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Neonatal developmental care makes SENSE: implementation of an evidence-based guideline for developmentally appropriate multi-modal positive sensory exposures.

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by

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Signature DNP Project Chair Date

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Dedication

My Faithful Husband

For sharing in copious amounts of carryout and overlooking stacks of articles, syllabi, and rubrics on all horizontal spaces. For keeping a sense of humor about the company I am nodding off in the evening glow of an open laptop. For coming around to support this big idea.

My Beloved Children

For our time together surrendered for the pursuit of my doctorate. You are the wind beneath my wings. Now we can focus on kindergarten homework and all reduce our screen time.

My Loving Parents

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pursuit of NANN's developmental care specialist designation. All of these contributions added to the project and staff development and what we will be able to do for babies and families moving forward. I could not have dreamed a better project team.

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Abstract

Background: There is increasing awareness of the contribution of the neonatal intensive care (NICU) environment and the importance of developmental care (DC) interventions to long-term outcomes in high-risk infants. Care at the project site reflected that given at many hospitals, where positive sensory experiences and negative sensory mitigation are done, but inconsistently. There was not a guideline in place for DC interventions.

Setting: The project site housed a newly renovated single-family room (SFR) NICU with 12 licensed Level II beds and ability to flex to 19 beds. Neonates at gestational ages ≥ 28 weeks, requiring critical care for a variety of reasons make up the patient population.

Purpose: This project assessed implementation of the Supporting and Enhancing NICU Sensory Experiences (SENSE©) Program in a Level II NICU in a suburban setting in the southeast United States as a way to increase consistent application of positive sensory experiences in routine caregiving.

Procedures: Staff were educated on neurodevelopment and neurosupportive care and oriented to SENSE©. Program-provided materials were supplied in the unit. Families were oriented to SENSE© via a program-provided educational website and interventions were supplied per evidence-based sensory guidelines for gestational age (GA).

Measures: Nurses' integration of developmentally supportive practices in routine care were assessed before education/implementation and then again after 14 weeks of program implementation. Data was collected from bedside SENSE© medical log sheets and analyzed to assess the use of DC interventions as prescribed by SENSE©.

Keywords: Neurosupportive care, family-centered care, neurodevelopment, Supporting and Enhancing NICU Sensory Experiences (SENSE©)

Neonatal Developmental Care Makes SENSE: Implementation of an Evidence-based Guideline for Developmentally Appropriate Multi-Modal Positive Sensory Exposures

Preterm birth is a significant health problem globally and a leading cause of infant mortality and morbidity (CDC, 2020). The World Health Organization (WHO) (2018) estimates that 15 million infants are born preterm each year, which translates to approximately 1 in 10 births occurring before 37 weeks gestation. Prematurity occurs on a spectrum defined as moderate to late preterm (MLPT) birth (32-37 weeks), very preterm birth (28-32 weeks), and extremely preterm birth (<28 weeks) (WHO, 2018).

Advances in neonatal care contribute to decreasing infant mortality (Ely and Driscoll, 2019; Murphy et al., 2016). Neonates born at 28 to 32 weeks gestation have survival rates increasing from 80 to 95% in those 4 weeks, and those reaching gestations >34 weeks survive at rates near term (University of Utah Health, 2021). While neonatal mortality improves, the risk of developmental disabilities, including cerebral palsy, autism spectrum disorder, intellectual disability, behavioral disorders, attention-deficit-hyperactivity disorder, learning disability, and other general developmental delays is not declining nor is the threat limited to only the most premature (Altimier & Phillips, 2016; Schieve et al., 2016; You et al., 2019).

Background

The sensory environment of the neonatal intensive care unit (NICU) with its bright lights, intrusive noises, and medical interventions is increasingly suspect as playing a role in neurodevelopment, both directly and indirectly, by way of challenges to parent-infant bonding, parent mental health, and family functioning, which upsets an attachment process fundamental for growth and neurobiological development in children (Gómez-Cantarino et al., 2021; Kim et al., 2020; McAndrew et al., 2020; Montirosso et al., 2017; Twohig et al., 2016; White-Traut et

al., 2018). The final months and weeks of gestation are appreciated for timed, multi-dimensional sensory exposures of fetal development in a protected environment. An infant born early encounters visual, auditory, gustatory, tactile, and vestibular exposures much different from the intrauterine environment and stimuli can be primarily negative. Likewise, the NICU is sometimes void of exposures important for development, and it is understood that sensory minimization is detrimental at a point (Lester et al., 2016; Pineda et al, 2014).

There is evidence that early interventions, especially those that encourage the parent-infant relationship, have a moderate effect on a neonate's developmental progression and cognitive, language, motor, and social and behavioral outcomes (Burke, 2018; Philpot-Robinson, et al., 2017; Pineda, et al., 2020; White-Traut, et al., 2018). To positively influence an infant's developmental trajectory, interventions take a preventative focus and are best applied as early as possible, ideally in the NICU.

Significance to the Study Site

Setting and Population

The project site is part of an extended network of hospitals located in a suburban area of its larger metropolis, which houses 519 beds offering a wide range of healthcare services, including emergency, oncology, women's health, neonatal, orthopedic, neurosurgery, cardiovascular, behavioral health, occupational health, and in-home care. The women's health service line delivers more than 3000 babies annually. The site houses 12 licensed Level II NICU beds with the ability to flex up to 19 beds, as needed. Its' patient population is comprised of neonates born at 28 weeks GA or greater, requiring critical care after birth for a variety of reasons. The NICU was recently renovated to an SFR design, of which three rooms offer beds for multiples. Site data from January 2018 to December 2019 indicates that about 5% of babies

born were admitted to the NICU. In that period, 152 infants were preterm (<37 weeks GA), of which 84 infants were 34 weeks GA or less, and another 141 NICU admissions were 37 weeks GA or more.

Needs Assessment

There is a realization of the significance of DC interventions to motor and cognitive development up to 12 months of life (Soleimani et al., 2020). Developmental care at the site reflects the care given at many hospitals where positive sensory experiences are done but inconsistently. Other developmental education offered most recently at the site focused on skin-to-skin care (SSC), swaddled bathing, and infant positioning. Prior to the project, there was not a guideline for providing DC interventions. Without a guideline, nurses decided upon the appropriateness of interventions, leaving room for interventions to be given based on individual nurse's comfort level or the day's schedule, rather than the baby and family's needs. There was not a standard means to make parents aware of the varied ways to interact with their infant to positively affect the baby's sensory environment.

Furthermore, there was no specific lighting recommendation in the unit, and like many units, the noise level often exceeded AAP recommendations, though official decimeter levels were not recorded. The site's recent updates to SFR design offer many benefits to DC but also present new risks than those existing in open ward designs. Shortcomings of current practice were assessed through a fishbone exercise (see Appendix A).

Purpose

Three decades have passed since DC was defined, but interventions remain inconsistent in most NICUs. Developmental care bundles focus largely on encouraging the parent-infant relationship while creating a developmentally conscious sensory environment to promote

developmental skills over time. There is growing evidence of the significant role that positive sensory exposures, such as parent speech and singing, lighting regimens, massage, and SSC, have on parent and infant outcomes. Across the literature, interventions are individualized, which means they are based on a baby's physiological and behavioral cues. Where there are gaps and discrepancies in the literature, family-centered DC is recognized as a model of care compassionate to the infant-parent dyad.

The purpose of this project was to evaluate SENSE© as a way to offer positive multi-modal sensory exposures to infants in a suburban Level II NICU. The finalized program is the result of a rigorous process of protocol development, which involved a large integrative review and input from an expert multidisciplinary panel of 108 providers followed by multidisciplinary focus groups review and parent interview (Pineda et al., 2014). Preliminary evidence demonstrated positive effects on parent confidence and infant neurobehavioral outcomes (Pineda et al., 2020). A longitudinal randomized clinical trial evaluating outcomes related to SENSE© (n=70) found that while communication scores were higher in the study group on the Ages and Stages Questionnaire administered at 1 year corrected GA, the significance of this finding was lost when controlling for medical and social risks (Pineda et al., 2021). While there is a need for more research with larger sample sizes to explore the significance of SENSE© interventions longitudinally, the research to date suggests SENSE© offers an effective and feasible package.

This quality improvement (QI) project focused on implementing SENSE© to enhance each family and baby's experience by encouraging parental involvement through sensory interventions supported by nursing and occupational therapy (OT). The program offers guidelines for individualized, age-based, positive sensory experiences that are evidence-based and timed for each week of GA starting soon after admission and continued throughout NICU

hospitalization. Guideline use generates a standard of care, and so the project aimed to increase the regular application of positive sensory exposures and reduce negative sensory stimuli in a Level II NICU, and encourage parent presence and consistency in the information given to parents. The project examined nurses' knowledge and integration of DC practices in routine care with SENSE© compared to standard practice. Applying positive sensory experiences as therapeutic interventions, the project also intended to protect infants from the risk of sensory minimization possible in SFR NICUs in the newly designed unit. Furthermore, the project offered supportive care to the parent-infant dyad to inspire a unit culture of family-centeredness.

Stakeholders

Neonates and their families remain at the core of DC programs as they experience the direct impact of DC and its associated outcomes. As businesses exist to serve their customers, the NICU exists to serve babies and their families. The SENSE© program supports the parent-infant relationship, imparts receptive parenting skills, and offers potential long-term benefits. These long-term benefits are realized in the ongoing parent-infant relationship beyond discharge and mitigation of developmental delays and disabilities throughout the neonate's lifespan.

Site leaders and staff supported enhanced DC by way of an evidence-based guideline. Not limited to the study site, a well-received DC package supportive of the parent-infant relationship has the potential to increase marketability. Parents shop for an experience when choosing where they will deliver their baby. Skin-to-skin care and breastfeeding are generally very important to mothers, so knowing that these and other DC interventions will be supported even in the NICU offers reassurance. Furthermore, bedside staff can benefit when parents are involved at the bedside. Parents active in their baby's care may reduce bedside nurses' tasks.

A Culture for Change

Developmental care requires a culture change, which is important to consider when discussing stakeholders. Busy NICU assignments can create a task-based culture where SENSE© solicits an individualized family-centered care model. This paradigm shift and the changing physical work environment were not without challenges. The practice change was valued as a nurse-driven and nurse-given standard of care capable of changing outcomes and empowering to neonatal bedside.

Implementation of SENSE© involved the collaboration of staff nurses, unit OTs, the NICU educator, the NICU manager, and medical staff. The research describes barriers to DC implementation, such as staff assignments and staff-patient ratios that do not allow adequate time for staff to meet parent and infant needs (Warren, et al., 2019). NICU nurses at the site were generally responsible for 2-3 patient assignments, unless one-to-one care was required. Nurses' workloads are important to the successful implementation of individualized family-centered DC because parent education and prescribed interventions require additional time. Nursing management at the site was attentive to the importance of DC and involving families as partners in care but staffing was still challenged by staff shortages and high census days.

The DC committee is an established team that had interdisciplinary involvement supportive to this project. The committee was effective in implementing and promoting past developmental interventions, including new positioning aids and Turtle Tub swaddle bathing, in the past two years. Human resources recently funded staff certifications in infant massage demonstrating interest and concern for DC.

Even where there is overwhelming support, budgetary restraints create barriers. This was an important consideration when reviewing DC intervention packages, which are offered in several programs at varying levels of intensity, cost, and commitment. Feasibility analysis

involves financial, schedule, technical, market, organizational, and operational assessments. The SENSE© program offers a feasible and affordable method for systematizing DC interventions at the study site with good preliminary results and interventions, which parallel other successful developmental intervention packages. It is in more than 140 NICUs worldwide (Pineda et al., 2020). It is purchasable from the University of Southern California for 200 US dollars, which includes electronic parent education materials and printable log sheets in the implementation package. Parent education books can be purchased separately.

Literature Review

As Watson (2013, p. 189) fittingly states, "Just as the lungs and gastrointestinal system were not prepared to develop and function outside the womb after premature birth, neither was the brain." A careful sequence of biological and developmental events is interrupted by preterm delivery, thereby altering a baby's developmental trajectory by way of extrauterine development, cerebral white matter insult, and the noxious effects of the NICU environment (Bröring et al. 2017; Philpott-Robinson et al., 2017; Spittle et al., 2015). The extrauterine sensory experience is disproportionate to a preterm neonate's developmental stage where the NICU environment can overstimulate later developing auditory and visual sensory systems and understimulate earlier developing tactile and vestibular systems (Altimier and Phillips, 2016). Bright lighting, auditory overstimulation, and painful procedures contribute to associated sensory processing disorders, delayed motor development, disrupted habituation, and disturbed cognitive and motor development (Bröring et al., 2017; Philpot-Robinson et al., 2017).

Birth prior to 38 weeks finds that morbidities double at each earlier gestational week (Shapiro-Mendoza et al., 2008). Life cycle morbidities experienced post-discharge include developmental delays, specific learning impairments, reduced academic achievement, chronic

respiratory problems, growth failure, and vision and hearing impairment (Aagaard et al., 2015). The sensory environment of the NICU is increasingly suspect in its role in neurodevelopment, both directly and indirectly, via challenges to parent-infant bonding, parent mental health, and family functioning, which upsets an attachment process fundamental for growth and neurobiological development in children.

Neonatal neuroplasticity encourages investigation of the extrauterine environment as a place to affect outcomes given the unavoidable changes to physiologic neurodevelopment. Animal and human models illustrate environmental effects during critical periods of development, which explain the vulnerabilities of the preterm infant's brain in the stressful NICU environment (Spittle et al., 2015). Infants learn via sensory experiences where early exposures influence brain organization, so DC is a preventative approach that targets brain connectivity during key periods of rapid growth and neuronal assignment to improve developmental outcomes (Altimier and Phillips, 2016; Spittle et al., 2015). Family-centered DC interventions promote a culture, which encourages congruent care of the family unit and infant while creating a developmentally conscious sensory environment to foster developmental skills over time (Adama et al., 2016; Purdy et al., 2015).

The Need for Developmental Care in New NICU design

Shortcomings of the traditional open ward (OW) NICU environment encouraged a shift toward single-family room (SFR) units. The SFR design is reported to improve patient safety and privacy, support breastfeeding, and especially pertinent to this review, promote developmentally appropriate care and parent-infant attachment (Kuhn et al., 2018; Vohr et al., 2017). A private room allows for individualized levels of stimuli appropriate for clinical and developmental needs. Sensory minimization has proven beneficial as used by caregivers to replicate intrauterine

light and sound filtering (Pineda et al, 2017; Pineda et al., 2019; Bröring et al., 2017). However, the precise recipe to support early development is yet to be discovered and it must not omit auditory, visual, gustatory, tactile, and vestibular experiences. Sensory exposures in SFRs may be reduced to levels detrimental to infant development (Pineda et al., 2014; Bröring et al., 2017; Kuhn et al., 2018).

Bayley-III cognitive ($p=.02$) and language ($p=.03$) scores improved at 18-24 months of life in infants with birth weights <1250 g cared for in SFRs ($n=297$) as compared to OW beds ($n=394$) who otherwise had no significant differences in characteristics (Vohr et al., 2017). In contrast, testing at two years old ($n=86$) in another setting found Bayley-III language scores were strongly associated with room type but in the opposite direction ($p=.006$) (Pineda et al., 2014). Interactions between caregivers decrease in SFR units, which may affect language development via reduced exposures (Kuhn et al., 2018).

Still, other work describes the significant role of maternal involvement where every day per week more that mothers were involved in NICU cares, there was an associated increase in cognitive and language scores at 18 months, regardless of NICU design (Lester et al., 2016). It is arguable that SFR room type had an indirect effect where parents were more involved and parent-infant closeness increased (Lester, et al., 2016; Tandberg et al., 2018). Higher-level quasi-experimental studies speak to the greater role of parental presence and sensory stimulation in development than architectural design despite SFRs other benefits (Kuhn et al., 2018). Therefore, the French Group of Reflection and Evaluation of the Environment of Newborn (GREEN) committee of the French Society of Neonatology recommends that as NICUs evolve to provide SFRs, they must also advance to support staffing needs and provide greater family support (Kuhn et al., 2018).

Guidelines for Developmental Care

The GREEN committee referenced updates in the last few decades to the American Academy of Pediatrics (AAP) guidelines regarding the most suitable physical environment for newborn care (Kuhn et al., 2018). The AAP Committee on the Fetus and the Newborn vaguely states that NICU configuration and design strategies should address the medical, developmental, educational, emotional, and social needs of infants, families, and staff while permitting flexibility given individual program goals (White et al., 2013). The standards address appropriate lighting and acoustic environments, noting the potential benefits of diurnally cycled lighting for infants after 28 weeks GA and maintaining that permissible noise levels under 45 decibels are optimal (White et al., 2013). However, neither the AAP nor other major medical associations, such as the Canadian Pediatric Society, address DC except as secondary items in other standards and policies (Milette et al. Part A and Part B, 2017).

The National Association of Neonatal Nurses (NANN) is the sole professional association worldwide to have specific DC guidelines. First published in 1995 and most recently updated in 2000, the NANN guidelines for DC are based on Als' foundational Synactive Theory of Development, exhaustive literature reviews, expert consultation, NANN's own core measures for developmentally supportive care endorsed in 2011, and the "universe of developmental care" conceptual model (Gibbins et al., 2008; Milette et al. Part A and Part B, 2017). Evidence-based practices are collectively published in the *Developmental care of newborns and infants: A guide for healthcare professionals* (3rd. Ed) by NANN, who offers a specialist designation based on the study of this book (Kenner & McGrath, 2021).

Developmental core care measures endorsed by NANN, are as follows: (1) protected sleep, (2) pain and stress assessment and management, (3) developmental activities of daily

living, (4) family-centered care, and (5) the healing environment (Kenner and McGrath, 2018). These themes resonate in the available literature. The seven core measures outlined in The Neonatal Integrative Developmental Care Model are similar to NANN's recommendations as are The Standards, Competencies, and Recommended Best Practices for Infant and Family-Centered Developmental Care (IFDC) components, which both offer frameworks guiding neuroprotective interventions in clinical practice (Altimier & Phillips, 2016; Browne et al., 2020).

Literature is vast and varied, sometimes offering randomized controlled trials, but more often, recommendations are made based on cohort studies, case-controlled studies, consensus statements, qualitative studies, and systematic reviews of these studies. Resources focus on individual interventions and an array of DC bundles. The perfect method remains inconclusive, but while awaiting the results of ongoing research, recommended interventions are parallel and offer a compassionate care model capable of improving neonatal outcomes.

Developmental Care for Neonates

While intervention bundles vary in the research and are known by many acronyms, evidence suggests that early DC interventions are significant to cognitive, language, motor, social, and behavioral outcomes (Bröring et al., 2017; Burke, 2018; Cheong et al., 2017; Pineda et al., 2017; Pineda et al., 2020; Soleimani et al., 2020). Exploration of the auditory, tactile, visual, and vestibular (ATVV) environment as related to outcomes of sensory modulation shows that exposure to bright lighting, alarm sounds, and painful procedures in NICU may have detrimental consequences for some aspects of later motor development, sensory processing, and cognitive development (Bröring, 2018; Vohr, et al., 2017). Positive outcomes are associated with ATVV interventions like diurnally cycled lighting, exposure to parent voice, intact ambient sounds but otherwise reduced noise, SSC, and supplementation of medical care with controlled

visual, auditory, tactile/kinesthetic/vestibular, and multimodal stimulation as proposed in many of the DC programs reviewed (Bröring, 2018; Cheong et al., 2017; Pineda et al., 2017; Pineda, et al., 2020; Soleimani et al., 2020; Vohr et al., 2017).

Developmental Care for Families

Developmental care and family-centered care are not synonymous, but together, they represent a perfect union, and developing one will surely nurture the other. Programs focused on parent-child relationships are more effective than those focused on the infant or parent alone (Kim et al., 2020; McAndrew, et al., 2020; Spittle et al., 2016; Welch et al., 2015).

Six of ten studies included in a review indicated significantly decreased stress levels as related to the parent role, NICU environment, and appearance of the infant when families were actively engaged in ATVV interventions (McAndrew, et al., 2020). Interventions focused on the parent-infant relationship and reducing NICU environmental stressors, which significantly reduced maternal depressive and anxiety symptoms (Kim et al., 2020; McAndrew, et al., 2020; Welch et al., 2015). Whereas, low-quality DC was associated with decreased infant neurobehavioral adaptability and higher maternal depressive symptoms in the first 6 months (Montirosso et al., 2017). Tactile interventions, including SSC, infant massage, and calming touch, are shown to reduce anxiety and depression and also increase parent satisfaction and knowledge acquisition thereby helping families adapt more quickly to the NICU environment (McAndrew et al., 2020; Welch et al., 2016).

Nurses utilize family-centered strategies like parent education, personalized information sharing, and meaningful involvement to help parents make sense of their experience and provide them with a sense of agency in the NICU setting where they have little control (Gilstrap, 2020; Gómez-Cantarino et al., 2021). Staff and parents note greater closeness in the parent-infant dyad

with engagement interventions (Gómez-Cantarino et al., 2021; McAndrew, et al., 2020). Parents regarded infants more positively and were more sensitive in their exchanges and more involved than control groups after video and interactive guidance about parent caregiving in the NICU (McAndrew et al., 2020). Language barriers and cultural differences ease as parents experience and observe infant progress through participation (Gómez-Cantarino et al., 2021).

Factors that hinder responsive parenting in the NICU include maternal and/or baby medical conditions, maternal emotional or mental health factors, infant state of arousal and behavior, parents' past childhood experiences of trauma or loss, parental relationship, and social circumstances (Twohig et al., 2016). Sociodemographic factors add their own risks to development, but also play a role in maternal involvement in the NICU where poverty presents additional barriers, including, but not limited to, transportation issues, work requirements, childcare needs, and an increased incidence of maternal depression (Vohr et al., 2016).

Parent engagement affects infant behavior and maternal distress in a dynamic process that influences maternal representation and sensitivity, necessary for optimal growth and development of high-risk infants (Kim et al., 2020; Montirosso et al., 2017; White-Traut et al., 2018). The significance of DC parental depression and anxiety is vital given their disturbances to the parent-infant relationship, contributing to infant risk for long-term deficits (Welch et al., 2015; White-Traut et al., 2018).

Developmental Care for Clinical Caregivers

Neonatal professionals note the increased quality of care and find greater satisfaction and confidence in their professional roles when working in partnership with families through DC interventions (Gómez-Cantarino et al., 2021). Nurses are largely positive about DC regardless of education level or practice location (rural versus metropolitan) (n=783) (Griffiths et al., 2020).

However, nurses also report that DC negatively impacts the working environment despite recognizing its benefits for infants (Warren et al., 2019). Developmental care is experienced more positively when nurses are included in evidence-based training to build value in their own DC practices (Warren et al., 2019). Appreciation of the infant-family dyad as the whole client increases with nursing years of experience and staff grow in appreciation of the impacts of responsive parenting (Gómez-Cantarino et al., 2021; Twohig et al., 2016).

Problem

Cognitive, language, motor, and social functioning deficits are well-known risks to the very premature, but there is increasing awareness of developmental delays in moderate and late preterm (MLPT) infants (Cheong et al., 2017; Schieve, et al., 2016). Because more than 80% of preterm infants are those born at MLPT gestations, defined as 32 to 36 weeks' completed gestation, small increases in adverse outcomes in this large populace have the potential to add considerable public health burden (National Vital Statistics Reports Volume 68, Number 13, November 30, 2019, Births: Final Data for 2018, 2019). These statistics are important to the Level II site, which provides services to neonates at ≥ 28 weeks' gestation. Recently, the site averaged about half of admissions at MLPT gestations. Statistics from Canada show that by two years old, more than 25% of neonates born between 28 and 32 weeks' gestation exhibit developmental disorders, which increases to 40% by the age of ten (Johnston et al., 2014).

The SENSE© Intervention

The SENSE© program offers a guideline for consistently providing individualized, age-based, positive sensory experiences that are evidence-based starting soon after admission and sustained throughout hospitalization (Pineda et al., 2019). Auditory, tactile, visual, and vestibular interventions, as prescribed in SENSE©, are a focus of many DC bundles and programs.

Bobbi Pineda, Ph.D., OTR/L, CNT developed the program, and Washington University in St. Louis retains the 2017 copyright. The University of Southern California has licensed the rights to SENSE©, including exclusive permission for public distribution. The program was purchased at: <https://chan.usc.edu/research/clinical-tools/sense>. Purchase included electronic access to program materials, which were downloaded and printed per the purchase agreement. Materials include a weekly infant assessment and logsheets to track prescribed sensory exposures specific to the baby's postmenstrual age (PMA). Parent education is available in both English and Spanish, including a Microsoft PowerPoint, which contains embedded videos. Education materials can be accessed by personal computer, smartphone, or tablet via a QR code. The QR code was advertised to parents on flyers posted in the unit (see Appendix B). Parents were offered tablets for use in the NICU or their post-partum room or encouraged to use a personal device per their preference. Flip binders in printed format were also made available on the unit in both English and Spanish.

Justification: SENSE© Makes Sense

In a quasi-experimental pilot study exploring the SENSE© program's impact on babies of ≤ 32 weeks' gestation, neonates receiving SENSE© interventions were compared to historical controls receiving standard care. The study group received specific doses of visual, auditory, olfactory, tactile, and vestibular/kinesthetic interventions provided by parents based on corrected GA, medical status, and infant cues. Standard care included interventions that the SENSE© group also received, like SSC, holding, and the use of a scent cloth, but were provided unsystematically as decided by parents and the medical team (Pineda et al., 2020). The standard care group represents the care given at many hospitals where positive sensory experiences are

offered but usually inconsistently or for only a short time compared to the length of stay (LOS), which makes the SENSE© program different.

Preliminary evidence showed SENSE© improved neurobehavioral function per the NICU Network Neurobehavioral scale ($p = .02$) and increased scores on the Hammersmith Neonatal Neurological Evaluation ($p < 0.001$) at term corrected age (Pineda et al., 2020). The SENSE© program focuses on parent-delivered DC interventions, which are found to be ideal in the literature. Family-centered DC nurtures the parent-infant dyad while creating a developmentally conscious sensory environment to minimize negative sensory exposures and provide experiences that support neurodevelopment and parent-infant attachment (Altimier and Phillips, 2016; Montirosso et al, 2017; White-Traut et al, 2018). While SENSE© has not been studied specifically for its effects on parents, the parent-infant dyad, or clinicians to date, other work evaluated in the literature suggests how it could affect these stakeholders.

Purpose and Specific Aims

It was expected that this QI project would increase integration of DC practices in routine care through staff and parent education and implementation of the SENSE© program. By applying a guideline, a standard of care is created, which better supports regular use of interventions and improves the consistency of information exchange. By increasing awareness of the benefits of positive sensory experiences as therapeutic interventions, the project aimed to support DC practices important for maximizing neonatal cognitive and motor outcomes and protect infants from risks of sensory minimization possible in SFR NICUs, as at the newly designed site. At onset of the project, the aims were as follows:

- **Aim 1.** All nurses and pertinent ancillary NICU staff (OT, SLP, clinical assistants) will complete mandatory education on neurodevelopment and neurosupportive care as well as

orientation to SENSE©. Staff education and implementation of SENSE© in the unit will positively affect DC interventions in routine care.

- **Aim 2.** Project team members/DC committee members will serve as DC champions to create resource persons for this project and carry the initiative forward.
- **Aim 3.** A minimum of two staff members will pass the examination for Developmental Care Specialist designation. By creating experts, the project gains longevity. Standards and evidence for DC are collectively published by NANN in the *Developmental care of newborns and infants: A guide for healthcare professionals* (2nd ed.), and NANN offers a DC specialist designation based on the study of this book. A 3rd edition has since been published.
- **Aim 4.** Family education and orientation to the program will be initiated by the second day of life (DOL) unless there are extenuating circumstances related to maternal medical care. This will be achieved by using SENSE© program materials, which include education for families concerning medical terminology, fetal development in later pregnancy, the NICU sensory environment, sensory development, interpretation of infant cues and readiness for sensory exposures, and how to provide recommended sensory exposures. Materials will be accessed electronically via the QR code and password provided with the purchase of the program as advertised on flyers in the unit (see Appendix B).
- **Aim 5.** Families will engage in providing developmentally appropriate, positive sensory exposures to their babies, while supported by nurses and OTs also trained in prescribed DC interventions to inspire a culture of family-centeredness. The SENSE© program will be available to all families and data analysis to include all NICU admissions with additional focused evaluation on those babies less than 35 weeks. Engagement in SENSE© to be tracked on program logs (see Appendix C).

Conceptual Framework

Nursing evolves through QI and evidence-based practice (EBP) in the effort of translating knowledge to improve clinical practice, patient outcomes, and patient experiences (Iowa Model Collaborative et al., 2017). The Iowa Model of Research-Based Practice to Promote Quality Care offers a systematic approach for applying research findings to infuse change in healthcare and then evaluating it for full integration and sustainability (Buckwalter et al., 2017). This algorithm was chosen for the implementation of this project to ensure appropriate measures were applied when implementing SENSE©, driven by evidence and science, to generate quality improvement. The Nursing Research and Oversight Team at the project site recommends the Iowa Model and so its use was consistent with the facility's preferred methodology.

The Iowa Model guides a process for practice change through several steps, which include: identification of a trigger for change, assessment for organization/department/unit needs and/or interest in change, team formation, analysis of available research, and subsequent determination of adequacy and applicability of findings for the proposed change, change implementation, and finally evaluation of the change and dissemination of results (Buckwalter et al., 2017). The framework was applied as related to the implementation of SENSE© (see Appendix D).

Methods

Sample Groups

Sample sizes were computed for both staff and infant groups using a calculator from Creative Research Systems at URL: <https://www.surveysystem.com/sscalc.htm>. A 95% confidence level and a +/-10% confidence interval were applied. A wider confidence interval was chosen based on the projected available population of babies meeting inclusion criteria so

that a reliable sample size became more feasible within the time constraints of the project. The same parameters were applied for the staff sample group to maintain consistency.

Based on the site's 2020 NICU admission data, there were 300 babies admitted to the NICU, of which 78 babies met the project's layered inclusion criteria gestational age <35 weeks. A sample of 43 babies was needed based on the site's population data and the chosen confidence level and interval. Inclusion in the project was extended to all NICU admissions to improve the probability of achieving the calculated sample size in the relatively short time frame of the project with specific evaluation of preterm babies <35 weeks gestation.

The site had 40 working NICU nurses, while actively seeking additional staff. Based on this population and the chosen confidence level and interval, it was the goal that at least 28 nurses complete training and pre- and post-assessments to completion.

Educational Sessions

Education occurred as a portion of annual NICU reviews. These reviews were mandatory, per NICU management, for all staff. Education related to SENSE© had a dedicated 2 hours, which was followed by skills training as organized by the NICU educator. Didactic education, as related to the project, included a presentation about neonatal brain development and the effects and indications for DC practices as supported in SENSE© (see Appendix E). A hyperlink to the program-provided video introduction to SENSE© was included in the PowerPoint. Program-provided parent education materials were reviewed, which nurses then used to instruct families at the bedside (see Appendix F). There was also time dedicated to reviewing the parent diary and medical log sheets supplied by the program to track interventions.

Information was delivered via in-person learning options in several sessions timed for dayshift and nightshift participation as arranged and communicated to staff per the NICU

educator. The first session was held online due to Covid-19 restrictions in place at the facility. Flyers were posted to create anticipation of SENSE© education and implementation in the unit (see Appendix G) after IRB approval was attained (see Appendix H). Nurses received a special badge reel gift upon completion of education provided by the project lead (see Appendix I).

Pre-Assessment

Staff education sessions opened with administration of the NANN Self-assessment for Neonatal Developmental Care Specialist Designation Examination (see Appendix J), used with written permission from the organization (see Appendix K). The form was created by NANN for nurses to assess their own level of integration of developmentally supportive caregiving in routine practices in the NICU per four DC practice standards. There are 48 items in a Likert-type scale format with the possible answers: “seldom,” “most of the time,” and “all of the time.”

No reliability or validity data exists as the instrument was designed for self-assessment. It is suggested by NANN that applicants who report “all of the time” for at least 80% of items integrate DC at a level supportive to successful completion of the DC specialist designation examination, thereby indicating a higher understanding and application of DC practices. The practice standards are categorized by the following headings: 1) The infant receives individualized care, 2) Family-centered care is supported from birth, 3) All caregivers practice collaboratively, and 4) A developmentally appropriate environment is provided for every infant and family. There are 15 items in the first category, 12 items in the second category, 10 items in the third category, and 11 items in the final category. Numerical results were transferred to an unidentified staff data tracking worksheet (see Appendix L).

Participants supplied a four-digit number written on the pre-assessment that was repeated on the post-assessment to allow for paired statistical analysis via this anonymous unique

identifier. Demographics were collected at the time that the pre-assessment was completed for observations about DC practices as related to gender, age, years of total nursing experience, years of NICU nursing experience, highest educational degree attained, primary work shift, and participation in previous developmental care training.

Bedside Parent Orientation

Materials provided by the SENSE© program were readied and available in the unit at kick-off week starting January 31. Program-provided sensory guidelines for each gestational week were laminated to hang at individual bedsides, corresponding to the baby's every new week of gestation or PMA (see Appendix M). Flyers were posted in the unit, patient rooms, and the parent lounge advertising the QR code to electronic SENSE© materials (see Appendix B and Appendix G). The baby's nurse was responsible for orienting parents to the program via the online link, as reviewed in staff education sessions. Doing so was an effort to communicate the partnership of parents and nursing intended by family-centered DC.

Post-Assessment

Staff's developmentally supported care practices were reassessed after 14 weeks of SENSE© implementation. NANN's Self-assessment for the Neonatal Developmental Care Specialist Designation Examination (see Appendix J) was re-administered by sending via email with collection in the unit through the NICU educator to safeguard anonymity from the investigator. Participants were to supply the same four-digit number on the post-assessment as on their pretest, to allow for paired statistical analysis.

SENSE© Medical Team Logs

Parent diaries and infant weekly assessments, as prescribed by SENSE©, were kept in binders at each bedside. Medical team logsheets were kept on individual patient bedside

clipboards. The SENSE© program was available to all families and data analysis included all NICU admissions. Additional focused evaluation was conducted on those babies less than 35 weeks. Engagement in SENSE© was measured by analysis of documentation in program-provided medical team logs where interventions were charted per shift per day.

Data from SENSE© medical team logs (see Appendix C) were collected and non-identifying use of SENSE© interventions were recorded, for number of days of documentation per week of PMA. Early in implementation logsheets were revised and an adapted logsheet was used for intervention tracking (see Appendix N). Given dayshift and nightshift charting, each week presented 14 possible points of documentation. Evaluative data was tracked for days of documentation of SENSE© interventions on a separate, unidentified medical logbook data collection worksheet for each week of hospitalization for all infants in addition to infant demographics (see Appendix O). All families had SENSE© materials available to them. Parents retained SENSE© parent diaries at discharge. Unidentified medical team logs were collected for evaluation and then disposed of in the unit document shredder.

Nurse and Occupational Therapy Champions

Project team members interested in pursuing the Neonatal Developmental Care Specialist Designation offered by NANN were encouraged to study and sit for the examination. Specialists are to serve as unit champions to carry the initiative forward, serving as resource persons and ensuring that ongoing education is provided for new hires and as an annual competency. The DC committee served as the project team to gauge successes and failures of the program and make necessary adjustments and encourage continued integration of developmentally supportive caregiving in routine NICU practices.

Data Analysis

IBM SPSS Statistics Version 28 was used for statistical data analysis. Descriptive statistics were applied for analysis of demographic data (age, years of total nursing experience, years of NICU nursing experience, highest educational degree attained, current FTE status, primary work shift, and participation in previous developmental care training) supplied with the pre-intervention assessment. The investigator entered responses given on the Self-assessment for the Neonatal Developmental Care Specialist Designation Examination into an unidentified Excel spreadsheet to evaluate changes between the pre-and post-implementation responses. Any incomplete or improperly completed surveys or those that could not be paired were excluded from the analysis. A one-tailed, paired samples t-test was used for comparison of pre- and post-intervention assessment of developmental care practice integration in daily care as assessed by NANN's for the Neonatal Developmental Care Specialist Designation Examination applying a significance level of $p = .05$. To compare means, the item answers were assigned a numerical value as follows: "seldom"=1, "some of the time"=2, and "all of the time"=3. By doing this, the lowest possible score was 48, and the highest possible score was 144. Responses were analyzed in totality and also categorically as organized by the instrument's subsets.

Quantitative data collected from SENSE© medical log sheets were analyzed using descriptive statistics to evaluate the use of DC interventions per sensory guidelines for each week of hospitalization, specifically accounting for points of documentation on the logsheets per week of LOS. Infant GA and the DOL that SENSE© orientation were evaluated by descriptive analysis. Lastly, staff progress toward completion of Developmental Care Specialist designation through NANN was reviewed.

Ethical Considerations

This project was submitted to the Nursing Research and Oversight Team per the guidelines required by the site and approved on November 10, 2021 (see Appendix P). This proposal was submitted to the University of Louisville IRB seeking exempt status and was determined to be QI and not human subjects research on January 3, 2022 with permission to proceed (see Appendix H).

HIPAA compliance was upheld per University of Louisville and site requirements. All demographic and outcomes data were transferred to an excel spreadsheet on a password-protected computer. All paper documents were destroyed in unit medical document shredders.

Results

It was expected that this QI project would increase integration of DC practices in routine care through staff education and implementation of the SENSE© program.

Staff education and participation in SENSE©

Forty-eight NICU and ancillary staff completed mandatory education on neurodevelopment and neurosupportive care, including orientation to SENSE©. Two OTs, 2 speech therapists, and 2 NICU clinical assistants participated in full education sessions. Abbreviated sessions were offered to medical staff with 7 participants. NANN's Self-Assessment for the Neonatal Developmental Care Specialist Designation Examination was designed for staff nurses so forty-two participants were eligible to complete the pre-assessment survey; thirty-five pre-assessment forms were submitted. There was a loss of two NICU staff nurses between the pre-assessment and the post-assessment. Twenty-one post-assessment surveys were collected. Of these, seventeen could be matched to pre-assessment surveys by the respondent-provided, unique identifier and were filled out to completion for a response rate of 48.5% accounting for staff lost between assessments. Table 1 summarizes the characteristics of matched survey respondents.

Table 1*Staff respondent characteristics (n = 17)*

Age range	n	Percentage
<29	4	23.5%
30-44	8	47.1
45-59	4	23.5
>60	1	5.9
Years of total nursing experience	n	Percentage
<2-9	8	47.1
10-19	7	41.2
>20	2	11.8
Years of NICU nursing experience	n	Percentage
<2-9	10	58.8
10-19	5	29.4
>20	2	11.8
Highest educational degree attained	n	Percentage
Associates	2	11.8
Bachelors	13	76.5
Masters	2	11.8
Current FTE Status	n	Percentage
PRN	0	-
Part-Time	5	29.4
Full-Time	12	70.6
Primary Work Shift	n	Percentage
Dayshift 7A-7P	7	41.2
Nightshift 7P-7A	10	58.8
Participation in previous developmental care training	n	Percentage
No	5	29.4
Yes	12	70.6

Participants were all nurses with a majority having completed a Bachelors degree (76.5%) and having had prior participation in developmental care training (70.6%). Half of respondents had 9 or less total years of nursing experience, where 30% of those were in their first five years of nursing practice when the data was further broken down. More nurses earlier in their NICU career participated in the assessments; almost sixty percent had 9 or less years of NICU-specific experience (58.8%). A smaller number of nurses had more NICU experience with 10-19 years of NICU-specific experience (29.4%) and even lesser with >20 years (11.8%).

Pre- and post-test results from NANN's Self-Assessment for the Neonatal Developmental Care Specialist Designation Examination were entered into SPSS version 28.0. Paired samples *t*-tests were applied to evaluate survey responses in totality and by subsets representing the four developmental care practice standards applicable to the integration of developmentally supportive caregiving. Positive mean shifts were found overall and in all four subsets. The level of statistical significance was set at $p = .05$. Score differences were significant for all standards except Standard 2, with Standards 1 and 4 demonstrating extreme significance. Additionally, overall mean shifts were extremely significant. Results are summarized in Table 2.

Table 2

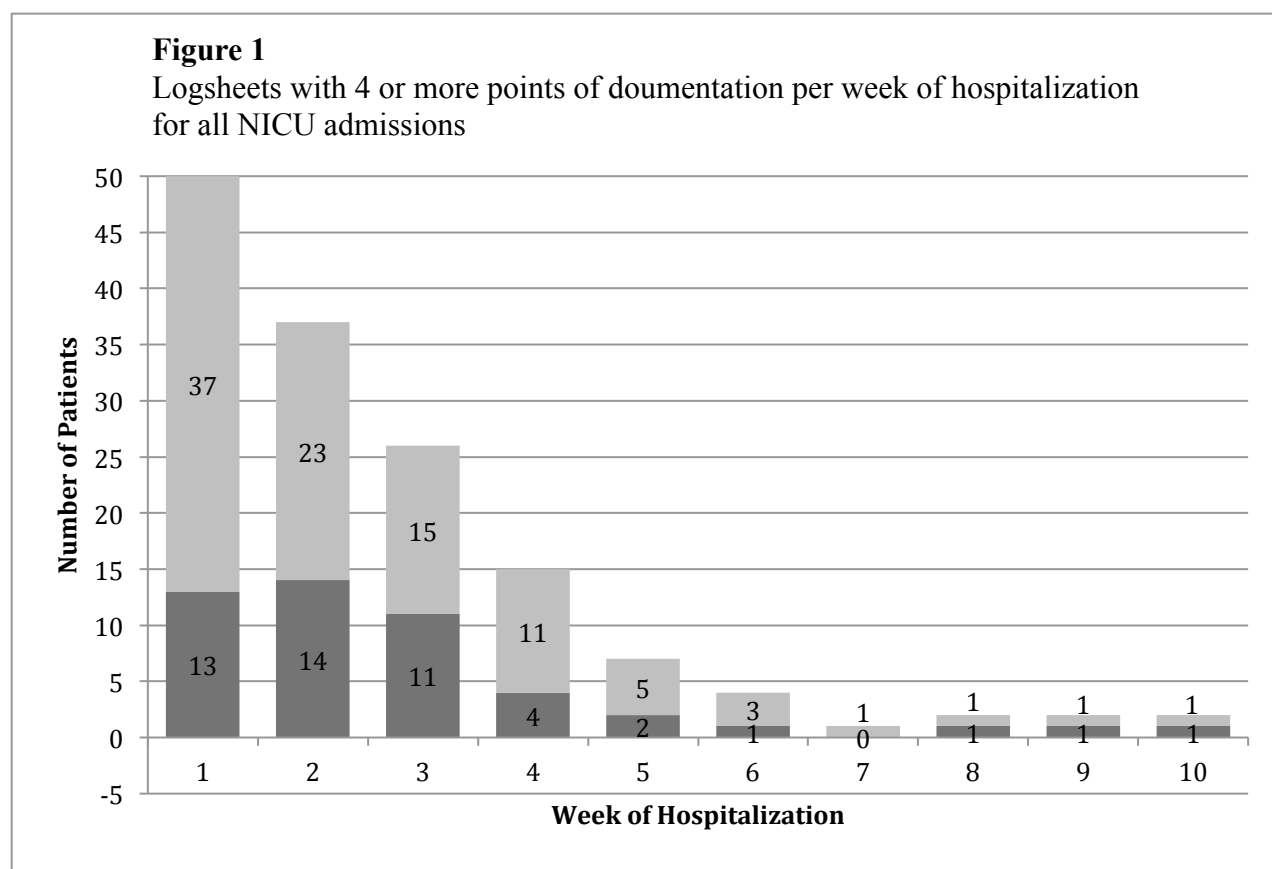
NANN Self-Assessment for the Neonatal Developmental Care Specialist Designation Examination Summary (n=17)

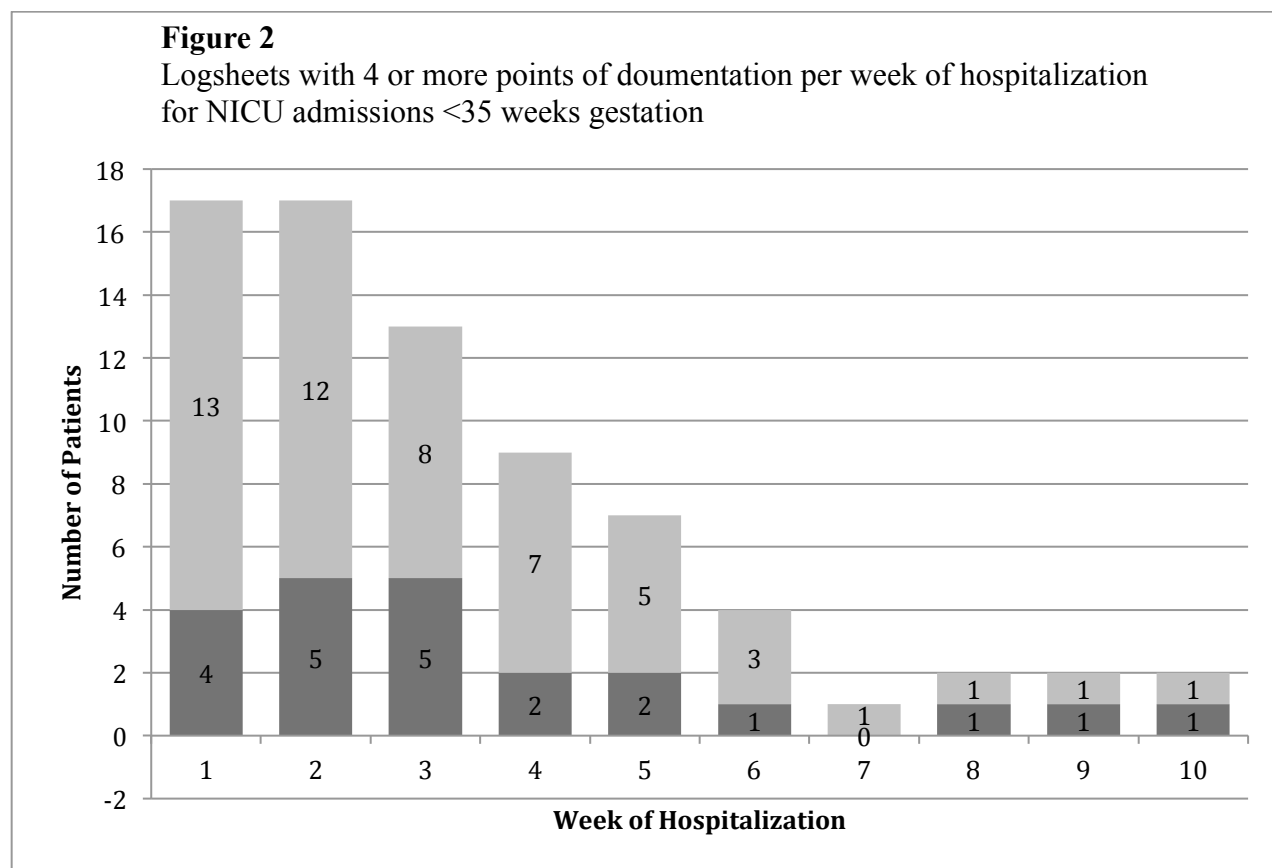
	Pretest <i>M</i>	Posttest <i>M</i>	<i>M</i> difference	<i>SD</i>	Significance (one-tailed) $p = .05$
Overall assessment <i>Max score 144</i>	121.88	132.35	-10.471	8.125	<.001
Standard 1: The infant receives individualized care. <i>Max score 45</i>	38.12	42.00	-3.882	2.619	<.001
Standard 2: Family-centered care is supported from birth. <i>Max score 36</i>	33.41	34.35	-.941	4.451	.198
Standard 3: All caregivers practice collaboratively. <i>Max score 30</i>	25.00	26.94	-1.941	2.461	.003
Standard 4: A developmentally appropriate environment is provided for every infant and family. <i>Max score 33</i>	25.76	29.00	-3.235	2.969	<.001

Family education and application of SENSE©

The SENSE© program was available to all families and data analysis was extended to include babies regardless of GA or LOS. Fifty-four medical logs were collected. Logs for patients already hospitalized at onset of implementation were excluded (n=3). Logs for patients

admitted thereafter were reviewed and those lacking documentation of SENSE© orientation day (n=13) were excluded. Thirty-eight logs remained. Family education and orientation to the program was initiated by DOL 2 in 84.2% of neonates with completed documentation (n=32). Of those, 6.3% represented babies born at 28-32 weeks gestation, 56.3% were babies born at 33-36 weeks gestation and 37.5% were babies born ≥ 37 weeks gestation. Intervention use was evaluated over the LOS for 4 or more points of documentation each week of hospitalization with findings summarized in Figure 1. Evaluation of logs for those patients less than 35 weeks, which as previously mentioned are patients requiring automatic NICU admission, showed a similar trend in documentation as exhibited in Figure 2.





Discussion

The SENSE© program offers an evidence-based guideline that prescribes visual, auditory, gustatory, tactile, and vestibular exposures to mitigate the negative sensory environment of the NICU and encourage positive parent-infant attachment processes fundamental for growth and positive neurodevelopment (Gómez-Cantarino et al., 2021; Kim et al., 2020; McAndrew et al., 2020; Montirosso et al., 2017; Twohig et al., 2016; White-Traut et al., 2018). Nurses are essential to creating an environment that encourages the parent-infant relationship, which is critical to the interventions demonstrated to have a moderate effect on a neonate's developmental progression and cognitive, language, motor, and social and behavioral outcomes (Burke, 2018; Philpot-Robinson, et al., 2017; Pineda, et al., 2020; White-Traut, et al., 2018). Staff education was the starting point for implementation. Training was recorded and

placed in an online education repository for future staff onboarding. Training sessions accounted for all NICU nurses employed, regardless of FTE status or shift, during this project's piloted practice change, except a single nurse on leave who completed training online upon their return to work.

Interpretation

Staff education and application of SENSE© proved to increase integration of developmentally supportive caregiving as assessed by NANN's Self-assessment for Neonatal Developmental Care Specialist Designation Examination, consistent with Aim 1 of this QI project. Surveys were completed at education sessions on six dates in January 2022 and then again post-implementation in May. A total of 17 assessments were matched, which did not meet the inclusion goal of 28 assessments to power results for the chosen confidence level and interval but did represent a 48.5% attrition rate.

There were 14 full weeks of program implementation between the last staff education session and the request for staff to complete the post-assessment evaluation, with an additional ten days allotted for assessment completion and submission. Overall assessment scores increased significantly, as did mean scores for the following subsets: "Standard 1: The infant receives individualized care," "Standard 3: All caregivers practice collaboratively," and "Standard 4: A developmentally appropriate environment is provided for every infant and family." Extreme significance was demonstrated for composite scores and for Standards 1 and 4.

NANN suggests that individual clinicians using the instrument to assess their own level of developmentally supportive caregiving who answer "all of the time" in 80% of items in each of the four standards are practicing at a level of integration supportive of passing the DC specialist designation exam. Looking at collective NICU nurses' scores at the project site, mean

scores were >80% both on pre- and post-assessments overall and on standards 1, 2, and 3. However, the pre-assessment results for “Standard 4: A developmentally appropriate environment is provided for every infant and family” suggests a score of 78% based on the mean. After SENSE©, the shift in the mean results in a passing score of 87.9%. This finding supports the program’s hallmark evidence-based guideline, which prescribes visual, auditory, gustatory, tactile, and vestibular exposures, as a way to support a developmentally conscious sensory environment. The attention to the sensory environment resounds in the literature. It is found in the guideline by NANN, the *Developmental care of newborns and infants: A guide for healthcare professionals* (3rd. Ed) (Kenner & McGrath, 2021). It is described and illustrated in The Neonatal Integrative Developmental Care Model, which has at its core “Healthy Environment,” where the senses are labeled touch, smell, sound, taste, and light (Altimier & Phillips, 2016).

The SENSE© program was supported by the project team and reviewed at regular Developmental Care meetings as consistent with Aim 2. Several team members championed various pieces of the project and served as resource persons in the unit and on staff huddles. While Aim 3 of this project, to have two staff members pass the examination, is yet to be accomplished, it is ongoing. There are six persons from the project team in addition to the primary investigator who formed a study group for NANN’s DC specialist examination that is ongoing at the project’s completion.

The evidence suggests that interventions are best applied as early as possible to most positively influence an infant’s developmental trajectory. Specific to SENSE©, the education timeframe was significant in an evaluation study of the program where earlier parent education was related to more parent participation in program interventions ($p = 0.04$) (Pineda et al., 2021).

Orientation to SENSE© was initiated by the second DOL 2 in 84.2% of babies with complete documentation (n=32) consistent with Aim 4.

While SENSE© education was embraced, documentation of ongoing intervention use was lacking overall even given low goal targets in this pilot phase. This was different from SENSE© developers' program evaluation where babies in the study arm received a significantly greater proportion of prescribed tactile and auditory exposures daily (91% compared to 48%; $p < 0.0001$; n=131) (Pineda et al., 2021). Staff and parents reported regular use of SENSE© interventions on rounds specific to the intervention, but medical log evaluation suggested that evolving practice change is necessary to meet the goals of Aim 5.

This project added to developmental care at the site in other ways. Prior to SENSE©, the site did cycle lighting, which is supported in the literature and prescribed in SENSE© per GA sensory guides. The project team researched and implemented a complimentary "Cycled Lighting Protocol" at the forefront of SENSE© implementation. It was through this project and protocol development that the project team was able to work with management and engineering to reverse light switches to turn on dim lighting and advance to brighter lighting with further adjustment, whereas prior lighting design introduced bright lighting that then required reduction.

The project team also worked with therapy services to collect children's book donations. Books were placed on a bookshelf purchased for the parent lounge to create a NICU Little Library where parents could borrow board books to take to babies' bedsides to read. This was supportive of auditory interventions promoted by the SENSE© program. The project team developed a protocol pertaining to the use and cleaning of NICU Little Library books and a plan for ongoing collections to create a sustainable library for parent use.

Multiple SENSE© interventions were noted in the documentation as prescribed for the various senses: visual, auditory, olfactory, tactile, and vestibular/kinesthetic on the shifts that nurses did document. In debriefings with the project team, interventions were noted in the unit despite lacking documentation in this pilot cycle. Parent massage classes were started during implementation supportive to one tactile SENSE© intervention. A group of nurses were certified in infant massage as mentioned and 20 staff nurses have been checked off as proficient in the skill to date with ongoing skill assessment.

Limitations

Data analysis was limited by the post-assessment response rate. Three surveys could not be matched despite urging staff at the first assessment point to choose a memorable four-digit number that would be used again. Attrition is a common problem in trials requiring data collection at two or more points (Edwards et al., 2016). Simply sending out follow-up questionnaires is generally not effective. An appeal was made via email, followed a few days later by a staff meeting where nurses were asked again to submit post-assessments, in an attempt to use two forms of communication reminders.

There was a fair mix of shift and experience in staff sampled, which supports the generalizability of findings. On the other hand, the small sample size and single site limits generalizability. A small majority of participants, 58.8% versus 41.2%, reported 7 PM to 7 AM as their primary work shift. Work shift could have contributed to the lack of effect on “Standard 2: Family centered care from birth” if families were more likely to be present at the bedside on dayshift. Furthermore, there may be less overall effect on developmental care practice integration in more experienced staff and with more prior DC training, though amount of prior training was not assessed only if prior training occurred. But most likely, the single-family room unit

supported a family centered environment prior to SENSE© despite lacking a guideline for developmental care interventions so this effect may be less realized in pre- and post-assessment scores. This reveals itself as the more certain contributor to the lack of effect observed in this standard especially when looking at the pre- and post- percentile scores (92.7%, 95.4%), where >80% as discussed is suggested by NANN to correlate with a level of integration supportive of passing the DC specialist designation exam.

Bedside logs required paper charting outside of the electronic medical record (EMR). Documentation was incomplete. Despite specific instructions given in education sessions, verbally in huddles, and written in guides, day of SENSE© education was not always documented. It was difficult to interpret the exact LOS because day of discharge was mostly omitted on logsheets. The program-provided logsheets were used initially, but these were found problematic and so were modified in the first week of implementation to simplify record keeping for DOL and GA (see Appendix N). This required re-instruction different from the original education sessions and may have contributed to staff difficulties with documentation.

While NICU management and the developmental care team were invested in the program, it was more difficult to gain staff support. Nurses, ancillary staff, and medical providers were given goodie bags provided by the developmental care team during kick-off week. Signage remained in the unit throughout the 14-week implementation period. SENSE© rounds were carried out weekly but there was lack of a daily driver. Where SENSE© developers described dedicated staff in their trial, the project team had patient assignments in addition to offering SENSE© support in the unit. Dedicated staff is common in other developmental care programs but is not feasible at large due to budgetary constraints. The SENSE© program was chosen as practicable at the project site because dedicated staff was not a requirement of the program.

Project team members did not have clinical time specific to SENSE© nor was the educator available in the unit as originally thought to support implementation due to office relocation to an offsite building. Change of shift huddles were used to remind staff regularly to document in logsheets to be submitted at discharge but not all charge nurses. The primary investigator met with charge nurses and provided a summary sheet to improve consistency of information to be shared in staff huddles, as not all charge nurses were project team members.

Despite a simplified logsheet and verbal and written directions and reminders about DC intervention documentation, the project was limited by staff motivation to document accessory information outside the EMR. Future iterations would benefit from a dedicated space for documentation within the EMR. Moving forward, it would be helpful to have an order added at admission to “Complete SENSE© education with baby’s family by DOL 2 and document in NICU Daily Cares.” Medical team training was offered but it was not mandatory. Seven providers participated, of which three were not primary providers at the site. In the future, mandatory provider training would aid program use. A provider order would increase awareness of needing to complete education and then provider follow-up of interventions with nurses and families on interdisciplinary rounds could encourage use of developmental care interventions important for neurodevelopmental outcomes.

Only two submissions of documentation were eligible for analysis for those babies born at 28-32 weeks gestation and one of these babies had incomplete documentation with no logsheets available after 33 weeks. Therefore, analysis was limited for babies of earlier gestations in the time frame of the project, and in part, by documentation submitted. This in turn limits the application of findings to babies delivered at these earlier gestations. The majority of documentation available represented shorter lengths of stay than would have been obtained in

earlier babies. Furthermore, the research demonstrates that developmental care interventions are especially important to babies born at these earlier gestations so their inclusion in future analyses is imperative. Originally, inclusion criteria were set for those babies of gestations < 35 weeks and/or with LOS >7 days based on the applicability of the evidence found working through the IOWA model. As the change was implemented, exclusions were eliminated so that all babies with any documentation were included to increase the sample size toward the goal sample of 43 babies needed based on the site's population data and the chosen confidence level and interval. A future cycle supported by medical providers and a medical order set as well as documentation in the EMR, would produce more applicable results. These changes and a longer interval would allow investigators to focus on babies <35 weeks, which includes all babies automatically admitted to the NICU and ensures a lengthier stay for more robust data collection.

Lastly, the Covid-19 pandemic limited the project in two ways. First, the initial staff education session could not be held in-person, which may have impacted that subset of assessment scores versus those classes held in the classroom. Secondly, DC programs including SENSE© in other units have relied on volunteers to provide DC interventions when parents are unavailable. Given Covid-19 restrictions, volunteers and visitors outside of parents were not allowed in the NICU. This places more onus on nurses already burdened with daily caregiving activities and short-staffed. Some positive sensory stimulation interventions are time consuming. While cycled lighting and talking to the infant can be accomplished within the other tasks of the day, holding, which is prescribed for a longer duration of time for increasing GA, may not be feasible within the time constraints of a busy assignment by a single clinician.

Conclusion

The project results have added to the evidence that use of a DC guideline in a Level II NICU generates a standard of care and unit culture supportive of a developmentally appropriate environment for every infant and family that is provided through the collaboration of caregivers. Applying a DC guideline supports individualized care for every baby, which is family-centered and supported from birth and results in greater consistency in the information given to parents. Nurses' knowledge and integration of DC practices in routine care increased with SENSE© compared to standard practice, which is imparted to the families for which they care. Results of this project will be submitted to the University of Louisville's School of Nursing, presented at the University of Louisville Graduate Poster Presentation, and be shared with the Nursing Research and Oversight Team and with NICU nursing and ancillary staff at the intervention site. It will also be shared with the primary investigator's division of Neonatology.

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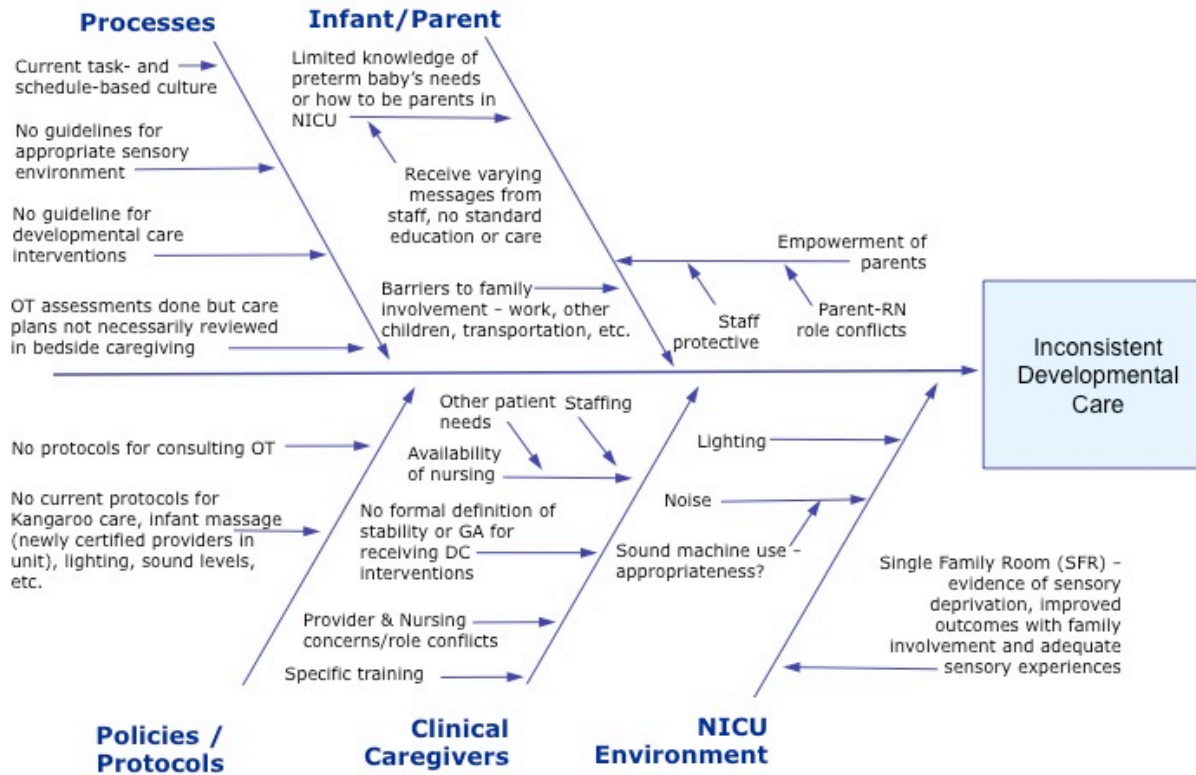
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Appendix A

Needs Assessment: Fishbone Exercise

Needs Assessment: Contributors to Inconsistent Developmental Care Provision in NICU



Appendix B

SENSE© QR Code Flyers for Program Parent Education

Families! Access SENSE education materials using the QR codes below. While in “camera” mode on your phone, aim the camera at the QR codes below to open the links in your web browser.



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Appendix C

SENSE© Program Preview Parent Log Week 23 as an Example of Program Weekly Logs

Week of _____ SENSE© Copyright 2017, by Washington University in St. Louis, Missouri and 2022, by University of Southern California in Los Angeles, California. All rights reserved.

Day of Week	Who did it today? (Check all that apply)	Time in NICU (Check all that apply)	Touch (Check all that apply)	Smell (Check all that apply)	Seeing	Movement
Monday	<input type="checkbox"/> Mom <input type="checkbox"/> Dad <input type="checkbox"/> Non-Binary Parent <input type="checkbox"/> Grandparent <input type="checkbox"/> Sibling <input type="checkbox"/> Other _____	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night Total time in NICU: _____ hrs _____ mins <small>*Recommended: at least 1 hr</small>	<input type="checkbox"/> Hand Hugs _____ mins <input type="checkbox"/> Kangaroo Care _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	<input type="checkbox"/> Scent Cloth _____ mins <input type="checkbox"/> Breast Milk _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	Isolette Cover: _____ On _____ Off Movement Opportunity -# of times: _____ -Total Time: _____ mins <small>*Recommended: 1 1/2/day for at least 2 mins</small> <input type="checkbox"/> Position Change -# of positions: _____ -Total Time: _____ mins <small>*Recommended: at least 10 minutes in 2 positions</small>	
Tuesday	<input type="checkbox"/> Mom <input type="checkbox"/> Dad <input type="checkbox"/> Non-Binary Parent <input type="checkbox"/> Grandparent <input type="checkbox"/> Sibling <input type="checkbox"/> Other _____	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night Total time in NICU: _____ hrs _____ mins <small>*Recommended: at least 1 hr</small>	<input type="checkbox"/> Hand Hugs _____ mins <input type="checkbox"/> Kangaroo Care _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	<input type="checkbox"/> Scent Cloth _____ mins <input type="checkbox"/> Breast Milk _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	Isolette Cover: _____ On _____ Off Movement Opportunity -# of times: _____ -Total Time: _____ mins <small>*Recommended: 1 1/2/day for at least 2 mins</small> <input type="checkbox"/> Position Change -# of positions: _____ -Total Time: _____ mins <small>*Recommended: at least 10 minutes in 2 positions</small>	
Wednesday	<input type="checkbox"/> Mom <input type="checkbox"/> Dad <input type="checkbox"/> Non-Binary Parent <input type="checkbox"/> Grandparent <input type="checkbox"/> Sibling <input type="checkbox"/> Other _____	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night Total time in NICU: _____ hrs _____ mins <small>*Recommended: at least 1 hr</small>	<input type="checkbox"/> Hand Hugs _____ mins <input type="checkbox"/> Kangaroo Care _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	<input type="checkbox"/> Scent Cloth _____ mins <input type="checkbox"/> Breast Milk _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	Isolette Cover: _____ On _____ Off Movement Opportunity -# of times: _____ -Total Time: _____ mins <small>*Recommended: 1 1/2/day for at least 2 mins</small> <input type="checkbox"/> Position Change -# of positions: _____ -Total Time: _____ mins <small>*Recommended: at least 10 minutes in 2 positions</small>	
Thursday	<input type="checkbox"/> Mom <input type="checkbox"/> Dad <input type="checkbox"/> Non-Binary Parent <input type="checkbox"/> Grandparent <input type="checkbox"/> Sibling <input type="checkbox"/> Other _____	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night Total time in NICU: _____ hrs _____ mins <small>*Recommended: at least 1 hr</small>	<input type="checkbox"/> Hand Hugs _____ mins <input type="checkbox"/> Kangaroo Care _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	<input type="checkbox"/> Scent Cloth _____ mins <input type="checkbox"/> Breast Milk _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	Isolette Cover: _____ On _____ Off Movement Opportunity -# of times: _____ -Total Time: _____ mins <small>*Recommended: 1 1/2/day for at least 2 mins</small> <input type="checkbox"/> Position Change -# of positions: _____ -Total Time: _____ mins <small>*Recommended: at least 10 minutes in 2 positions</small>	

PARENT LOG WEEK 23 Bed Space _____

Week of _____ SENSE© Copyright 2017, by Washington University in St. Louis, Missouri and 2022, by University of Southern California in Los Angeles, California. All rights reserved.

Day of Week	Who did it today? (Check all that apply)	Time in NICU (Check all that apply)	Touch (Check all that apply)	Smell (Check all that apply)	Seeing	Movement
Friday	<input type="checkbox"/> Mom <input type="checkbox"/> Dad <input type="checkbox"/> Non-Binary Parent <input type="checkbox"/> Grandparent <input type="checkbox"/> Sibling <input type="checkbox"/> Other _____	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night Total time in NICU: _____ hrs _____ mins <small>*Recommended: at least 1 hr</small>	<input type="checkbox"/> Hand Hugs _____ mins <input type="checkbox"/> Kangaroo Care _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	<input type="checkbox"/> Scent Cloth _____ mins <input type="checkbox"/> Breast Milk _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	Isolette Cover: _____ On _____ Off Movement Opportunity -# of times: _____ -Total Time: _____ mins <small>*Recommended: 1 1/2/day for at least 2 mins</small> <input type="checkbox"/> Position Change -# of positions: _____ -Total Time: _____ mins <small>*Recommended: at least 10 minutes in 2 positions</small>	
Saturday	<input type="checkbox"/> Mom <input type="checkbox"/> Dad <input type="checkbox"/> Non-Binary Parent <input type="checkbox"/> Grandparent <input type="checkbox"/> Sibling <input type="checkbox"/> Other _____	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night Total time in NICU: _____ hrs _____ mins <small>*Recommended: at least 1 hr</small>	<input type="checkbox"/> Hand Hugs _____ mins <input type="checkbox"/> Kangaroo Care _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	<input type="checkbox"/> Scent Cloth _____ mins <input type="checkbox"/> Breast Milk _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	Isolette Cover: _____ On _____ Off Movement Opportunity -# of times: _____ -Total Time: _____ mins <small>*Recommended: 1 1/2/day for at least 2 mins</small> <input type="checkbox"/> Position Change -# of positions: _____ -Total Time: _____ mins <small>*Recommended: at least 10 minutes in 2 positions</small>	
Sunday	<input type="checkbox"/> Mom <input type="checkbox"/> Dad <input type="checkbox"/> Non-Binary Parent <input type="checkbox"/> Grandparent <input type="checkbox"/> Sibling <input type="checkbox"/> Other _____	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Evening <input type="checkbox"/> Night Total time in NICU: _____ hrs _____ mins <small>*Recommended: at least 1 hr</small>	<input type="checkbox"/> Hand Hugs _____ mins <input type="checkbox"/> Kangaroo Care _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	<input type="checkbox"/> Scent Cloth _____ mins <input type="checkbox"/> Breast Milk _____ mins Total Time: _____ hrs _____ mins <small>*Recommended: at least 3 hrs</small>	Isolette Cover: _____ On _____ Off Movement Opportunity -# of times: _____ -Total Time: _____ mins <small>*Recommended: 1 1/2/day for at least 2 mins</small> <input type="checkbox"/> Position Change -# of positions: _____ -Total Time: _____ mins <small>*Recommended: at least 10 minutes in 2 positions</small>	

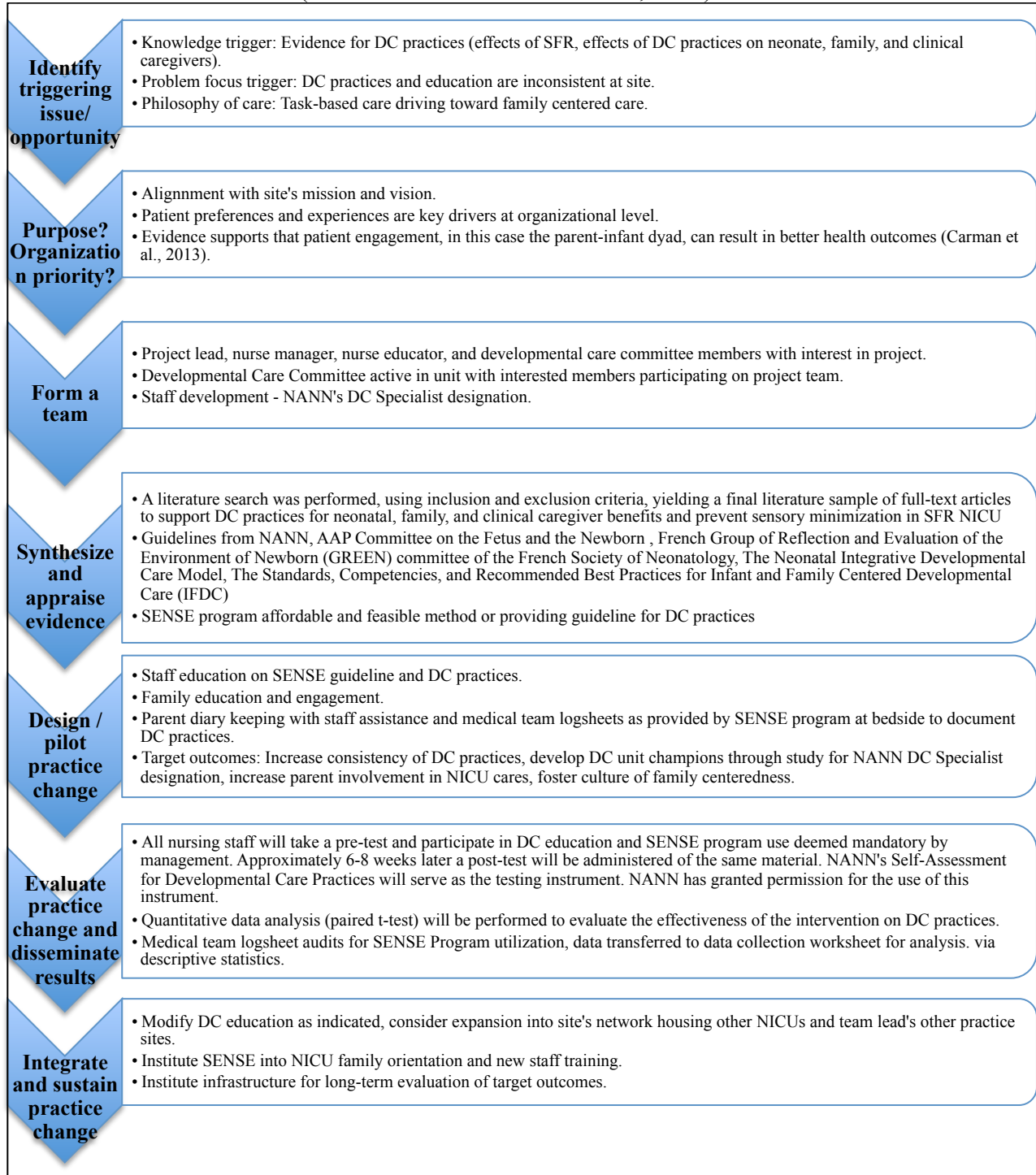
PARENT LOG WEEK 23 Bed Space _____

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Appendix D

Iowa Model of Evidence-Based Practice as Pertaining to the Project

(Iowa Model Collaborative et al., 2017)



Appendix E

Staff Education PowerPoint Slides

Developmental Care Makes SENSE

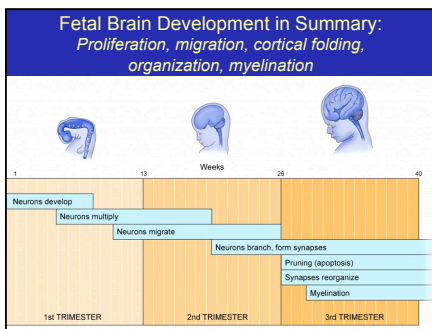


Learning Objectives

- Describe normal brain development and sensory integration and as related to preterm birth and extrauterine development
- Describe rationale for developmental care
- Identify key components of developmental care
- Identify strategies to improve developmental care practices in NICU
- Apply key components of SENSE program to provide neuroprotective, neurosupportive, neuropromotive, and family-centered care

Fetal & Neonatal Brain Basics

Stages of Neurological Development



Mass production of brain cells

- 2-4 months
- Environmental disruptions (maternal malnutrition, medications/drugs, and infections) affect brain growth and subsequent neonatal behavioral responses
- Moving into the second trimester (13 wks), as many as 100,000 cortical neurons per day migrate in waves to their final destinations in the brain

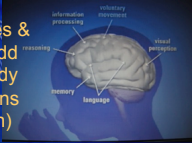
Appendix E (continued)

Migration to the Cerebral Cortex

- 3-5 months, Core outward
- Guided by adhesion molecules on stringy, elongated glial cells in radial pattern
- Other neurons occasionally transfer to axons & travel perpendicularly across regions & even hemispheres (ie. Brainstem formation)
- Other neurons combine the two forms of migration (ie. Cerebellum formation)

Formation of Synapses & Regions

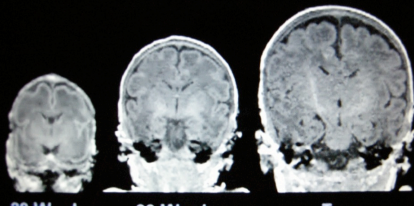
- Brain growth spurt (20 wks-2yo)
- As brain surface area increases:
 - Individual neurons mature & organize - Cells of same type recognize one another & cluster/align
 - Cortical sheet creases & folds as more cells add surface area to already crowded space (begins at 5 months gestation)



Myelination

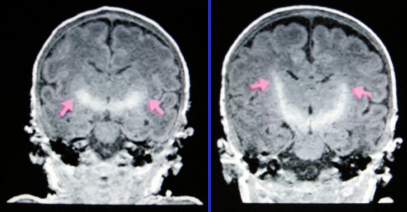
- Connections/Synapses form axon-dendrite, axon-cell body, cell body-cell body critical junctions where impulses pass
- **Myelin** = white, fatty substance surrounding mature neurons
- **Purpose:** Protects and insulates allowing neurons to transmit signals between one another with greater speed
- Pathways become functional with myelination

MRI Images of Brains at Various GA



28 Weeks 32 Weeks Term

Myelination with Maturation



30 weeks 40 weeks

Sensory Organization/Integration

Modified by external stimulation

Imprinting: Neurons pruned based on exposure

depends on interrelated factors: *timing, amount*, and *type* of sensory experience

Natural sequence altered by preterm birth & ICU care

Appendix E (continued)

Why integrate developmental care in practice?

- Early life exposure predicts later life outcomes
- Neurons that fire together wire together
- Goal has changed from survive to THRIVE
- Nurse driven...nurse and family given

Long-term Implications of Prematurity

- Hearing impairment
- CLD: repeat hospitalizations
- Failure to thrive in infancy
- Executive function disorders
- Motor impairment
- Cerebral palsy
- Psychosocial, emotional, economic stress on family
- Vision impairment
- Increased incidence of asthma
- Obesity in adolescence
- Cognitive impairment
- Autism Spectrum Disorder
- Mood disorders
- Attention disorders
- Increased risk of preterm births to former premies

In general preemies tend to:

- Be highly sensitive to noise, light, touch, and movement—even beyond the 2nd birthday
- Retain startle reflexes longer than usual
- Have abnormal tone persisting 12-18 months - may be either stiff or floppy, or a mix of both
- Be very distractible and highly active or extremely quiet and sleep more than expected
- Have increased risk for vision problems
- Often develop oral defensiveness due to negative oral experiences with feeding tubes, respirators and suctioning, which can interfere with feeding

Neuro NICU

- Neuroprotective care
 - Decrease early exposures to stimulation
- Neurosupportive care
 - Provide meaningful touch, smell, and sound
- Neuropromotive care
 - Intentional and specific exposures
- Family-centered care
 - Parents are the most consistent caregiver and must learn to advocate for their baby

Develops First—Brainstem (Primitive Brain)
Sensory motor input and survival.

Develops Second—Midbrain and Limbic Area
Attachment and emotional development.

Develops Third—Cerebral Brain
Thinking, learning, language and reasoning.

Implicit memory
Memories are stored in the sensory systems prior to language development.

Neonatal Integrative Care Model

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Appendix E (continued)

Development of the Fetal Senses

Order matters!

1. Touch (Tactile)
2. Balance (Vestibular)
3. Smell (Olfactory)
4. Taste (Gustatory)
5. Hearing (Auditory)
6. Site (Visual)

Tactile Development

Tactile	<p>Functions as a protection and discriminatory system</p> <p>Communicates sensory input from periphery to cortex - both pleasant and painful stimuli</p> <p>Week 7: Early fetal movement detected by ultrasound</p> <p>Week 7-8: Perioral area sensitive to stimulation</p> <p>Week 11: Sensory nerve endings in place and functioning</p> <p>Week 14: Sensory innervation completed</p> <p>By 26 weeks: Primitive tactile reflexes can be elicited; rooting is present</p> <p>Week 32: Back and legs modulate input</p>	<p>Infant perceives pressure, pain, & temperature at any viable GA</p> <p>Sensitivity to touch especially well-developed in the face, around the lips (root reflex) and in the hands (grasp reflex) - Perioral area very sophisticated by 24 weeks GA</p> <p>Entire system extremely sensitive and easily over-stimulated</p> <p>Behaviors resulting from over-stimulation include: pulling away from stimulus, squirming, crying, inability to settle/get comfortable, feeding aversions</p> <p>Tactile defensiveness can be an over active protective response</p>
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Excessive handling of preterm or sick neonates results in significant consequences:

- Blood pressure changes
- Alterations in cerebral blood flow
- Hypoxia
- Other stress behaviors

Common Sources of Caregiving Touch:

- Assessments
- Suctioning
- Weighing
- IV insertion
- Bathing
- Transferring for Kangaroo Care or holding
- Total body position change

Touch not related to caregiving:

- Provide when infant is aware, alert & receptive
- Empower parents
- Standing transfers to KC/SSC
- Less touching by RN within 2 hours before parental holding or SSC results in less mean brady/desaturation events



Vestibular Development

Vestibular	<p>Functions to provide input from inner ear to vestibular center in brainstem</p> <p>Maintenance of equilibrium and coordination of eyes and body and both body hemispheres</p> <p>Day 44: Primitive semicircular canal</p> <p>Week 14-16: Non-auditory labyrinth of inner ear formed allowing the fetus to sense and maintain balance in the womb</p> <p>Week 14: Sensory innervation completed</p> <p>Week 18: Myelination completed</p> <p>Week 21: System is functional</p>	<p>System is stimulated through movement and changes in position</p> <p>Stimulating system helps develop muscle tone - Muscle tone develops in caudoccephalic and centripetal directions and interacts with the simultaneous caudoccephalic development of movement/balance to help affect posture</p> <p>Impacts infant's state, ability to rest, ability to self-regulate</p> <p>Motion and position changes can be very over-stimulating</p> <p>Behaviors from over-stimulation include increased motor activity, color changes, crying, poor feeding</p> <p>Continuous assessment of muscle tone, response to positioning and handling, oral motor function, and response to sensory stimuli provide data for individualizing intervention.</p>
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Appendix E (continued)

- Tone develops in caudocephalic & centripetal directions
- Interacts with simultaneous caudocephalic development of movement/balance

Neuromuscular Maturity							
	-1	0	1	2	3	4	5
Posture							
Square Window (vertical)							
Arm Reced.							
Postural Angle							
Scarf Sign							
Head to Ear							

GA (weeks)	Development of Tone
29	Hypotonic - lacks all physiologic flexion
32	Hips and knees begin to show some flexion while arms remain extended
34	Flexor tone apparent in legs
36	Loose flexion of arms & legs evident, +grasp reflex
40	Flexed position in crowded intrauterine space; After birth, reflex activity and CNS maturity help term infant to unfold and extend and then return to all limbs in flexed position

Effects of Immobilization & Gravity

- Increased neck extension
- Shoulder retraction & abduction (reduces forward movement & ability to reach midline)
- Increased trunk extension with “arching” of the neck and back
- Frog-leg: Hips abducted & externally rotated
- Ankle and feet eversion

Positioning & Handling

Side-lying: Improves visual awareness of hands, encourages hands-to-midline movements, and discourages frog-leg position.


Prone positioning: Encourages the infant to work on using neck extension and promotes knee and arm flexion (TUMMY TIME)

“Premie flip”: Avoid by gently and slowly supporting baby into various positions throughout the day

Physiological Benefits of Prone Positioning:

- Decreases heart rate variability
- Enhances respiratory control
- Improves lung mechanics and volumes
- Improves oxygenation
- Decreases energy expenditure
- Decreases gastric reflux with head of bed elevated 30 degrees

“BACK TO SLEEP”



When baby is well-enough to be weaned to an open crib and PO feeding >4 times per day, he is physiologically and developmentally mature to tolerate supine sleep position in preparation for discharge.

Appendix E (continued)

Preventive Positioning

Plagiocephaly Brachycephaly Dolichocephaly

Sternocleidomastoid muscle stretches from the sternum to the skull behind the ear

"Why neck" #ADAM

NICU Healing Environment: Vestibular/ Kinesthetic Developmental Devices

- Z-flow mattress
- Oscillating bed / Snoo bed
- Rocking chairs
- Baby swings/Momaroo
- Baby carrying

Gustatory Development

<p>Gustatory</p> <p>Function is to transmit impulses to taste center in cerebral cortex</p> <p>Encourages exploration</p> <p>Facilitates developmental skills (hand-to-mouth, readiness for oral feeding, midline play)</p>	<p>Week 4: Mouth begins to form tongue bud</p> <p>Week 8: Mouth and tongue development complete</p> <p>Week 16: Taste receptors fully present</p> <p>Weeks 16-18: Chemoreceptors for taste are developed</p> <p>Week 21: Taste buds emerging</p> <p>Weeks 26-28: Withdrawal response to bitter taste</p> <p>Week 35: Differentiation between glucose and water with calming</p> <p>Newborn (Day 3 to 6): Differentiate between sweet, sour, bitter; And between breast milk and formula</p>	<p>Fetus sucks/swallows amniotic fluid daily in utero; provides practice for feeding and self-regulation</p> <p>High level of discriminatory taste - easily overstimulated</p> <p>Impacts later coordination of suck/swallow/breathe patterns and feeding</p>
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NICU Healing Environment: Bonding By Way of Taste

- Amniotic fluid rich with tastes:
 - Sweet: glucose and fructose
 - Sour/Acidic: citrate and lactate
 - Salt: potassium and sodium
- Encourage pumping
- Early opportunities for colostrum care
- Encourages developmental skills: oral play, hand to mouth, mouth exploration, & midline activities

Olfactory Development

<p>Olfactory</p> <p>Functions for recognition and discovery; elicits adaptive behaviors (breastfeeding, rooting) & warns of potential dangers</p> <p>One of most well-developed senses in newborns</p> <p>Assists in GI functions</p>	<p>Week 5: Nasal pits present</p> <p>Week 7: True nostrils formed</p> <p>Week 8: Nasal structure and components in place</p> <p>Week 11: Olfactory epithelia</p> <p>Week 13: Olfactory bulb walled off from nasal cavity by emerging bony plate</p> <p>Week 26: Olfactory bulb matures</p>	<p>Approach/withdrawal reactions present to olfactory stimuli - By week 28, preterm baby responds to strong odors by sucking, grimacing, or turning head</p> <p>Recognition of mother through smell</p> <p>Over-stimulation of system can lead to disinterest in feeding</p> <p>Hypoxia can affect smell, which affects feeding interest</p>
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NICU Healing Environment: Smell

- The Snoedel or another small parent scented cloth may be placed near the baby's face until in Safe Sleep protocol
- Avoid strong scents near the baby (perfume, alcohol, lotion, & cigarette smoke)

Appendix E (continued)

Auditory Development

Auditory	External, middle, inner ear and auditory center in cortex Important for attention and learning. Motivates alerting and orientation behaviors. Basic to development of spoken language.	Week 3: Earliest auditory neurons Week 4: First anatomical division of inner ear Week 6: Auditory nerve and cochlear nuclei are clearly distinguishable Week 11: Cochlea complete Week 13: Higher brainstem auditory centers become obvious Week 24: System structurally complete and functional, relays between ear and brain begin myelination Week 25: All parts of ear needed to hear are present Week 29 into first years of life: Auditory pathways of CNS mature	Premature inability to habituate makes the auditory system very sensitive Observed behaviors in response to increased auditory levels in NICU include: VS changes, desaturation events, reduced sleep, increased motor activity
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The Sound of Sound

Quality	Intensity, dBA	Example	Inside Incubator	Effect
Just audible	10	Heartbeat		
Very quiet	20-30	Whisper		<35 dBA desired for sleep
	40	Average home		
Quiet	50	Light traffic	Background	<50 dBA desired for work
	60	Normal conversation	Motor on and off	
Moderately loud	70	Vacuum cleaner	Bubbling in ventilator tubing	Annoyance
	80	Heavy traffic	Tapping incubator with fingers	Highest level that does not produce measurable hearing damage
Loud	90	Telephone ringing	Pneumatic drill	
	100	Power mower	Closing incubator cabinet doors	Hearing loss with persistent exposure
Very loud	120	Boom box in car	Closing solid plastic porthole	
	140	Jet plane 30 m overhead		Pain and distress

Effects of Loud Noise:

- Physiologic effects
- Increased stress and avoidance behaviors
- Alters development of sleep-wake cycles, ↑arousal state
- Abnormal auditory development

AAP Recommendation:

Noise levels should be below 45 dBA

Most NICU levels range from 38-75 dBA with noises bursts 57-90 dBA & sometimes higher

Quality	Intensity, dBA	Example	Inside Incubator	Effect
Quiet	40	Average home		
	50	Light traffic	Background	<50 dBA desired for work
Moderately loud	60	Normal conversation	Motor on and off	
	70	Vacuum cleaner	Bubbling in ventilator tubing	Annoyance
Loud	80	Heavy traffic	Tapping incubator with fingers	Highest level that does not produce measurable hearing damage
	90	Telephone ringing	Pneumatic drill	
	100	Power mower	Closing incubator cabinet doors	Hearing loss with persistent exposure

NICU Healing Environment: Sound Levels

- Continuous background sound shall not exceed an hourly continuous level of 45 dB
- Transient sounds in NICU shall not exceed 50 dB more than 10% of every hour
- The single-highest sound level shall not exceed 65 dB

Minimizing external auditory stimuli:

- Quite alarms quickly
- Close portholes & drawers gently
- Avoid shift report or rounds over or near infant's incubator/bed
- Repair noisy equipment
- Empty sloshing water in vent/CPAP/HFNC tubing
- Nursery design changes (OW vs SFR, soundproofing materials, lights for phone and alarm alerts versus sounds)
- Covers/blankets over incubators to muffle noise
- Do not place items on top of the incubator

Appendix E (continued)

**Parent Teaching Tip:
Hearing for Bonding & Attachment**


Hearing > vision for attachment & bonding.

Within seconds after birth, newborns are able to discriminate and prefer mother's face because they connect her familiar voice with her unfamiliar face.

- Infant preference for "parantese"
- Role model gentle talking to infant while touching & giving care
- Lullaby singing regulates infant state and decreases stress for infants and parents

Visual Development

<p>Visual</p> <p>Provides input for processing input to brain</p> <p>Most complex - starts early in development but longest to complete</p> <p>Integrates vestibular system by correlating visual reference with equilibrium</p> <p>Integrates strongly with tactile system</p>	<p>Day 22 - First optic tissue</p> <p>Weeks 6-8 - Optic nerve forms, retinal differentiation</p> <p>Week 12: Precursors of rods and cone</p> <p>22 weeks - All retinal layers present</p> <p>23 weeks - Immature rods and cones</p> <p>24 weeks - Myelination of optic nerve begins</p> <p>25-26 weeks - All neurons of visual cortex present</p> <p>26 weeks - Eyes open but cannot focus</p> <p>28-40 weeks - General rapid ocular growth, iris sphincter develops, retinal vessels reach the periphery</p>	<p>Prior to 6th month, there is no way for preterm infant to control the amount of light into the retinal field</p> <p>Behaviors observed in response to increased visual stimulation in NICU include squinting, shading face with hands, turning away</p> <p>The visual cortex is one of the last to be myelinated, so higher levels of perception occur later (visual spatial relationship, visual motor coordination, visual memory, figure ground)</p> <p>32-36 weeks: May respond to light but not color. Tries to look at objects. May take a while to focus and may focus for only a brief time. May follow objects. Prefers face with pleasant expressions. May take breaks by closing eyes or by eye aversion when stressed. Remove isolette covers when awake to encourage interaction.</p> <p>37-43 weeks: Sees outlines and shapes; unable to focus on distant objects. Eyes do not always work together and may appear crossed at times. May begin to enjoy mobiles and mirrors placed in the bed. Can look at one toy or object at a time.</p> <p>1-3 months post-term: Baby enjoys looking at faces, toys, mirrors, mobiles.</p>
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Visual Attentiveness



- Correlated with BW & GA
- May gaze but become easily stressed—offer opportunity to look at adult parent/caregiver's face as tolerated
- Use isolette covers per GA recommendations, shield eyes during procedures, allow for gradual exposure from darkness to light

Affects of 24-Hour Lighting with Bright Fluorescents:

- Chromosomal damage
- Changes in biological rhythms
- Affected endocrine gland function
- Reduced Vitamin D synthesis

**NICU Healing Environment:
Reduced Lighting**

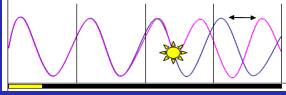
- Improves sleep
- Decreases motor activity
- Decreases heart rate
- Reduces feeding time
- Increases weight gain

Visual stimulation:

- Mobiles, pictures, & faces within visual range at appropriate GA
- Quiet alert state for visual encounters
- Tummy Time
- Place the infant at various heights (in baby carrier, crib, swing, infant seat, on the floor) so that he or she may see the world from various angles
- Place infant in side-lying to bring hands to midline in visual field
- Change arms during feedings and vary bed position in room

Appendix E (continued)

Promoting Circadian Rhythms



Circadian rhythms: Cyclic variations in body function occurring in a 24 hour period

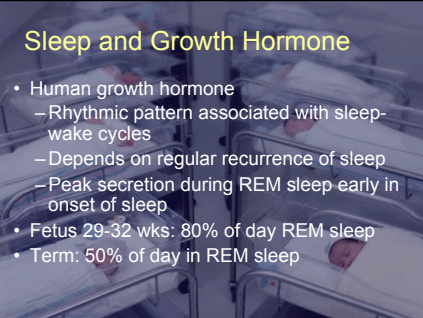
- Temperature
- Hormonal changes
- Blood pressure
- Urine volume
- Sleep-wake cycles

“Biological clock”

Suprachiasmatic nuclei (SCN)
 In anterior hypothalamus ↕
 Located at the base of the 3rd ventricle ↕

week 18: SCN forms and begins a maturation process that will continue after birth
week 25: SCN fully innervated by the retina (as based on animal studies)

Sleep and Growth Hormone



- Human growth hormone
 - Rhythmic pattern associated with sleep-wake cycles
 - Depends on regular recurrence of sleep
 - Peak secretion during REM sleep early in onset of sleep
- Fetus 29-32 wks: 80% of day REM sleep
- Term: 50% of day in REM sleep

NICU Healing Environment: Cycled Lighting

- Noise levels decreased in dim lighting
- More eye opening and gaze
- Improved state organization
- Improved clinical status
- Establishment of diurnal rhythms

Developmental Care Makes SENSE

- Provide opportunities for normal development & organization of sensory systems
- Detect early developmental problems
- Educate & encourage parents in their role in baby’s development in the NICU & after discharge
- **REMEMBER**...Interventions should be individualized
- Assess infant’s physiologic & behavioral responses before, during, & after interventions

Supporting & Enhancing NICU Sensory Experiences (SENSE)



[Introduction to SENSE](#)

Appendix E (continued)

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Appendix F

SENSE© Program Parent Education Slides Preview

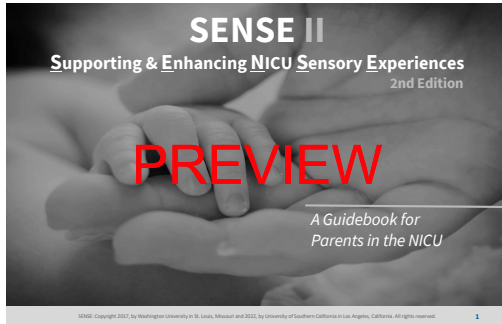


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Importance of Parents

- It is important to take care of yourself.
- Be sure you are eating right, drinking fluids, and getting enough sleep.
- Your care team is here to support you. Please ask for help when it is needed.

Interacting With Your Baby in the NICU

- Babies may be easily stressed by bright lights, noise, quick movements, and medical care. Your comfort can help your baby.
- Parents provide the most important touch for their babies.
- Babies, especially in the NICU, need touch. Sleep is very important for your baby's development.
- As babies grow and develop, they will wake for longer periods of time and will interact more.
- Whether babies are awake or sleeping, they can benefit from you speaking softly to let them know you are there or placing a hand on their body or head to let them experience loving touch.

Glossary

The NICU has its own language. We have created a list to explain some words that you will hear in the NICU and throughout this book:

*A baby who is not preterm grows inside the pregnant parent for 40 weeks before being born. So, the 29th week of pregnancy means that the baby is 11 weeks from the due date.

- NICU:** The neonatal intensive care unit.
- Due Date:** The date your baby would have been born if your baby had stayed inside the pregnant parent for 40 weeks.
- Full Term:** A baby who was born on the due date or two weeks before or after the due date.
- Preterm:** A baby who was born three weeks or more before the due date.
- Gestational Age:** The number of weeks that a baby has spent developing in the pregnant parent's womb prior to being born (from the date of the pregnant parent's last menstrual period).
- Postmenstrual Age:** The number of weeks that a baby has spent developing in the world since being born (from the date of birth).

This helps us understand the 'development' of our babies. For example, if your baby was born at 26 weeks gestation and is now 4 weeks old, your baby's postmenstrual age is 30 weeks (10 weeks before the due date):

- Term Age:** A baby who has reached the original due date.
- Womb or Uterus:** The place where a baby grows inside of the pregnant parent.
- Senses or Stimuli:** How you experience the world around you with touch, taste, smell, sight, hearing, and movement.
- Development:** The process of growing and learning new things.
- Stimulables:** Something applied to or around the baby to help the baby develop or grow.
- Interventions:** Something done to help with a situation; something done to help the baby develop or grow.
- Treatments:** Something done to help and/or fix a medical problem.
- Nursing Care:** Something the staff does to help care for your baby. This can include diaper changes, checking temperature and other vitals, and performing other procedures.

1 Parenting in the NICU

What You Can Do For Your Baby

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Appendix F (continued)



PREVIEW

2


Experiencing the World

Our Body's Senses

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We Have Seven Basic Senses




1. Touch.
2. Hearing.
3. Smell.
4. Taste.
5. Seeing.
6. Body Awareness (understanding the parts of your body, where they are located, how they feel, and what they can do).
7. Movement.



PREVIEW

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In the Womb: Touch & Body Awareness


PREVIEW

- Baby's arms and legs are flexed (brought in by the womb's walls).
- The tight wall of the womb keeps baby curled up, with pressure on the back, hands toward the middle of the body, and legs tucked in.
- **The "hug" of the womb makes the baby feel safe and secure. The baby is able to move about while still feeling the pregnant parent's "hug" all around the body.**
- This teaches the baby about the position of the bones and muscles during bending, straightening, pulling, and stretching.

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In the Womb: Smell & Taste



PREVIEW

- The baby's taste buds develop around the 13th to 15th week of pregnancy.
- The baby can smell and taste the pregnant parent's diet, including salty, sweet, sour, bitter, and savory. The baby can perceive the unique smell of the parent.
- The sense of smell and taste allow the enjoyment of many different flavors.
- Smell has a strong connection to long term memory, and the baby recognizes the parent's smell immediately after birth.
- **The parent's smell is important for bonding and makes your baby feel safe.**

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PREVIEW




3

Growing Up in The NICU

Supporting Your Baby's Developing Senses

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The NICU Experience

PREVIEW

- Premature birth and staying in the NICU changes how your baby experiences the world.
- Your baby no longer has the protection of the parent's body, and your baby experiences all of the noise, light, touch, pain, and gravity that is in the outside world.
- Your baby's senses continue to develop just like they would in the womb, but with the added challenge of a different stimulation.
- It is important to be sure that you are providing the right kind of stimulation that it will support developing senses.
- How? By giving positive sensory experiences that are close to what your baby would get in the womb, by getting sensory experiences that are backed by research, and by spending quality time with parents every day.
- Your health care team can help guide you about the types of sensory experiences that are best for your baby. This may change as your baby grows stronger.
- This guide provides suggested types of activities along with how long to conduct them. All the activities in this book have research that has shown them to benefit you and/or your baby.

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Appendix F (continued)

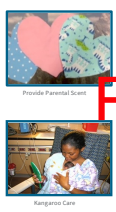
Supporting Your Baby’s Sense of Touch



- Touch and contact help your baby feel calm.
- Your touch is comforting to your baby.
- Gentle touch lets your baby know you are there.
- You can provide touch to your baby during nursing care or during a blood draw to help your baby deal with what is happening.

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Supporting Your Baby’s Sense of Smell



- Your scent is comforting and familiar to your baby.
- Breastfeeding and kangaroo care are great ways to allow your baby to experience your scent.
- Providing your scent and the scent of breast milk through scent cloths or other items can also provide your baby with comfort when you cannot be present.

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4 How Your Baby Talks To You

Watching Baby’s Signals

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Approach Behaviors: “I’m Ready to Interact”



- Focused Attention:** Baby will make eye contact with you.
- Bright Eyed & Sucking Movements:** Regular Breathing Rate
- Face, Arms, and Legs Relaxed**
- Good Color**
- Awake, Quiet, & Alert**

Baby nestled, relaxed, and ready for comforting touch.

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Stressed Behaviors: “I Need a Rest”



- Worried Face, Salute (Arms Up), & Finger Splay**
- Stiff Body (Hands up and out with fingers splayed)**
- Worried Face, Wrinkled Forehead (Furrowed Brow), & Hand Splaying**
- Yawning**

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5 Your Time With Your Baby

When To Interact

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Appendix F (continued)

Sensory Support: 24 Weeks

Here are some things to do with your baby each day this week (as long as tolerated)

- Touch**
 - Do kangaroo care (skin-to-skin) on a head bag with your baby for at least 1 hour per day.
- Hearing**
 - Engage in quiet conversation near the bedside during waking diaper changes.
- Smell**
 - Hold your baby for at least 1 hour after a breastfeed or a small of breast milk.
- Seeing**
 - Hold your baby in a basket or cradle with indirect lighting.
- Movement & Body Awareness**
 - Unwrap your baby and allow stretching and free movement for at least 2 minutes prior to a diaper change at least 3 times per day.
 - Allow your baby to experience being in at least 2 different positions for at least 10 minutes each.

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Sensory Support: 32 Weeks*

*Denotes change from previous week


Here are some things to do with your baby each day this week (as long as tolerated)

- Touch**
 - Give at least 2 hours of positive touch each day by doing one or more of these things:
 - Provide a hand hug.
 - Do kangaroo care (skin-to-skin) for at least 1 hour.
 - Hold your baby in a blanket for 15 minutes at a time, or longer if your baby's temperature remains stable.
 - Do massage for up to 15 minutes.
- Hearing**
 - Give at least 1 1/2 hours of positive sound each day by doing one or more of these things:
 - Read, sing, and/or speak to your baby (can be broken up into 30 minute periods several times per day).
 - Play soft music or recorded voice.
 - *At the sound of whisper or quiet conversation.
- Smell**
 - Hold your baby for at least 1 hour after a breastfeed or a small of breast milk.
- Seeing**
 - Hold your baby in a basket or cradle with indirect lighting, when there is no natural light during the day and dim light or darkness at night.
 - Avoid direct and bright lights.
- Movement & Body Awareness**
 - Unwrap your baby and allow stretching and free movement for at least 2 minutes prior to a diaper change at least 3 times per day.
 - Allow your baby to experience being in at least 2 different positions for at least 10 minutes each.
 - Rock during holding for at least 3 minutes.

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Sleep is Important!


- Sleep is important for your baby, but having positive sensory experiences with you is most important.
- By planning activities around your baby's sleep, you and your baby can have both uninterrupted sleep AND positive sensory experiences.
- Some activities can be done while your baby is sleeping and may help your baby sleep.
- Other activities can be structured around a time when your baby is going to be waking soon.



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Your Baby's Care Schedule

- Many babies are on a schedule so that all needed care happens around a scheduled time.
- While your baby is in the NICU, this is usually every 3 to 4 hours.
- When all of your baby's care is done on this schedule, it allows your baby to sleep for long periods.
- Parents are welcome in the NICU and encouraged to interact with their baby regardless of care schedule.



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6 Supporting Your Baby's Senses

Week-By-Week Sensory Plan

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Week-By-Week Sensory Plan

Each week in the NICU, your baby's senses are developing. This next section will introduce activities to do with your baby every day. The postmenstrual age at the top of each page will indicate the activities appropriate for your baby's developmental stage. The symbols on the left show which sense each activity is for.

You will see recommendations for the amount of time to provide sensory experiences for your baby. These are goals. Some babies will enjoy more or less of an activity, and you might not always be able to do as much as you would like. Do what you can, and follow your baby's lead!

- Touch (Tactile)**
- Hearing (Auditory)**
- Smell (Olfactory)**
- Seeing (Visual)**
- Movement & Body Awareness (Vestibular & Proprioception)**

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Appendix F (continued)

Sensory Support: 24 Weeks

Here are some things to do with your baby each day this week (as long as tolerated)

- Touch:** Do kangaroo care (skin-to-skin) or a hand hug with your baby for at least 1 hour per day.
- Hearing:** Engage in quiet conversation near the bedside and during diaper changes.
- Smell:** Engage in quiet conversation near the bedside or the smell of breast milk.
- Sight:** Engage in quiet conversation near the bedside or the smell of breast milk.
- Response:** Respond to your baby's eye contact or direct eye contact.
- Movement & Body Awareness:**
 - Unwrap your baby and allow stretching and free movement for at least 2 minutes prior to a diaper change at least 3 times per day.
 - Allow your baby to experience being in at least 2 different positions for at least 10 minutes each.

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Sensory Support: 32 Weeks*

*Denotes change from previous week

Here are some things to do with your baby each day this week (as long as tolerated)

- Touch:** Give at least 2 hours of positive touch each day by doing one or more of these things:
 - Provide a hand hug.
 - Do kangaroo care (skin-to-skin) for at least 1 hour.
 - Hold your baby in a blanket for 10 minutes at a time, or longer if your baby's temperature remains stable.
 - Do massage for up to 15 minutes.
- Hearing:** Give at least 1 1/2 hours of positive sound each day by doing one or more of these things:
 - Read, sing, and/or speak to your baby (can be broken up into 30 minute periods several times per day).
 - Play soft music or recorded voice.
 - *At the sound of whisper or quiet conversation.
- Smell:** Engage in quiet conversation near the bedside or the smell of breast milk.
- Sight:** Engage in quiet conversation near the bedside or the smell of breast milk.
- Response:** Respond to your baby's eye contact or direct eye contact.
- Movement & Body Awareness:**
 - Unwrap your baby and allow stretching and free movement for at least 2 minutes prior to a diaper change at least 3 times per day.
 - Allow your baby to experience being in at least 2 different positions for at least 10 minutes each.
 - Rock during holding for at least 3 minutes.

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Sensory Support: 37 Weeks

Here are some things to do with your baby each day this week (as long as tolerated)

- Touch:** Give at least 3 hours of positive touch each day by doing one or more of these things:
 - Provide a hand hug.
 - Do kangaroo care (skin-to-skin) for at least 1 hour.
 - Hold your baby in a blanket for at least 15 minutes at a time.
 - Do massage for up to 15 minutes at a time.
- Hearing:** Give at least 2 hours of positive sound each day by doing one or more of these things:
 - Read, sing, and/or speak to your baby (can be broken up into 30 minute periods several times per day).
 - Play soft music or recorded voice.
 - *At the sound of whisper or quiet conversation.
- Smell:** Engage in quiet conversation near the bedside or the smell of breast milk.
- Sight:** Engage in quiet conversation near the bedside or the smell of breast milk.
- Response:** Respond to your baby's eye contact or direct eye contact.
- Movement & Body Awareness:**
 - Unwrap your baby and allow stretching and free movement for at least 2 minutes prior to every diaper change.
 - Allow your baby to experience tummy time and being in at least 3 other positions for at least 10 minutes each.
 - Rock during holding for at least 2 minutes.

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7 Helping Your Baby's Senses

A "How-To" Guide

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Kangaroo Care

- It may be easier if you wear something that opens in the front, such as a robe, hospital gown, or a button-down shirt.
- Use the restroom, wash your hands, and get any items you will need during your time holding your baby.
- Have a member of the care team assist you as needed.
- Ensure that there is enough space between the bed and the chair to allow movement from the bed to the chair.
- There are different ways to transfer your baby to your chest:
 - To do a stand transfer, bend down over your baby until your chest is close to your baby's chest. Pull your baby onto your chest and then stand up straight and sit in the chair (pulled up behind you).
 - If you are not able to do a stand transfer, a member of the care team can put your baby on your chest and help secure any leads.
- You can do kangaroo care for as long as you would like, as long as you and your baby are tolerating it.
- Do kangaroo care for at least 1 hour to allow your baby to settle into it and achieve its benefits.
- Kangaroo care can be done chest-to-chest or can be done with your baby's side to your chest.
- You can add your voice, music, or other touch to kangaroo care, as long as your baby tolerates it.
- Take time to enjoy this special moment with your baby.
- Your calmness helps your baby feel calm and connected to you.

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Providing Scent

- You can provide your scent through close contact with your baby.
 - Kangaroo care, breastfeeding or nuzzling at the breast, and holding your baby are great ways to do this!
- Another way to provide your scent, when you cannot be present with your baby, is to use a baby's scent cloth that has your scent on it.
 - Each day you can wear or scent cloth and place it other under your baby's head.
 - Exchange the scent cloths every 24 hours.
 - Have an extra in case one scent cloth is in the laundry.
 - You can also add breast milk to the scent cloth.
 - You can also bring clothes or bedding for your baby that smell like you.
- Provide your scent for your baby at least 3 hours each day.

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Appendix F (continued)

Cycling Light

- Always protect your baby from direct or bright lights.
- Use different items in the NICU (curtains, blankets, coverings over incubator, etc.) to change light level for your baby.
- Once your baby is around 32 weeks postmenstrual age (2 months before their due date), cycling light can be beneficial:
 - Use natural light or dim light (if there is no access to natural light)
 - During the daytime
 - Light levels consistent with moderate office lighting
 - Your baby should still be protected from bright and direct light
 - Use dim light or darkness
 - During the nighttime
 - Light levels consistent with nighttime (twilight or darkness)
- It is ideal if the light levels can gradually go down at the end of the day and gradually come up at the beginning of the day to be similar to normal day and night cycles.

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Movement Opportunity

- You can help your baby move prior to diaper changes.
 - Talk to your baby quietly.
 - Place a hand on your baby's chest.
 - Unwrap your baby.
 - Allow your baby to move freely for at least 2 minutes.
- If your baby has large or uncontrolled movements or is exhibiting movements that give you concern with your hand to aid controlled movement.
- If your baby is <28 weeks postmenstrual age, has large and uncontrolled movements, or becomes stressed, allow smaller movements of only one arm or leg while leaving your baby tucked into any positioning items or blankets that are being used.
- You can also use your hands to gently guide smooth, stretching movements of the arms and legs.
- Swaddle and/or reposition in appropriate positioning when finished.



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Appendix G**Unit Signage**

do you SENSE my little smile?
hanging out with me awhile

being held skin-to-skin
is every reason for me to grin

who doesn't love new baby smell?
I love your scent just as well

rock me bundled nice and slow
massage my body head to toe

read a book, sing lullabies
while I gaze into your eyes

whisper in my tiny ears
big dreams for the coming years

your face, your touch, your sounds
nurture me...it's quite profound

SENSE the magic that is shaping
great things take time in their making



Poem by Nicole Moseley Jaeger
Illustration 173287092 / Sloth © Marina Ermakova | Dreamstime.com

Appendix G (continued)

**SENSEd the sloth
slowly going**



**the wonder of
babies growing**

Illustration 173287092 / Sloth
© Marina Ermakova | Dreamstime.com

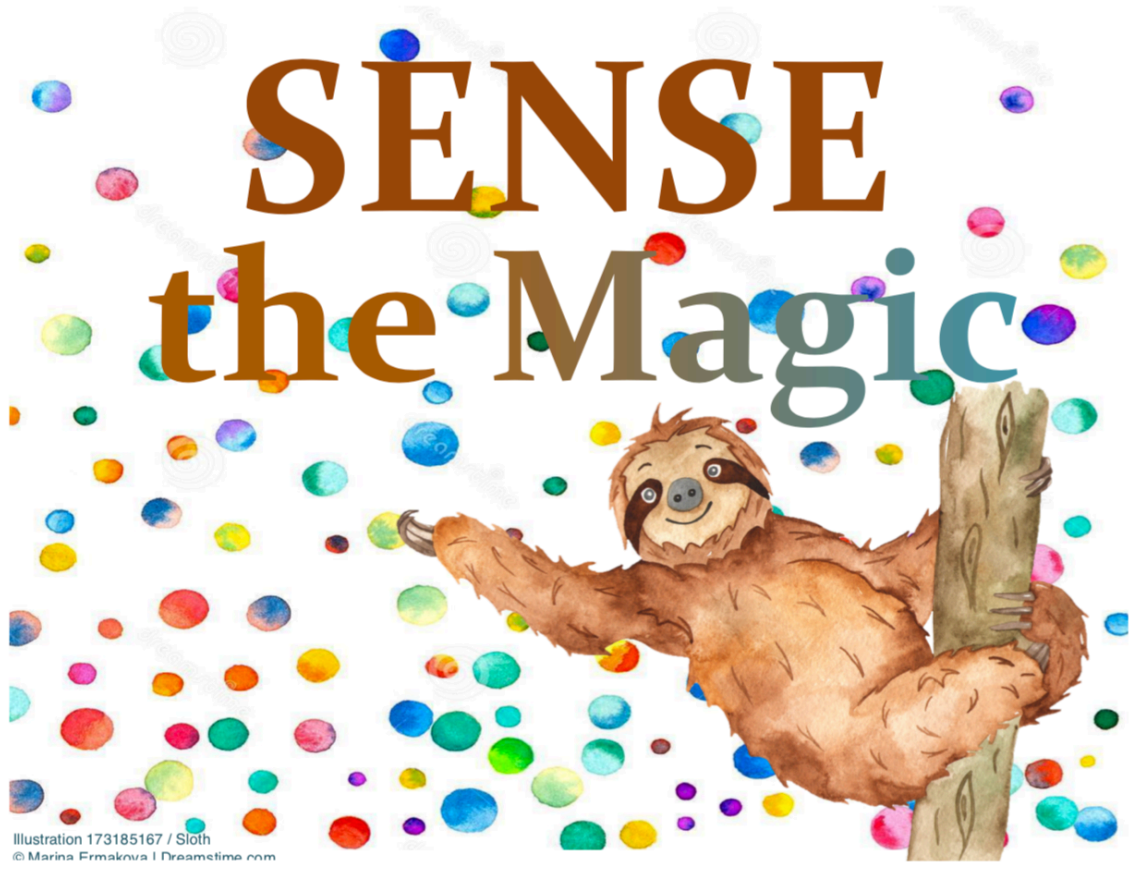
Appendix G (continued)

SENSE & Wonder



Illustration 173185158 / Slott
© Marina Ermakova | Dreamstime.com

Appendix G (continued)



Appendix G (continued)

Baptist
NICU loves
babies with
all our
SENSEs

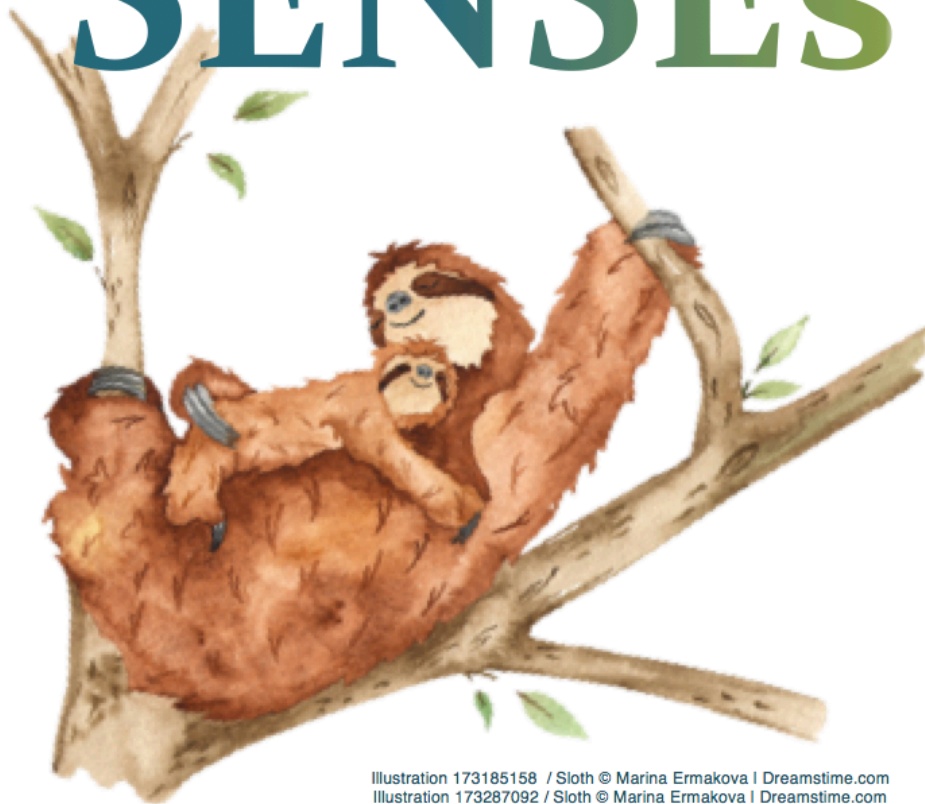
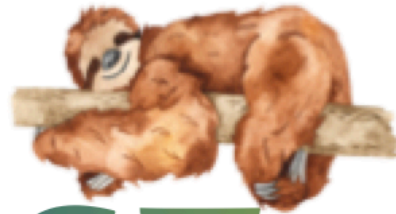


Illustration 173185158 / Sloth © Marina Ermakova | Dreamstime.com
Illustration 173287092 / Sloth © Marina Ermakova | Dreamstime.com

Appendix H

IRB Approval Letter

University of Louisville

Human Subjects Protection Program Office
 300 East Market Street, Suite 380
 Louisville, Ky 40202
 P: 502. 852.5188 E: hsppofc@louisville.edu

DATE:	January 04, 2022
TO:	Lela A Baker
FROM:	The University of Louisville Institutional Review Board
IRB NUMBER:	21.0963
STUDY TITLE:	Neonatal Developmental Care Makes SENSE: Implementation of an Evidence-based Guideline for Developmentally Appropriate Multi-Modal Positive Sensory Exposures
REFERENCE #:	737921
DATE OF REVIEW:	01/03/2022
CONTACT FOR QUESTIONS:	Sherry Block 852-2163 slbloc04@louisville.edu

The IRB Chair/Vice-Chair (or An IRB member) has reviewed your submission. The project described does not meet the "Common Rule" definition of human subjects' research. The IRB has classified this project as Non-Human Subjects Research (NHSR). The project can proceed.

This submission has been determined to be quality improvement, and not human subjects research, based on the goal(s) stated in the protocol.

Institutional policies and guidelines on participant privacy must be followed. If you are using protected health information, the HIPAA Privacy rules still apply.

Any changes to this project or the focus of the investigation must be submitted to the IRB to ensure that the IRB determination above still applies.

Amendments for personnel changes or study closures are not required.

Sincerely,



Paula Radmacher, Ph.D., Vice Chair,
 Biomedical Institutional Review Board
 PR/slb

We value your feedback; let us know how we are doing: <https://www.surveymonkey.com/r/CCLHXP>

Appendix I

Staff Badge Reel Gift Provided by the Project Lead




Appendix J

Project Instrument: Self-Assessment for the Neonatal Developmental Care Specialist

Designation Examination

Self-Assessment for the
**Neonatal Developmental Care Specialist
 Designation Examination**



Applicants for the Neonatal Developmental Care Specialist Designation may use this document as a means to assess their own level of integration of developmentally supportive caregiving into their routine practices in the NICU. It is recommended that an applicant’s assessments fall into the “all the time” category in 80% of the answers for each of the four developmental care practice standards. Practicing at this level of integration will best support successful completion of the Specialist Designation examination.

Standard 1: The infant receives individualized care.

Practice Standard	Personal Assessment	Comments and Study Notes
If an infant has an individualized developmental care plan, I read it carefully and use it as a guide for timing and structuring my care.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I am mentally and emotionally engaged with each infant in my care, continually guided by the behavior of the infant.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I stay attuned to every infant between care periods, so that I respond promptly if an infant needs attention or added support to stay relaxed and restful even if I am not the infant’s assigned caregiver. I am ready to begin care when the infant is showing a natural change of state, recognizing that state changes are often very subtle.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I am flexible in timing my care to support and protect a quiet sleep state.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I carry out care that can be flexibly timed together with procedures for which timing is less flexible, being careful to avoid overwhelming the infant.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I make ongoing judgments about the necessity of interventions for each infant and make collaborative decisions to delay or eliminate interventions that may create unnecessary stress.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
If it is necessary to wake a sleeping infant, I approach the infant gently with a soft touch or whisper and spend the necessary moments to help the infant move smoothly and comfortably to a higher state before doing any assessment or procedure.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I avoid doing any procedures, assessments, or caregiving tasks with an infant in a prone position where he or she is unlikely to be able to use self-comforting abilities.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I ensure that every feeding experience is a positive, pleasant, and nurturing time regardless of the size or age of the infant or the route or volume of the feeding.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	

(continued)

Appendix J (continued)

Standard 1: The infant receives individualized care. (continued)		
Practice Standard	Personal Assessment	Comments and Study Notes
I am aware of the infant’s fragile digestive systems during hands-on care before feedings and work carefully to avoid fluctuations in perfusion that may influence how the gut accommodates and digests feedings.	___ all the time ___ some of the time ___ seldom	
If an infant has difficulty remaining stable and organized in spite of my careful handling, I slow down or stop, help the infant recover completely, and reconsider my approach before continuing.	___ all the time ___ some of the time ___ seldom	
I respond to and support the infant’s efforts to spend time quietly awake in relaxed engagement with his or her caregivers, recognizing the development of quiet alertness as the necessary foundation for each infant’s formation of social relationships.	___ all the time ___ some of the time ___ seldom	
I stay with the infant and support a smooth transition back to restful sleep before stepping away from the bedside.	___ all the time ___ some of the time ___ seldom	
I provide appropriate pain management when noxious procedures are necessary.	___ all the time ___ some of the time ___ seldom	
I integrate a pain assessment tool into my practice.	___ all the time ___ some of the time ___ seldom	
Standard 2: Family-centered care is supported from birth.		
Practice Standard	Personal Assessment	Comments and Study Notes
My manner toward families and those supporting them is warm, respectful, and welcoming.	___ all the time ___ some of the time ___ seldom	
My manner toward families is consistent with my words.	___ all the time ___ some of the time ___ seldom	
I maintain flexibility to welcome and support families consistently at all times of the day.	___ all the time ___ some of the time ___ seldom	
I accommodate the presence of families in the nursery during rounds or shift changes by sharing information in a tone of voice that preserves confidentiality.	___ all the time ___ some of the time ___ seldom	
I model careful, nurturing, and supportive caregiving for families.	___ all the time ___ some of the time ___ seldom	
I form relationships with families, show genuine interest in their experience, and respect their central role in the life of their infant.	___ all the time ___ some of the time ___ seldom	

(continued)

Appendix J (continued)

Standard 2: Family-centered care is supported from birth. (continued)		
Practice Standard	Personal Assessment	Comments and Study Notes
I can be counted on to support the same inclusion of family members that other colleagues have provided for families in previous shifts.	__all the time __some of the time __seldom	
I support families in understanding and supporting their infant's behavioral and developmental goals from the earliest possible time and nurture their confidence in supporting their infant's goals.	__all the time __some of the time __seldom	
I support families in supporting their infants during potentially stressful procedures.	__all the time __some of the time __seldom	
I reserve family activities (e.g., bathing) for families.	__all the time __some of the time __seldom	
I help families understand the ways in which their infant's behavior communicates how the infant is handling their interaction and help them use these behavioral cues as their guide for pacing, positioning, and interacting with their infant.	__all the time __some of the time __seldom	
I ensure that families see all infants consistently treated with the support and respect they would want for their own infant when they are not around.	__all the time __some of the time __seldom	
Standard 3: All caregivers practice collaboratively.		
Practice Standard	Personal Assessment	Comments and Study Notes
I stay at the bedside to support infants in my care through stressful procedures.	__all the time __some of the time __seldom	
If I need to perform a procedure or examination on an infant who is in the care of another person (nurse or parent), I respectfully discuss the need with that person and agree on a time that is in the mutual interest of all.	__all the time __some of the time __seldom	
I talk with the other person about how to proceed and what the infant needs before we begin.	__all the time __some of the time __seldom	
I show flexibility whenever possible by gently completing my own caregiving or assessments while the infant is available for another procedure rather than disturbing the infant again later.	__all the time __some of the time __seldom	
I seek another person to support an infant in my care during a potentially stressful experience, including bathing and weighing.	__all the time __some of the time __seldom	

(continued)

Appendix J (continued)

Standard 3: All caregivers practice collaboratively. (continued)		
Practice Standard	Personal Assessment	Comments and Study Notes
I am willingly available to my colleagues to provide support for infants in their care during potentially stressful procedures.	__all the time __some of the time __seldom	
I consistently share information about infants' behavioral competencies, vulnerabilities, and thresholds when communicating with colleagues during rounds or shift changes.	__all the time __some of the time __seldom	
I respect and support the roles of other individuals and disciplines in the lives of infants in my care.	__all the time __some of the time __seldom	
I participate (as preceptor or mentor) in developmental care orientation of new staff.	__all the time __some of the time __seldom	
I serve on the Developmental Care Committee at my institution.	__all the time __some of the time __seldom	
Standard 4: A developmentally appropriate environment is provided for every infant and family.		
Practice Standard	Personal Assessment	Comments and Study Notes
I adequately support all infants by maintaining a consistently calm, relaxing environment with muted sound and lighting between and during caregiving interactions.	__all the time __some of the time __seldom	
I consider all the sources of light, sound, movement, smell, and taste confronting an infant during care and eliminate all inappropriate or unnecessary sources of stimulation.	__all the time __some of the time __seldom	
I am mindful of my own voice and other sounds I produce in the nursery.	__all the time __some of the time __seldom	
I silence alarms as soon as possible and avoid unnecessary alarms.	__all the time __some of the time __seldom	
If I need to use an over-the-bed light for hands-on care, I carefully shield the infant's eyes but do not use a blindfold so I can respond to and support the infant if he or she attempts to gaze at me.	__all the time __some of the time __seldom	
I provide infants with the bedding and other physical supports they need to maintain optimal tone and position and to remain either in a quiet, restful sleep or a relaxed, comfortable wakefulness.	__all the time __some of the time __seldom	

(continued)


Appendix J (continued)

Standard 4: A developmentally appropriate environment is provided for every infant and family. *(continued)*

Practice Standard	Personal Assessment	Comments and Study Notes
I am continually mindful of the need to structure an infant’s visual field to support alert wakefulness as appropriate (without overwhelming), transition to sleep, or quiet, restful sleep.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I provide as much space and comfort as possible for family caregiving, keep charts and equipment nicely organized, and avoid clutter.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I encourage families to personalize their infant’s bed space and make the environment more homelike.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I participate (as preceptor or mentor) in developmental care orientation of new staff.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	
I serve on the Developmental Care Committee at my institution.	<input type="checkbox"/> all the time <input type="checkbox"/> some of the time <input type="checkbox"/> seldom	

Appendix K

Organizational Permission for Instrument Use

 Anna Lapso **NANN** <alapso@nann.org> 🔗 ↶ ↷ ⋮
Mon 9/20/2021 3:15 PM
To: Moseley Jaeger,Nicole; Lauren Shelley <lshelley@Connect2amc.com>

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Hi Nicole,

Thank you for reaching out about this. You would be able to use the developmental care designation self-assessment PDF so long as **NANN** is properly recognized as the owner of the document. We unfortunately do not have any information about the likelihood of passing the examination when the recommendation is met for the self-assessment, since the self-assessment is not reported back to us.

Please let me know if you have any further questions or concerns!

Thank you,

Anna Lapso
Education Coordinator



LET'S GIVE IT ANOTHER SHOT
2022
YEAR OF THE NURSE CONTINUES

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Appendix L

Staff Data Tracking Worksheet

Pre- and Post-Intervention Assessment: Demographic Data Tracking (supplied with pre-intervention assessment)						
Age	Years of total nursing experience	Years of NICU nursing experience	Highest educational degree attained	Current FTE status	Primary work shift	Participation in previous developmental care training
<25	<2	<2	Associates	PRN	Dayshift 7AM-7PM	Yes
25-29	2-5	2-5	Bachelors	Part time	Nightshift 7PM-7AM	No
30-34	6-9	6-9	Masters	Full time		
35-39	10-14	10-14	Doctorate			
40-44	15-19	15-19				
45-49	20-24	20-24				
50-54	25-29	25-29				
55-59	30-34	30-34				
60-64	35-39	35-39				
65-69	40-44	40-44				
>70	45+	45+				
NANN’s Self-Assessment for the Neonatal Developmental Care Specialist Designation Examination completed pre-intervention and post-intervention						
The infant receives individualized care <i>Items 1 - 15</i>				“seldom” =1	“some of the time” =2	“all of the time” =3
Family-centered care is supported from birth <i>Items 1 - 12</i>				“seldom” =1	“some of the time” =2	“all of the time” =3
All caregivers practice collaboratively <i>Items 1 - 10</i>				“seldom” =1	“some of the time” =2	“all of the time” =3
A developmentally appropriate environment is provided for every infant and family <i>Items 1 - 11</i>				“seldom” =1	“some of the time” =2	“all of the time” =3

Appendix M

SENSE Program Sensory Support Guides per PMA Example

Sensory Support: 32 Weeks*

*Denotes change from previous week

Here are some things to do with your baby each day this week
(as long as tolerated)

 <p>Touch</p> <p>Give at least 2 hours of positive touch each day by doing one or more of these things:</p> <ul style="list-style-type: none"> • Provide a hand hug. • Do kangaroo care (skin-to-skin) for at least 1 hour. • Hold your baby in a blanket for 15 minutes at a time, or longer if your baby's temperature remains stable. • Do massage for up to 15 minutes. 	 <p>Hearing</p> <p>Give at least 1 ½ hours of positive sound each day by doing one or more of these things:</p> <ul style="list-style-type: none"> • Read, sing, and/or speak to your baby (can be broken up into 30 minute periods several times per day). • Play soft music or recorded voice. <p>*At the sound of whisper or quiet conversation.</p>	 <p>Smell</p> <p>Provide at least 1 hour per day of parent scent or the smell of breast milk.</p>	 <p>Sight</p> <ul style="list-style-type: none"> • Cycle light to your baby with natural light (or lights on, when there is no natural light) during the day and dim light or darkness at night. • Avoid direct and bright lights. 	 <p>Movement & Body Awareness</p> <ul style="list-style-type: none"> • Unwrap your baby and allow stretching and free movement for at least 2 minutes prior to a diaper change at least 3 times per day. • Allow your baby to experience being in at least 2 different positions for at least 10 minutes each. • Rock during holding for at least 3 minutes.
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Sensory Support: 37 Weeks

Here are some things to do with your baby each day this week
(as long as tolerated)

 <p>Touch</p> <p>Give at least 3 hours of positive touch each day by doing one or more of these things:</p> <ul style="list-style-type: none"> • Provide a hand hug. • Do kangaroo care (skin-to-skin) for at least 1 hour. • Hold your baby in a blanket. • Do massage for up to 15 minutes at a time. 	 <p>Hearing</p> <p>Give at least 3 hours of positive sound each day by doing one or more of these things:</p> <ul style="list-style-type: none"> • Read, sing, and/or speak to your baby (can be broken up into 30 minute periods several times per day). • Play soft music or recorded voice. <p>*At the sound of whisper or quiet conversation.</p>	 <p>Smell</p> <p>Provide at least 1 hour per day of parent scent or the smell of breast milk.</p> <p>Hold your baby as often as possible.</p>	 <p>Sight</p> <ul style="list-style-type: none"> • Cycle light to your baby with natural light (or lights on, when there is no natural light) during the day and dim light or darkness at night. • Avoid direct and bright lights. • While shielding your baby from direct light, have your baby try to focus on or follow your face. 	 <p>Movement & Body Awareness</p> <ul style="list-style-type: none"> • Unwrap your baby and allow stretching and free movement for at least 2 minutes prior to every diaper change. • Allow your baby to experience tummy time and being in at least 3 other positions for at least 10 minutes each. • Rock during holding for at least 7 minutes.
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Appendix N

Adapted Medical Log

Weekday of birth: M / T / W / Th / F / Sat / Sun Week of: _____  DAY SHIFT

*Please indicate on what day SENSE education was completed by marking with a ★ in DOL/CGA column (goal is DOL 0-2)

DOL/CGA	Auditory (minutes)	Tactile (minutes)	Movement	Visual & Smell
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N

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Appendix N (continued)



Week of: _____

*Please indicate on what day SENSE education was completed by marking with a ★ in DOL/CGA column (goal is DOL 0-2)

DOL/CGA	Auditory (minutes)	Tactile (minutes)	Movement	Visual & Smell
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N
DOL ____ CGA ____	Talking ____ Reading ____ Singing ____ Music ____ Total Time ____ Provided by: Parent / RN / OT / Other	Comforting Touch ____ Blanket Holding ____ KC Care ____ Massage ____ Total Time ____ Provided by: Parent / RN / OT / Other	Movement opportunity # of times ____ Rocking # of times ____ Provided by: Parent / RN / OT / Other	Isolette Cover __Y/__N Lights __On / __Off Scent Cloth __Y/__N Follow your face/Gaze __Y/__N

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Appendix P

Site Letter of Project Approval



BAPTIST HEALTH

November 10, 2021

To Whom It May Concern:

Nicole Moseley's DNP project, "Neonatal Developmental Care Makes SENSE", has been reviewed and approved by the Baptist Health Louisville Nursing Research Oversight Team. Please feel free to contact me with any questions.

Sincerely,



Anna Laura Trimbur, DNP, APRN, FNP-BC, CHFN

Chair, BH Louisville Nursing Research/EBP Council

anna.trimbur@bhsi.com