sample sizes pre- and post-implementation were not identical (pre- *n*=91, post-*n*=150); they maintain, however, that each of these groups included a comparable proportion of acuity levels and types of patients. Additionally, the implementation of the Infant-Driven Feeding protocol was a change in practice for them. Because of this, they note that the data is truly reflective of a complete change in unit practice and culture. They included the nursing staff and the physicians in the education, which included changing feeding orders as well as documentation practices in the EHR.

The aim of this project was to improve nurses' neuroprotective care skills on this unit, specifically positioning and feeding. Based on direct observation of infant positioning and nurses' actual feeding practices, there was a disconnect between nurses' actual practice and the unit's evidence-based policies and protocols surrounding positioning and feeding, despite several years of annual skills training aimed at improving these practices.

Chapter 3: Methods

Project Design & Setting

This quality improvement project was a quasi-experimental, pre-test post-test educational intervention implemented in a 26-bed, level III NICU at Kaiser Permanente Santa Clara Hospital, a facility located in Santa Clara, California. This NICU provides care to patients with a variety of diagnoses, from prematurity to congenital anomalies to respiratory distress and many others. The average daily census during this project was 19. Though positioning and Infant-Driven Feeding protocols have been in place for a number of years, there has not been systematic evaluation of the feeding and positioning practices to determine whether the education that has been provided via annual skills days was effective. There is a Developmental Care Committee, but their priorities include infant massage, a reading program, and the use of breast milk as pain relief. There is a distinct lack of prioritization for basic hands-on care that is neuroprotective in nature.

The unit generally has commercially produced developmental positioning supplies such as small gel pillows, buntings, Bendy Bumpers, and Z-flo pads, as well as infant t-shirts and blankets to use as positioning aids. The commercially available positioning devices are inconsistently available as ordering is not centralized. The t-shirts and blankets are part of unit par levels so are consistently available.

Population and Sample

This was a convenience sample of registered nurses whose home unit is the NICU. There are approximately 90 nurses on the NICU staff roster with some variability, due to leaves of absence, travelers, and the usual in- and out-flow due to job changes. At the time of this study, there were approximately 75 staff nurses who were invited to participate.

Interventions

Prior to the pre-survey or any education, IPAT (Appendix A) scores were collected by the primary researcher on approximately 100 infants. This information was used to determine the baseline practice level of the nurses. After collection and recording of the IPAT scores, a pre-intervention survey (Appendix C) was introduced and all NICU nurses were invited to participate. There was an invitational poster in the break room that included the web address of the survey in addition to a QR code for accessing the survey from their smartphones. As some of the nurses expressed difficulty with phone or computer use for the survey, hard copies were also made available. There was a 4-week window in which staff could access the survey.

After the NICU nurses had an opportunity to complete the pre-intervention survey, the educational interventions were completed over a 6-week period and included in-services at change-of-shift huddles, poster boards (Appendix D) placed throughout the unit, and hip-to-hip bedside teaching. Educational materials were also given to each nurse - these included laminated copies of the Infant-Driven Feeding protocol scoring systems (Appendix B), the IPAT tool, and the QR code for an educational website that was built for this project (Appendix D). The website included information about Infant-Driven Feeding (i.e., how to score, what the scores mean in terms of feeding practice, and how much of a feeding to gavage based on quality of breastfeeding), neuroprotective positioning (i.e., how to do it and why to do it), a printable handout, and knowledge check quizzes.

After the 6-week educational period, the nurses were invited to take a post-intervention survey (Appendix C). In order to be able to pair the pre- and post-surveys as much as possible, participants were asked to provide an anonymous identifier (i.e., the last 4 digits of their phone number) when taking the pre-survey and to use that identifier in the post-survey as well. Due to time constraints, there was a 2-week window of opportunity for staff to participate in the post-survey.

Instrumentation

The IPAT tool and the pre- and post-surveys developed by the research team were used for this project. The IPAT tool is a validated and reliable tool used for research in NICUs throughout the world as noted in the literature review. The pre- and post-surveys included demographic questions, Likert scale questions surrounding neuroprotective care knowledge and beliefs, and opportunities for participants to score both IPAT and Infant-Driven feeding practices via case study examples.

Data Collection

The pre-intervention IPAT scores were collected over 17 days, prior to beginning any interventions. The post-intervention scores were collected over 15 days, just after the educational interventions were complete. Nurse survey responses were collected during the 4 weeks prior to the project implementation and for 2 weeks post-intervention. The primary researcher and one team member were responsible for collecting the pre- and post-intervention IPAT scores. Interrater reliability was established via use of independent scoring of five patients and then discussion between the two scorers to establish agreement.

Though there are scoring tools used for the Infant-Driven Feeding protocol, those scores relate to infant readiness, ability, and success to nipple feed. There was no feasible way to collect scores of nurses' practice without uninterrupted direct observation by the research team. Given the time constraints during the time of the research, there was not a reasonable way to collect direct observation data for the nurses' feeding practices.

Data Analysis

The pre- intervention and post-intervention IPAT scores were analyzed using a two-sample *t*-test because the sample of infants scored before the intervention and the sample of infants scored after the intervention were different. Levene's test was used to test for homogeneity of variances prior to the *t*-test.

Demographic data and sample scoring on the NICU nurses' surveys were collected for descriptive analyses.

Ethical Considerations

This project was deemed a quality improvement project by the Institutional Review Boards (IRBs) of both San Jose State University and Kaiser Permanente. Both IRBs determined this study to be of minimal risk as the positioning and feeding practices were evidence-based and the population being measured was the registered nurse. To prevent bias, the survey was voluntary and all data were aggregated before analysis by the primary researcher. The registered nurses were reminded throughout the study that the data being collected on their patients was for informational and educational purposes only. Results were not being reported to administration, and there was no punitive aspect associated with scores or responses. The IPAT measurements did not contain any identifiable information about the infant being scored nor the nurse assigned to that patient during that shift.

Results

There was a significant difference in the number of pre-intervention surveys (n=32) versus post-intervention surveys (*n*=8). Because of this, there was no reliable way to conclude whether nurses' attitudes or knowledge changed. However, there were some clear trends uncovered in the surveys specifically related to barriers to providing neuroprotective positioning and adherence to the IDF protocol. The positioning barriers noted most frequently included a lack of positioning supplies, the various equipment attached to the baby, and nurse-centered barriers, such as lack of understanding of how and why to position in a neuroprotective way. The most frequent IDF barriers were nurse-specific factors, such as time constraints and lack of nurses' belief in the value of IDF. Scores for the case studies were essentially identical both pre- and post-intervention.

Pre-intervention mean total IPAT scores were 8.5 and post-intervention mean total scores were 9.9. This difference resulted from three individual areas of score improvement. The shoulder area scores went from a mean of 1.27 to 1.75, hips from 1.44 to 1.82, and knees/ankles/feet from 1.32 to 1.72. These differences were statistically significant based on a *p*-value of $\leq$0.05. Hand position scores also improved from 1.15 to 1.26, though this did not meet the statistically significant threshold. Head and neck scores remained virtually the same. This demonstrates not only a statistically significant increase in scoring, but a clinically significant improvement in practice. Though the improvement did not reach the target score of 10-12, it came extremely close at 9.9.

IDF protocol compliance was improved based on direct observation. However, as there is no specific tool to measure actual practice, besides direct observation of feeding practices, there was no reasonable way to quantify the difference. Based on anecdotal observation, infants were positioned appropriately more often during feeds and nurses stopped oral feeds when infants demonstrated disengagement cues.

Staff offered some comments about their understanding of and value for neuroprotective care. Responses included, “it provides positive experience”; “neuroprotective care nurtures and supports baby growth and development”; “It improves short- and long-term outcomes”.; “It is multifaceted including parental inclusion and encouragement, protected sleep, skin care, good nutrition, positioning, pain management, and creating a healing environment”; “essential to provide each and every care to protect our vulnerable preemie brain”; “It’s essential and would love to see our unit take more of an initiative on this. I would love to see a policy developed”; “neuroprotective care is extremely important and under supported on our unit.”

One of the most detailed responses is below:

"Where should I start? I believe it is up there with the most important things we do. It's my favorite part of my job (positioning, etc.). I probably spend more time positioning than anything else. It's my belief that if we can get the baby into the best position/situation (with respecting to positioning, noise and light reduction, decreased stimuli, etc.), that then everything else will usually follow. A baby in a good position will be a baby that then breathes, digests, sleeps, grows, and bonds well."

These comments were significant in that they demonstrate that we have staff who would likely champion a neuroprotective care program on our unit. This would be a step forward in our commitment to providing the best possible outcomes for our patients. It was also heartening to get real feedback that demonstrates an understanding of the importance of protecting the premature brain and its development and how that one thing can have profound effects on the patient's condition today as well as their lifelong well-being.

Discussion and Clinical Implications

In alignment with the literature review findings, this study demonstrates that education can improve practice. However, as Charafeddine et al (2018) found, change is hard and changing professional practice necessitates a unit culture change. This unit's culture is one that is resistant to change. The phrase, "but we've always done it this way" is heard frequently, especially during introductions to proposed changes in practice, equipment, supplies, or processes. Recruiting neuroprotective care champions provided a certain amount of acceptance of the proposed change. Another facilitation tool was to act on staff recommendations. For example, staff recommended that rather than simply giving each nurse their own laminated copies of the IPAT and the IDF scoring scales and algorithms, placing laminated copies at each bedspace would make them easier and more likely for staff to use them. One nurse said that she appreciated having them handy at the bedside because she used them to teach parents about why and how we feed and position the way that we do. She also used the laminated copies to show parents how to feed and position. In that way, she made them direct members of their baby's care team.

One of the most significant barriers to general acceptance of the concepts included in the education was that initially, staff believed that they were already providing neuroprotective care, so the intervention was, at best, redundant. However, during the intervention phase, staff verbalized increased understanding of and comfort with including IPAT and IDFP in their bedside care. This was a shift in attitude for staff and it occurred relatively quickly offering further credence to the idea that education can change practice, despite initial resistance to change.

Stress can have lifelong effects (Coughlin, 2017). How we, as care providers, mitigate the stress of positioning and feeding will also have lifelong effects. How the healthcare provider or parent approaches and interacts with the infant has a profound effect on the infant's response. This is the primary argument in favor of neuroprotective care. The better we do as a care team to consistently provide neuroprotective care, the better the long-term outcomes will be for our patients

Limitations

The lack of post-intervention survey responses was a limiting factor as it made it virtually impossible to assess education effectiveness by using the case study scenarios in both the pre- and post-intervention surveys. Scores for the case studies were essentially identical both pre- and post-intervention. This was somewhat overcome by the pre- and post-intervention direct observation scoring via the IPAT. It would have possibly been more instructive to have the survey responses to back up the observations.

There is no tool to measure IDF compliance short of direct observation of practice. Due to time constraints, observing nurses to assess their IDF practices was not done consistently. As noted prior, anecdotally, there was improvement in practice. Again, it would have been quantifiable had there been an available tool.

Physical proximity for hip-to-hip education was also a challenge during the Covid19 pandemic. The research team was somewhat able to overcome this with consistent use of personal protective equipment (PPE). The discomfort with close physical proximity that staff expressed, despite rigorous PPE use, was a limiting factor and may have interfered with the amount of personalized education that staff received.

Finally, competing priorities on the unit also acted as limitations. The Developmental Care Committee was focused on other interventions which led to decreased emphasis on this project from leadership. Though the committee's priorities consisted of interventions that would complement neuroprotective care practices, those interventions were not necessary to protect brain development.

Future Opportunities

There continues to be a need for further research into neuroprotective care measures and how to successfully implement them. Considering unit culture, human factors engineering, and change theories, this research could go in many different directions while still advocating for the provision of neuroprotective care. The addition of long-term outcome information would enhance these efforts. An additional benefit could also be found in identifying barriers to providing neuroprotective care and discovering how to overcome them.

A potentially significant research focus is determining how active parental involvement in neuroprotective care might affect outcomes. For example, tracking how parents position and feed their babies could offer insight into how we advocate for parental involvement in the care team. It could also identify what education they need to do so.

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Appendix A – IPAT Tool

Infant Positioning Assessment Tool (IPAT)

Background

Developmentally supportive positioning in premature and critically-ill infants is one of the seven core measures for family-centered developmental care detailed in the Philip's Neonatal Integrative Developmental Care (NIDC) Model.[1,2] (Philips HealthTech, Cambridge, MA). Positioning infants in the NICU is a neuromotor developmental intervention used to minimize positional deformities and to improve muscle tone, postural alignment, movement patterns, and ultimately developmental milestones.[3] Developmentally supportive positioning positively influences physiologic function and stability, sensory development, neurobehavioral organization, skin integrity, thermoregulation, bone density, sleep facilitation, optimal growth, brain development, and neonatal developmental outcomes.[1-9] The core measure 'Positioning & Handling' incorporates the Infant Positioning Assessment Tool (IPAT), which was developed with three goals for use:

1. as a reference and educational tool for teaching,
2. as an evaluation instrument, and
3. as a method of standardizing best positioning practices of premature infants in the neonatal intensive care unit.[4]

Introduction

The IPAT is a validated and reliable easy-to-use pictorial tool used to evaluate posture of premature infants in six areas of the body (head, neck, shoulders, hands, hips/pelvis, and knees/ankles/feet), with cumulative scores ranging from **0 – 12**. A two-point scoring system is used on each area of the body with a score of **2** for ideal therapeutic positioning, **1** for acceptable positioning, and **0** for unacceptable positioning. Any asymmetrical positioning of the arms or legs is scored a **1** (a full score of **2** is never granted). According to the IPAT, a full score of **12** is indicative of ideal positioning, scores of **9** to **11** are acceptable as it accommodates for asymmetry of positioning often needed when technology interfaces (infants with various venous or arterial access needs, drains, surgical sites, etc.) are present, and scores of **8** or lower indicate a need for positioning support that offers containment, promotes flexion and ensures proper body alignment.[4,5,6] Routine utilization of a validated & reliable positioning assessment tool provides appropriate positioning and encourages accountability.

How to use the tool (A, B, Cs)

A) Utilize the IPAT prior to engaging in caregiving interactions to identify infant movements that may benefit from developmentally supportive positioning, as well as ensure that the infant is repositioned appropriately to promote self-regulation, musculoskeletal development, sleep, comfort, sensory system development, and growth. Spontaneous movement is a natural phenomenon for infants; however, in the absence of therapeutic positioning supports, these spontaneous movements may leave the infant 'stranded' in a suboptimal position.

B) Assess and score the infant utilizing the IPAT in each of the six body-part areas.

1. Score a **2** for an ideal therapeutic position
2. Score a **1** for acceptable alternative positioning
   - Score any asymmetrical positioning of the arms or legs
3. Score a **0** for unacceptable positioning.
4. Total the cumulative score.
5. Once this baseline information/IPAT score is assimilated by the clinician, s/he is ready to provide consistent developmentally supportive positioning.

C) Positioning in the NICU simulates the flexed/contained/midline posture of the infant in utero; external supports provide a temporary substitute for the immature infant's diminished internal motor control. Provide premature infants with positioning aids and boundaries to help them maintain optimal tone and position, remain either in a quiet, restful sleep or a relaxed, comfortable wakefulness. Consistency in positioning for the infant can promote strong neuronal connections. Positioning aids provide greater ease-of-use and consistency among caregivers.

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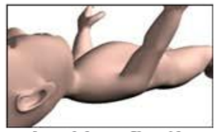
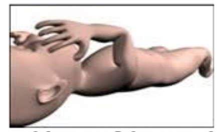
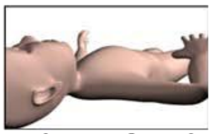
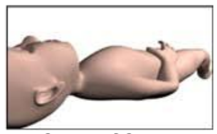
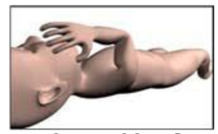
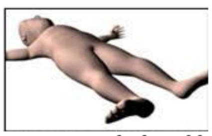
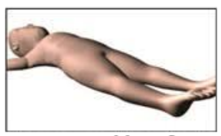
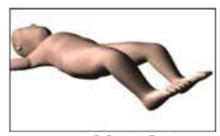
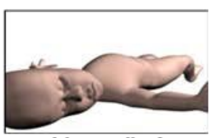
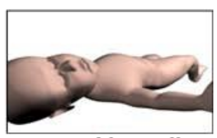
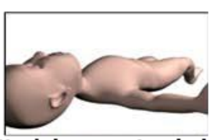
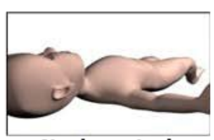
IPAT tool:

Patient's Name:	**Corrected Gestational Age:**
Clinician's Name:	**Date/Time of Assessment:**

Indicator	0	1	2	Score
Shoulders	 Shoulders retracted	 Shoulders flat/in neutral	 Shoulders softly rounded	
Hands	 Hands away from the body	 Hands touching torso	 Hands touching face	
Hips	 Hips abducted , externally rotated	 Hips extended	 Hips aligned & softly flexed	
Knees, ankles, feet	 Knees extended, ankles & feet externally rotated	 Knees, ankles, feet extended	 Knees, ankles, feet are aligned & softly flexed	
Head	 Rotated laterally (L or R) greater than 45° from midline	 Rotated laterally (L or R) 45° from midline	 Positioned midline to less than 45° from midline (L or R)	
Neck	 Neck hyperextended, flexed	 Neck neutral	 Neck neutral, head slightly flexed forward 10°	
			Total Score	

Ideal Cumulative Score = 10-12

Appendix B – IDFP Scales & Algorithm

Infant-Driven Feeding™ Readiness Scoring

Score	Description
1	Alert or fussy prior to care. Rooting and/or hands to mouth behavior. Good tone.
2	Alert once handled. Some rooting or takes pacifier. Adequate tone.
3	Briefly alert with care. No hunger behaviors. No change in tone.
4	Sleeping throughout care. No hunger cues. No change in tone.
5	Significant change in HR, RR, O2, or work of breathing outside safe parameters.

Ludwig, S. M. & Waitzman, K. A. (2007). Changing Feeding Documentation to Reflect Infant-Driven Feeding Practice. *Newborn and Infant Nursing Reviews, 7*(3), pp. 155-160.

Waitzman, K. A., Ludwig, S. M., & Nelson, C. L. (2014). Contributing to Content Validity of the Infant-Driven Feeding Scales© through Delphi surveys. *Newborn and Infant Nursing Reviews, 14*(3), pp. 88-91.

Infant-Driven Feeding™ Quality Scoring

Score	Description
1	Nipples with a strong coordinated SSB throughout feed.
2	Nipples with a strong coordinated SSB but fatigues with progression.
3	Difficulty coordinating SSB despite consistent suck.
4	Nipples with a weak/inconsistent SSB. Little to no rhythm.
5	Unable to coordinate SSB rhythm. Significant change in HR, RR, O2, work of breathing outside safe parameters or clinically unsafe swallow during feeding.

Ludwig, S. M. & Waitzman, K. A. (2007). Changing Feeding Documentation to Reflect Infant-Driven Feeding Practice. *Newborn and Infant Nursing Reviews, 7*(3), pp. 155-160.

Waitzman, K. A., Ludwig, S. M., & Nelson, C. L. (2014). Contributing to Content Validity of the Infant-Driven Feeding Scales© through Delphi surveys. *Newborn and Infant Nursing Reviews, 14*(3), pp. 88-91.

Infant-Driven Feeding™ Caregiver Strategies

Score	Description
A	Modified sidelying: Position infant in inclined sidelying position with head in midline to assist with bolus management.
B	External Pacing: Tip bottle downward/break seal at breast to remove or decrease the flow of liquid to facilitate SSB pattern.
C	Specialty Nipple: Use nipple other than standard for specific purpose, i.e. nipple shield, slow-flow, or specialty feeding system
D	Cheek Support: Provide gentle unilateral support to improve intra-oral pressure.
E	Frequent Burping: Burp infant based on behavioral cues, not on time or volume completed.
F	Chin Support: Provide gentle forward pressure on mandible to ensure effective latch/tongue stripping if small chin or wide jaw excursion.

Ludwig, S. M. & Waitzman, K. A. (2007). Changing Feeding Documentation to Reflect Infant-Driven Feeding Practice. *Newborn and Infant Nursing Reviews, 7*(3), pp. 155-160.

Waitzman, K. A., Ludwig, S. M., & Nelson, C. L. (2014). Contributing to Content Validity of the Infant-Driven Feeding Scales© through Delphi surveys. *Newborn and Infant Nursing Reviews, 14*(3), pp. 88-91.

Infant-Driven Feeding™ Breastfeeding Algorithm

Per RN discretion i.e. EBM production and audible swallow

Quality Score	DBF Time	Amount Supplemented
1-5	0-5 minutes	Gavage All
1-3	6-10 minutes	Gavage 2/3
1-3	11-16 minutes	Gavage 1/3
1-3	>16 minutes	No Gavage

Appendix C

Neuroprotective Care Survey

Start of Block: Default Question Block

To link your pretest and posttest responses we need a label or identifier that you develop and use for both surveys. You will need to remember this identifier so you can enter it on both of your surveys. Some options are: the last 4 digits of your RN license, and the last 4 digits of your drivers license. Please do not use your name or full license numbers as an identifier.

____

Q1 What is your current age in years?

____

Q2 Please specify your ethnicity. ◯ White or Caucasian (1)

◯ Hispanic or Latino (2)

◯ Black or African American (3)

◯ Native American or American Indian (4)

◯ Asian or Pacific Islander (5)

◯ Other - please specify (6) ____

Q3 What is your highest level of education? ◯ Associate's Degree (1)

◯ Bachelor's Degree (2) ◯ Master's Degree (3) ◯ Doctoral Degree (4)

Q4 What is your marital status?

○ Single, never married (1) ○ Married or domestic partnership (2) ○ Widowed (3)

○ Divorced (4)

○ Separated (5)

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Q5 What is your employment status? ○ Status 1.0 (1)

○ Status 0.9 (2)

○ Status 0.8 (3)

○ Status 0.7 (4) ○ Status 0.6 (5) ○ Status 0.5 (6) ○ Per Diem (7) ○ Traveler (8)

6. Q6 How many years have you been a registered nurse?
   ____
7. Q7 How many years have you worked in the NICU specialty?
   ____

*

*

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Q8 How often do you use neuroprotective positioning techniques in the NICU? ○ Never (1)

○ Rarely (2) ○ Sometimes (3) ○ Usually (4) ○ Always (5)

Q9 Which neuroprotective positioning devices do you routinely use? Select all that apply.

☐ Gel Pillow (1)

☐ Snuggle Up/Snugglie (2)

☐ Bendy Bumper (3)

☐ Freddy Frog (4)

☐ Linen Rolls (cloth diapers, blankets, t-shirts) (5)

Q10 Providing neuroprotective care in the NICU is important. ○ Strongly agree (1)

○ Somewhat agree (2) ○ Neither agree nor disagree (3) ○ Somewhat disagree (4) ○ Strongly disagree (5)

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Q11 I know what neuroprotective care is.

○ Strongly agree (1) ○ Somewhat agree (2) ○ Neither agree nor disagree (3) ○ Somewhat disagree (4) ○ Strongly disagree (5)

Q12 I provide neuroprotective care to all of my patients, ○ Strongly agree (1)

○ Somewhat agree (2) ○ Neither agree nor disagree (3) ○ Somewhat disagree (4) ○ Strongly disagree (5)

Q13 My colleagues provide neuroprotective care to all of their patients. ○ Strongly agree (1)

◯ Somewhat agree (2) ◯ Neither agree nor disagree (3) ◯ Somewhat disagree (4) ◯ Strongly disagree (5)

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Q14 Neuroprotective care is a priority on my unit.

◯ Strongly agree (1) ◯ Somewhat agree (2) ◯ Neither agree nor disagree (3) ◯ Somewhat disagree (4) ◯ Strongly disagree (5)

Q15 My unit has policies in place describing how to provide neuroprotective care. ◯ Strongly agree (1)

◯ Somewhat agree (2) ◯ Neither agree nor disagree (3) ◯ Somewhat disagree (4) ◯ Strongly disagree (5)

Q16 My unit has the necessary supplies to provide neuroprotective care. ◯ Strongly agree (1)

◯ Somewhat agree (2) ◯ Neither agree nor disagree (3) ◯ Somewhat disagree (4) ◯ Strongly disagree (5)

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Q17 Neuroprotective care includes interventions in which of the following areas: (select all that apply).

☐ positioning (1) ☐ handling (2) ☐ feeding (3)

☐ pain management (4) ☐ sleep (5)

☐ noise (6)

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Q18 Barriers to neuroprotective positioning include: (select all that apply) ○ lack of appropriate supplies (1)

○ patient condition/diagnoses/acuity (2) ○ patient equipment (lines and tubes) (3) ○ inadequate knowledge (4) ○ inadequate training (5)

○ inadequate skills (6)

○ lack of belief in benefits of proper positioning (7) ○ time constraints (8)

○ nurse preference (9)

○ parentpreference (10)

○ infant preference (11)

○ other - please specify (12) ____

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Q19 Barriers to infant driven feeding include: (select all that apply) ○ lack of appropriate supplies (1)

○ inadequate knowledge (2)

○ inadequate training (3)

◯ inadequate skillls (4)

◯ lack of belief in benefits of infant driven feeding (5) ◯ time constraints (6)

◯ other - please specify (7) ____ Q20

12

Shoulder status Shoulders hyperextended

Shoulders softly rounded

Indicator

0

Shoulders flat/in neutral

Hand and arm location Hands away from the body

Arms extended Hands touching torso Arms extended Hands touching face

Arms flexed

Pelvic position
Hips abducted/externally rotated, and/or in extension

Hips in alignment but extended Hips softly flexed and in alignment with pelvic tilt

Knees, ankles/feet orientation
Knees extended, ankles everted and feet supinated Knees.

ankles, feet straight in extension orientation with supported flexion

Knees, ankles and feet are in midline

Head position
Head rotated laterally (L or R) greater than 45▫ from midline

Head rotated laterally (L or R) 45▫ from midline Head positioned midline to less than 45▫ from midline (L or R)

Chin/Neck position

without tone position with tone

Neck in hyperextension
Neck in extension poorly aligned with spine Neck aligned with spine

Chin in neutral position
Chin in neutral

Q21

12

Shoulder status Shoulders hyperextended

Shoulders softly rounded

ankles, feet straight in extension orientation with supported flexion

Knees, ankles and feet are in midline

Chin in deviated laterally (L or R)

Score this infant's position using the IPAT. Picture courtesy of https://neonataltherapists.com/development-premature-infant-chest-wall-nant-7-pre- conference-session-ii/

Shoulder status : _______ (1)
Hand and arm location : _______ (2)
Pelvic position : _______ (3)
Knees, ankles/feet orientation : _______ (4) Head position : _______ (5)
Chin/neck position : _______ (6)
Total : ________

Indicator

0

Shoulders flat/in neutral

Hand and arm location Hands away from the body

Arms extended Hands touching torso Arms extended Hands touching face

Arms flexed

Pelvic position
Hips abducted/externally rotated, and/or in extension

Hips in alignment but extended Hips softly flexed and in alignment with pelvic tilt

Knees, ankles/feet orientation
Knees extended, ankles everted and feet supinated Knees.

Head position
Head rotated laterally (L or R) greater than 45▫ from midline

Head rotated laterally (L or R) 45▫ from midline Head positioned
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midline to less than 45▫ from midline (L or R)
Chin in deviated laterally (L or R)

without tone position with tone

Neck in hyperextension
Neck in extension poorly aligned with spine Neck aligned with spine

Score this infant's position using the IPAT. Picture courtesy of https://neonataltherapists.com/development-premature-infant-chest-wall-nant-7-pre- conference-session-ii/

Chin/Neck position
Chin in neutral position

Chin in neutral

Shoulder status : _______ (1)
Hand and arm location : _______ (2)
Pelvic position : _______ (3)
Knees, ankles/feet orientation : _______ (4) Head position : _______ (5)
Chin/neck position : _______ (6)
Total : ________

Q22

12

Shoulder status Shoulders hyperextended

Shoulders softly rounded

ankles, feet straight in extension orientation with supported flexion

Knees, ankles and feet are in midline

Indicator

0

Shoulders flat/in neutral

Hand and arm location Hands away from the body

Arms extended Hands touching torso Arms extended Hands touching face

Arms flexed

Pelvic position
Hips abducted/externally rotated, and/or in extension

Hips in alignment but extended Hips softly flexed and in alignment with pelvic tilt

Knees, ankles/feet orientation
Knees extended, ankles everted and feet supinated Knees.

Head position

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Head rotated laterally (L or R) greater than 45▫ from midline
Head rotated laterally (L or R) 45▫ from midline Head positioned

midline to less than 45▫ from midline (L or R)
Chin in deviated laterally (L or R)

without tone position with tone

Neck in hyperextension
Neck in extension poorly aligned with spine Neck aligned with spine

Chin in neutral

Score this infant's position using the IPAT. Picture courtesy of :
https://www.britannica.com/science/premature-birth Shoulder status : _______ (1)
Hand and arm location : _______ (2)

Pelvic position : _______ (3)
Knees, ankles/feet orientation : _______ (4) Head position : _______ (5)

Chin/neck position : _______ (6)
Total : ________

Q23 Readiness Score 1

Description Drowsy, awake or fussy

prior to care. Rooting or hand to mouth. Keeps pacifier. Good tone.
2 Drowsy or awake once handled. Some rooting or

takes pacifier. Adequate tone.
Briefly alert with care. No hunger cues. No change in tone.

4 Sleeping throughout care. No hunger cues. No
5 Needs increased oxygen with care. Apnea and/or bradycardia with care. Tachypnea over baseline with

care. When you begin your assessment, the baby opens their eyes briefly, opens their mouth, and accepts the pacifier. Provide a readiness score for this behavior.

____

Q24 Quality Score Description
1 Nipples with strong coordinated

change in tone.

Chin/Neck position
Chin in neutral position

3

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suck throughout feed. 2
Nipples with a strong coordinated suck initially, but fatigues with progression.

3 Nipples with consistent suck, but difficulty coordinating swallow, some loss of liquid or difficulty pacing. Benefits from external

pacing. 4 Nipples with a weak/inconsistent suck. Little to now rhythm. May require some rest breaks.

5 Unable to coordinate suck/swallow/breath pattern despite pacing. May result in frequent or significant A/Bs or large amount of liquid loss

and/or tachypnea significantly above baseline with feeding.

The baby sucks vigorously and forgets to breathe in the first minute of the feeding, and has a brief bradycardia episode that responds to removing the bottle and sitting the baby up. When you resume the feeding, the baby continues to suck vigorously, begins to have a heart rate dip, and stops eating. When you change the angle of the bottle and slow the milk flow, the heart rate returns to baseline and baby begins sucking again. Provide a quality score for this infant's feeding.

____

Q25 Please share your beliefs about neuroprotective care.

____
____
____
____
____

End of Block: Default Question Block

Appendix D – Educational Tools

Website URL & QR code

https://weebsner.wixsite.com/nicuneuroprotection

SCAN ME

Educational Poster