Evaluation of a Neonatal Intensive Care Unit Volunteer Cuddler Program on Neonatal Neurodevelopmental Outcomes

Brieann Lloyd

University of Missouri Kansas City, School of Nursing and Health Studies

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Dr. Lyla Lindholm

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Project Faculty Mentor: Dr. Lindholm, DNP

Project Preceptor: Dr. Brandon, DNP

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Abstract

Infants born prematurely are at an increased risk for neurodevelopmental delays. The Neonatal Intensive Care Unit is a toxic environment that fails to harbor proper brain growth. Additionally, infants spend an excessive amount of time isolated during hospitalizations which can be detrimental to their neurodevelopment. The purpose of this quasi-experimental, evidence-based quality improvement project was to evaluate the effectiveness of a volunteer cuddler program on neonatal neurodevelopmental outcomes at discharge. Data was collected on fifty infants born at less than 32 weeks gestation in a level IV Neonatal Intensive Care Unit between March 2020 and November 2020. These infants were part of a retrospective chart review group that did not receive cuddler interaction because the cuddler program was suspended during the Covid-19 pandemic. Data was collected on twenty-four infants born at less than 32 weeks gestation January 2020 through March 2020. The information was compared between the two groups based on differences between admission and discharge length, weight and head circumference, length of stay, and scores on the Hammersmith Neurologic Exam. No statistical significance was found between the two groups. The neurodevelopment was improved in the intervention group based on the average score of 65 Hammersmith Neurologic Exam. Improved neurodevelopmental outcomes enhances the infants' quality of life, decrease the length of stay in the hospital, and decrease the healthcare system's burden.

Keywords: Neonatal Intensive Care Unit, neonates, neurodevelopment, neurodevelopmental outcomes, cuddlers

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Due to advances in medical sciences and technology in recent years, infants born prematurely have a higher survival rate than in past decades (Welch et al., 2015). The definition of premature birth is any infant born before 37 weeks gestation (Vogel et al., 2018). The World Health Organization (WHO) estimates that infants born prematurely account for 5-7% of all births globally (Zeraati et al., 2018). Many risk factors contribute to premature birth including, socioeconomic status, nutritional status, access to proper health, medical, obstetric care, and environmental factors; however, the exact etiology remains unknown (Vogel et al., 2018). The United States spends 26 billion dollars annually caring for premature infants (Painter et al., 2019). The average Neonatal Intensive Care Unit (NICU) course for a neonate born at less than 26 weeks can cost between $250,000-$1,000,000 (Painter et al., 2019; Petteys & Adoumie, 2018).

Significance

Infants born prematurely are at a higher risk of developing language and cognitive delays, neurodevelopmental delays, and behavior problems (Neel et al., 2018; Pineda et al., 2018). Short-term and long-term complications can be seen when infants are born prematurely (Welch et al., 2015). Welch et al. (2015) suggest that as many as 5 per 100 infants born prematurely have shown characteristics of core deficits associated with the Autism Spectrum Disorder throughout their lifetime. The impairments include but are not limited to attention, executive function, and language delays (Welch et al., 2015). Experts believe as many as 50% of infants weighing less than 1000 grams will have some impaired cognitive function throughout their lifetime (Welch et al., 2015). Saigal and Doyle (2008) define disability and point out that

severity is not a uniform term, further complicating standardized healthcare measures for medical professionals. Hence, follow-up care is essential to monitor for motor delays, cerebral palsy, language delays, and cognitive delays (Medina-Alva et al., 2019).

Lavallée et al. (2019) describe the phenomenon of neuroplasticity as the brain's ability to rewire and develop new connections of the synapses. The synaptic development of a fetus is most prevalent during 34 to 38 weeks of development (Lavallée et al., 2019). The brain tissue's myelination process begins as early as 28 weeks gestation and continues throughout the first year of life age (Lavallée et al., 2019). The central nervous system development occurs between 24-40 weeks gestation (Lavallée et al., 2019). Infants born prematurely do not benefit from the full development of these vital pathways; therefore, increasing the risk for neurodevelopmental delays (Lavallée et al., 2019).

At baseline, the NICU can be a stressful environment for preterm infants. The Neonatal Infant Stressor Scale, a tool that incorporates 36 daily procedures and interventions used to measure the effects of stress on a NICU infant, showed increased exposure to stressors correlated with diminished brain size in the frontal and parietal regions, subsequently negatively impacting neurodevelopment (Smith et al., 2011). Pain activates the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis (HPA; Lavallée et al., 2019; Painter et al., 2019; Vittner et al., 2018). This activation can cause long-term consequences that affect preterm infant's central nervous systems, alter brain plasticity, and affect long-term motor and intellectual outcomes (Lavallée et al., 2019; Painter et al., 2019; Vittner et al., 2018). A variety of care strategies have been investigated for their impact on neurodevelopmental outcomes (Lavallée et al., 2019; Painter et al., 2019). Protected sleep, quiet environments, and clustering care can positively impact weight gain (Lavallée et al., 2019; Painter et al., 2019). Maintaining infants in the fetal

position promotes sleep and reduces stress, subsequently allowing for brain growth (Lavallée et al., 2019; Painter et al., 2019).

Welch et al. (2015) state infants who have regular mother-infant interactions have improved neurodevelopmental outcomes at discharge and 18 months corrected gestational age. One study found increased parental presence and skin-to-skin contact in the NICU were related to improved reflex development at term corrected and improved gross motor development at four to five years, reinforcing the importance of parent participation in the NICU (Smith et al., 2011). The NICU can be an overwhelming arena for new parents (Pineda et al., 2018). They are often afraid of their new infant's fragility and hesitant in performing daily activities with their child (Pineda et al., 2018). Furthermore, neonates spend an inordinate amount of time alone which can significantly impact their neurodevelopment (Gonya et al., 2018). Consequently, volunteer programs were developed to provide human contact for infants when families and healthcare providers are unavailable ("Volunteer," 2020). Key terms necessary to define in this project included prematurity, Hammersmith Neurological Examination Tool (HNE), and cuddler (see Appendix A).

Local Issue

A local level IV-NICU is located in Missouri that has a population of approximately 994,205 individuals (United States Census Bureau, 2019). The population of Caucasians is 68.2%, and 24.9% are African Americans (United States Census Bureau, 2019). The proportion of females living in the county is 24.9% (United States Census Bureau, 2019). The county's median household income is $65,300 and has a poverty rate of 10.5% (United States Census Bureau, 2019).

A local hospital serves as an enormous Labor and Delivery Hospital for the area (personal communication, April 20, 2020). Approximately one-fourth of the county is female of childbearing years (United States Census Bureau, 2019). In 2019, this local hospital had 3,576 deliveries; 816 of these deliveries, or 23% of total deliveries resulted in NICU admissions (personal communication, April 20, 2020).

Diversity Considerations

According to the Centers for Disease Control and Prevention (CDC), 1 in 10 infants born in the United States is born prematurely (CDC, 2020). Decreasing the number of premature births in the United States has become a national health priority (CDC, 2020). Despite not knowing all the risk factors that contribute to premature birth, there is a disparity between various races and premature births (CDC, 2020). The CDC estimates that the premature birth rate for non-Hispanic black women to be approximately 14% compared to 9% of non-Hispanic white women (CDC, 2020). The rate for non-Hispanic black women is 50% higher than non-Hispanic white women (CDC, 2020). Additionally, women with a history of previous preterm births, tobacco use, substance abuse, and a short period between pregnancies are at an increased risk of delivering prematurely (CDC, 2020).

Problem and Purpose

Problem Statement

The NICU environment is a noxious environment for preterm infants, which can substantially impact their neurodevelopment. Poor neurodevelopmental outcomes increase neonates' risk for developing characteristics of core deficits associated with the Autism Spectrum Disorder throughout their life, such as attention issues, executive function delays, language delays, motor delays, and cerebral palsy.

Purpose Statement

Infants born prematurely have an increased risk of neurodevelopmental delays (Neel et al., 2018; Pineda et al., 2018). Premature infants' neurodevelopment must be supported throughout a NICU hospitalization to meet future neurodevelopmental milestones. The research suggests that infants with consistent interaction with their caregivers during hospitalization have improved neurodevelopmental outcomes (Welch et al., 2015). The purpose of this Doctor of Nursing Practice (DNP) project was to evaluate the effectiveness of a volunteer cuddler program on neonatal neurodevelopmental outcomes.

Facilitators

The facilitators for the project were the NICU cuddlers, bedside nurses, and parents. The NICU cuddlers had to buy into using the data collection tool and employing its use during every interaction with patients. The bedside nurses were essential in allowing the cuddlers to interact with their patients. If bedside nurses were more willing to have the cuddlers interact with their patients, it could improve neonates' neurodevelopmental outcomes. Lastly, the patients' families were considered facilitators for the project. The parents had to be comfortable with the cuddlers interacting with their child while they were not present at the bedside.

Barriers

As with any proposed change, barriers were identified. The most substantial barrier was the nursing staff's adherence to allowing the NICU cuddlers to hold their patients. Often, the nurses have a time-consuming patient assignment and prefer to have their patients left alone to complete their tasks promptly. Not allowing cuddler interaction is not conducive to providing neurodevelopmentally appropriate care. The project leader's education was essential in

addressing the importance of human interaction and positive neurodevelopmental outcomes (Welch et al., 2015).

The second barrier to this project was the NICU cuddlers using the provided human-infant interaction form developed to track interaction time and activity. As this was a new intervention and outside of the NICU cuddlers' current practice, education was provided for the cuddlers to utilize the form correctly. Occasionally, this education was problematic due to scheduling conflicts between the volunteers and the project leader.

Sustainability and Feasibility

The sustainability and feasibility of this project are very realistic. It is sustainable and feasible because the NICU cuddler program is already in existence. Cuddlers actively participating in the patients' care supports the longevity of this project. This project evaluated and showed the volunteers how essential their work is for fragile infants. By having this information, it is the hope that the volunteer office will allow more individuals to become NICU cuddlers to support neonatal neurodevelopment once they are allowed back in the NICU after Covid-19.

Review of Evidence

Inquiry

In infants born at less than 32 weeks gestation, does regular interaction with NICU cuddlers decrease their risk for neurodevelopmental delay compared to infants who do not have regular interaction with NICU cuddlers throughout their hospital course or within six months of admission to a NICU?

Search Strategies

To prepare and evaluate the literature for the inquiry, an extensive, comprehensive literature search was conducted. The primary databases utilized during this search were through The University Missouri—Kansas City Health Sciences Library. They included Cumulative Index to Nursing and Allied Health (CINAHL), PubMed, EBSCOhost, Ovid, Cochrane Databases, and ScienceDirect to find relevant studies. Google Scholar was also employed. The keywords used were neurodevelopmental outcomes, neonatal intensive care unit, NICU, premature infants, neonate, neonatal, and human interaction. A combination of the keywords neonates AND neurodevelopmental outcomes, neonates AND neurodevelopmental outcomes AND human interactions were also utilized in the search. Articles produced by the search terms were scanned and evaluated for possible inclusion. Only articles and studies published between 2000-2021 in a NICU were assessed and included. Articles or studies not written in English language or full text were excluded from the literature review.

Initially, the search resulted in 226 articles (see Appendix B). The articles were pared down to 127 based on the title and abstract of the article. Based on Melnyk and Fineout-Overholt's (2018) *Rapid Critical Appraisal* to evaluate the validity, 31 articles were chosen.

Of the 31 articles identified, four were level I, representing three systematic reviews and one meta-analysis (Melnyk & Fineout-Overholt, 2018). Six articles were randomized control trials, level II evidence (Melnyk & Fineout-Overholt, 2018). Three-level III articles included three quasi-experimental studies (Melnyk & Fineout-Overholt, 2018). Six level IV evidence included two prospective cohort studies, three retrospective cohort studies, and one prospective exploratory study (Melnyk & Fineout-Overholt, 2018). Three-level V articles that were incorporated were systematic reviews of qualitative studies (Melnyk & Fineout-Overholt, 2018). One level VI article was chosen, a single qualitative study (Melnyk & Fineout-Overholt, 2018).

Finally, eight level VII articles were employed, with five being expert opinions and three being integrative reviews (Melnyk & Fineout-Overholt, 2018).

Synthesis of Evidence

Once the chosen articles were thoroughly reviewed, six different themes were evident throughout the literature. Evidence of themes grid was utilized to visualize the major themes present throughout the writings (see Appendix C). The central theme that aligns closest to the inquiry was human interaction and its effect on neurodevelopmental outcomes. Seventeen articles supported this theme. Five articles detailed information about skin-to-skin care and its impact on neurodevelopmental outcomes. Two studies about the different themes supported the following two themes, skin-to-skin care and massage and their effect on neurodevelopmental outcomes. The theme of pain in the neonate and its influence on neurodevelopmental outcomes had three additional articles. Finally, the theme of neonatal head circumference and the result on neurodevelopmental outcomes had two separate studies. The articles were summarized to provide a Synthesis of Evidence (see Appendix D).

Human Interaction

The overarching theme evident throughout the literature search was human interaction and the positive impact on neonatal neurodevelopmental outcomes. Human interaction is defined as any care or interaction the neonate has during their stay in the NICU (Pineda et al., 2018; Welch et al., 2015). The care can be from the bedside nurse, doctors, advance practice nurses, physical and occupational therapists, music therapists, speech-language therapists, child life specialists, and most important, interactions with their guardians (Gonya et al., 2018; Lin et al., 2019; McGowen & Vohr, 2019; Pineda et al., 2018; Sanots et al., Smith et al., 2014; Vanderveen et al., 2009). Throughout the central theme of human interaction, four sub-topics

were identified. The sub-topics include family-centered care, family nurture intervention, developmental care, and multisensory care.

Family-Centered Care. Stress that neonates endure daily negatively impacts their overall health (Pineda et al., 2018; Silva et al., 2018). In response to stress, premature infants will exhibit an increase in heart rate, respiratory rate, blood pressure, dysregulation of the HPA axis, and oxygen desaturation (Pineda et al., 2018). Pineda et al. (2018) found that all of these increased energy expenditures can harm the central nervous system development. Lavallée et al. (2019) and Pineda et al. (2018) found that the relationship between parental involvement with NICU patients' care and their future neurodevelopment has been well studied and well understood. However, when an infant is born prematurely, the parent-infant bonding is broken (Goyna et al., 2018; McGowan & Vohr, 2019; Pineda et al., 2018). Henceforth, the initiative to promote and support family-centered care within the NICU.

Goyna et al.'s (2018) study found that neonates spend approximately 80% or an average of 19 hours of the day interacting with their environment solely, meaning non-human interaction. Isolation can have determinantal effects on their brain development (Gonya et al., 2018). Infants who had consistent human interaction, approximately 85 minutes a day throughout their NICU course achieved a higher Social Competence score and lower Dysregulation scores on the Brief Infant-Toddler Social and Emotional Assessment (BITSEA; Gonya et al., 2018).

Hospitals worldwide employ Child Life Specialists to interact with patients in the children's hospitals (Smith et al., 2014). They provide patients with games, toys, learning opportunities, and various enrichment activities to lessen the stress of isolation many children feel while hospitalized (Smith et al., 2014). Many NICUs with Child Life Specialists can help ease parents' apprehension towards their hospitalized neonate (Smith et al., 2014).

Infants whose parents were actively involved in their care throughout a NICU course at 12 months corrected gestational age had statistically significantly higher mental and physical performance scores on various neurodevelopmental tools (Vanderveen et al., 2009). Approximately 76.9% of five-year-old ex-premature infants with regular family interaction in the NICU had expected neurodevelopmental outcomes at three and five years of age (Lin et al., 2019). Santos et al. (2016) reported regular human contact in the NICU caused infants to perform better on the Bayley exam at two years corrected gestational age. A positive correlation exists between physical contact between preterm infants and their caretakers and an overall improvement in movement and tone, and a decreased stress response (Santos et al., 2016).

Family Nurture Intervention. Family nurture intervention was designed to allow parents to take an active role in their child's care with hopes that it will counteract the adverse neurodevelopmental and behavioral outcomes associated with NICU admissions (Welch et al., 2015). Welch et al. (2015) conducted a randomized control trial to evaluate if family nurture interventions improved neonates' social interactions, quality of attention, and neurodevelopment at 18 months corrected gestational age. Preterm infants' Bayley III scores improved drastically for cognitive and language functioning (Welch et al., 2015). The family nurture intervention group had fewer attention problems noted on their Child Behavior Checklist (CBCL; Welch et al., 2015). Furthermore, only 27% of infants involved with the family nurture intervention group failed at least one item on the Modified Checklist for Autism in Toddlers (M-CHAT) compared to 76% of the standard care intervention group (Welch et al., 2015). Additionally, Welch and cohorts (2015) found that 36% of infants that received routine care in their NICU stay failed at least one social-relatedness item on the M-CHAT compared to 0% of the family nurture intervention group.

Beebe et al.'s (2018) study evaluated if infants randomized into the family nurture intervention group had higher incidences of a positive correlation between infant-mother face-to-face engagement at four months corrected gestational age. It was found that mother and infant pairs assigned to the family nurture intervention were more likely to sustain positive touch and revert negative touch experiences to positive touch experiences (Beebe et al., 2018). Infants exhibited more touching and positive touch, more positive vocal intonation, and sustained longer and more positive gaze patterns when interacting with their mothers (Beebe et al., 2018). These correlations showed a positive predictive value of improved neurodevelopmental and developmental trajectories (Beebe et al., 2018).

Developmental Care. A shift in the neonatal care paradigm has occurred from merely focusing on medicinal care to incorporating developmental care with medicinal care (Aucott et al., 2002; Laudert et al., 2007). Aucott et al. (2002) and Laudert et al. (2007) suggest that the most effective approach to improving neonatal neurodevelopmental outcomes is family participation in developmentally appropriate care. Lavallée et al. (2019) found that parents and healthcare providers play a crucial role in delivering and maintaining developmentally appropriate care to NICU patients through a systematic review. Petteys and Adoumie (2018) discovered that infants whose parents participated in neurodevelopmentally appropriate care had a significantly shorter length of stay by 18.5 days. Shorter NICU lengths of stay equate to a lesser financial burden on the families and improved NICU patients' neurodevelopmental outcomes (Petteys & Adoumie, 2018).

In a systematic review conducted by Burke (2018), an average of 19 different tools measure neurodevelopmental outcomes by either behavioral observation or neuroimaging. Infants who received developmentally appropriate care from their families or healthcare

professionals positively impacted their language, motor, and cognitive development up to 18 months corrected gestational age and impacts on their IQs up to five years old (Burke, 2018).

Silva et al. (2018) found in their systematic review infants who received developmentally appropriate care displayed fewer signs of stress during care times. Therapeutic touch was found to decrease an infant's heart rate variability, and they were able to mitigate their stress response (Silva et al., 2018). When neonatal toxic stress is decreased during hospitalization, it has a positive association with improved neurodevelopmental outcomes (Silva et al., 2018).

Multisensory Care. Multisensory care is described as a combination of auditory, tactile, visual, and vestibular interventions while providing care to a hospitalized neonate (Kanagasabai et al., 2013). Zeraati et al. (2017) performed a randomized control trial evaluating multisensory stimulation effect on neuromuscular development. While admitted to the NICU, it was noted that infants who received multisensory care, which included human interaction, had significantly higher neuromuscular scores on the New Ballard exam (Zeraati et al., 2017). Similarly, Kanagasabai et al. (2013) found that infants who received multisensory care in the NICU showed significantly higher neuromotor scores, contributing to improved neurodevelopmental outcomes.

Skin-to-Skin

Skin-to-skin care or kangaroo care is an intervention performed in the NICU (Evereklian & Posmontier, 2017; Head, 2014; Gonya et al., 2017; Mitchell et al., 2013; Pados, 2019; Pados & Hess, 2019). Infants are placed in an upright position with direct skin-to-skin contact with their caregivers (Evereklian & Posmontier, 2017; Head, 2014; Gonya et al., 2017; Mitchell et al., 2013; Pados, 2019; Pados & Hess, 2019). In an integrative review produced by Head (2014), kangaroo care increased parental involvement in patient care, thus enhancing the parent-infant

bond. Skin-to-skin care decreases neonatal stress which promotes the myelination of neuropathways and subsequently improves neurodevelopment (Head, 2014). Pados (2019) notes that infants who received regular skin-to-skin care intervals showed improved motor and cognitive development at 12 months corrected gestational age. However, Evereklian and Posmontier (2017) found that only 57% of NICUs in the United States promote daily skin-to-skin care.

Pados and Hess (2019) conducted a systematic review to determine the effects of skin-to-skin care on short-term stress and long-term outcomes on neonatal neurodevelopment. Skin-to-skin care reduces the amount of stress neonates experience as evidenced by decreased bradycardic and apnea events, fewer oxygen desaturation episodes, lower respiratory rates and blood pressures, contributing to improved neurodevelopmental outcomes (Pados & Hess, 2019).

Mitchell and colleagues (2013) developed a randomized control trial to determine the effects of skin-to-skin care on cardiorespiratory parameters. Infants who participated in skin-to-skin care with their caretakers were found to have significantly fewer bradycardic events and fewer oxygen desaturations (Mitchell et al., 2013). A decrease in the severity of bradycardia and oxygen desaturation events could lead to improved neurodevelopment in neonates (Mitchell et al., 2013). Additionally, Gonya et al. (2017) discovered infants who received skin-to-skin care were more likely to perform better on the cognitive and communication portions of the Bayley-III exam.

Positioning

Neonatal positioning has been found to have positive implications on neonates' development and cognition (Lavallée et al., 2019). Lavallée et al. (2019) suggest maintaining in-utero positioning while in the NICU can promote physiologic stability, better sleep-wake cycles,

and reduce stress, encouraging associations on future neurodevelopment. Infants are at a decreased risk of developing contractures, shortened ligaments, tendons, and muscles when positioned correctly by their caregivers (Lavallée et al., 2019).

Painter et al. (2019) developed a quasi-experimental retrospective chart review to establish if correct neonatal positioning equates to better neurodevelopmental outcomes. The infants were evaluated using the HNE and the Infant Position Assessment Tools (Painter et al., 2019). Infants positioned by super users had better weight gain and higher HNE tool scores which correlates to improved tone and flexion scores (Painter et al., 2019). Consequently, improved weight gain and improved muscle tone can positively impact neurodevelopment (Painter et al., 2019).

Massage

Extrauterine life is extremely stressful and can alter neural pathways development affecting neonatal development (Abdallah et al., 2013; Álvarez et al., 2017). In a level V systematic review developed by Álvarez et al. (2017), neonatal massage was found to impact neurodevelopmental outcomes positively. Abdallah et al. (2013) developed a quasi-experimental study to evaluate the effect of neonatal massage performed by their mothers on pain responses and weight gain at discharge, length of stay, Bayley scores, and duration of breastfeeding at 12 months corrected gestational age. Infants whose mothers massaged at regular intervals had significantly higher cognitive scores on their Bayley exams (Abdallah et al., 2013). Pain scores were also decreased by the use of massage (Abdallah et al., 2013). Abdallah et al. (2013) reported no difference between the two groups on weight gain, length of stay, or breastfeeding duration.

Pain

Premature infants have a heightened sense of pain compared to full-term infants (Grunau et al., 2006). Neonates admitted to the NICU experience an average of 7.5-17.3 painful procedures daily (Bucsea & Riddell, 2019). Buscea and Riddell (2019) also report that 70% of all premature infants' procedures are considered painful. It is further noted that experiencing painful procedures in the NICU can negatively affect neurodevelopment (Bucsea & Riddell, 2019; Cong et al., 2017; Grunau et al., 2006).

Cong et al. (2017) performed a prospective exploratory study to evaluate the impact pain has on neurobehavioral outcomes. Infants undergoing painful or stressful procedures displayed a decreased habituation incidence (Cong et al., 2017). Decreased habituation correlates with decreased neurodevelopment (Cong et al., 2017). Subsequently, it was found infants who were either held during painful procedures or breastfed during painful procedures demonstrated better habituation (Cong et al., 2017). Moreover, Cong and colleagues (2017) and Bucsea and Riddell (2019) correlate a robust parental presence during a neonates' hospitalization to a better quality of movement, arousal, excitability, and stress responses, as evidenced by early neurobehavioral testing.

Head Circumference

A strong correlation between an increase in head circumference size and neonatal neurodevelopmental outcomes exists within the literature (Raghuram et al., 2017). An increase in head circumference equates to brain growth and maturation (Raghuram et al., 2017). A retrospective cohort study discovered that infants who had poor initial head growth and head growth caught up after discharge had an increased risk for motor and cognitive delay at 16 and 36 months follow-up appointments (Raghuram et al., 2017). The infants with the most deficient

head growth received longer parental nutrition intervals, mechanical ventilation and displayed poor weight gain (Raghuram et al., 2017).

Approximately 7-12% of very low birth weight infants will have some degree of microcephaly (Medina-Alva et al., 2019). In Medina-Alva et al.'s (2019) prospective study, there was a strong association between microcephaly and neurodevelopmental delays. Medina-Alva et al. (2019) report a higher incidence of decreased brain tissue, especially gray matter, in microcephalic patients. Additionally, there has been a positive predictive value in head circumference at discharge and improved neurodevelopmental outcomes (Medina-Alva et al., 2019).

Evidence Summary and Discussion

Infants born prematurely are at an increased risk for neurodevelopmental delays. The poor neurodevelopmental outcomes include an increased risk for language delays, motor delays, cognitive impairment, and behavioral problems (Pineda et al., 2018). The focus of caring for the neonate in the NICU is to have the highest quality medical care, which is the sole reason the child survives (Welch et al., 2015). However, strictly using medicine to care for the infant will not improve long-term cognitive and neurodevelopmental outcomes (Welch et al., 2015).

Early maternal separation can have determinantal effects on a neonate's neurodevelopment (Lavallée et al., 2019; Lavallée et al., 2019; Medina-Alva et al., 2019; Pados, 2019; Pineda et al., 2018; Welch et al., 2015). The NICU is an environment that does not harbor proper bonding between parents and their infant (Painter, Lewis, & Hamilton, 2019; Pineda et al., 2018; Petteys & Adoumie, 2018; Welch et al., 2015). Infants in the NICU spend most of their time isolated from human interaction which increases the patients' mortality rate (Gonya et al., 2018). Due to this lack of bonding and parental involvement, the infant can experience

increased stress levels, increased apnea and bradycardia spells, and increased pain during routine care and procedures in the NICU (Pineda et al., 2018; Welch et al., 2015).

The literature supports that parental involvement and human interactions can significantly impact the neonate's future neurodevelopmental outcomes (Gonya et al., 2018; Petteys & Adoumie; Pineda et al., 2018; Welch et al., 2015; Zeraati et al., 2018). Gonya et al. (2018) cite infants who have consistent human interactions with their parents and received developmentally appropriate care have improved functional competence and brain development. Bayley scores at 18 months corrected gestational age were higher in infants who had documented human interactions compared to their counterparts that did not have regular human contact (Welch et al., 2015).

Strengths of Evidence

Thirty-one articles were identified and pertained to the inquiry in determining if infants less than 32 weeks gestation had better neurodevelopmental outcomes with regular cuddler interaction throughout their stay when families were not present at the bedside. It was noted that six themes were identified throughout the literature: human interaction, skin-to-skin, positioning of the neonate, massage, and head circumference, all of which were associated with neurodevelopmental outcomes. Fifteen of 31 articles identified were related to the inquiry of human interaction and its impact on neurodevelopmental outcomes (Beebe et al., 2018; Burke, 2018; Gonya et al., 2018; Kanagasabai et al., 2013; Lavallée et al., 2018; Lin et al., 2019; McGowan & Vohr, 2019; Petteys & Adoumie, 2018; Pineda et al., 2018; Santos et al., 2015; Silva et al., 2018; Smith et al., 2014; Vanderveen et al., 2009; Welch et al., 2015; Zeraati et al., 2017).

Limitations of Evidence

Every neonate has a different medical course throughout their stay, which directly impacted their neurodevelopment trajectory. Since no two patients have the same course, it was challenging to depict interventions that genuinely affected their neurodevelopmental outcomes. Many studies had small sample sizes and had difficulty enrolling patients in the studies due to exclusion criteria. Frequently, exclusion criteria included congenital anomalies, grade IV intraventricular hemorrhage, and congenital heart disease (Gonya et al., 2018; Petteys & Adoumie; Pineda et al., 2018; Welch et al., 2015; Zeraati et al., 2018). More studies need to be conducted with larger sample sizes to accurately picture how human interaction directly affects neurodevelopmental outcomes (Pineda et al., Welch et al., 2015).

Gaps in Evidence

There was a vastly large gap in the literature regarding the use of volunteer cuddlers interacting with NICU patients. The majority of the literature discussed parental and hospital staff involved with the patients. Another gap in the literature was that the results were skewed based on decreased adherence by caregivers to return for follow-up on neurodevelopmental outcomes appointments (Pineda et al., 2018; Welch et al., 2015). Lack of follow-up was often due to parents of NICU patients having many other life, family, and job obligations (Pineda et al., 2018). Lastly, there were no universal tool to assess neurodevelopmental outcomes in NICU patients.

Theory

The theory that aligned closest with the DNP project was Bowlby's Attachment Theory. Bowlby's attachment theory was developed in the 1950s (Ackerman, 2018; Peterson & Bredow, 2013). Children develop the most reliable attachment to their caregivers within the first 18 months of life (Ackerman, 2018). Bowlby believed that children's interaction with their family

members shaped their emotional and behavioral well-being throughout their lifetime (Ackerman, 2018; Schwartz, 2015). A child's attachment matures in different stages from birth to 3 years of age, with the most progression between 7 months to 3 years (Bowlby as cited in Peterson & Bredow, 2013).

Bowlby proposed that real-life experiences and human interactions are essential for an individual's psychological well-being (Holmes, 2014; Peterson & Bredow, 2013). Children are biologically programmed to develop an attachment to others to survive (McLeod, 2017). A child's initial bond with a primary caregiver sets the tone for future social relationships (McLeod, 2017). If the initial bond is damaged, it can have irreversible damages and consequences later in life (McLeod, 2017). Bowlby suggested that infants' fear of strangers is an important survival mechanism built by nature (McLeod, 2017).

Three main concepts are critical to Bowlby's Attachment Theory. Those concepts are basic needs, care, and health (Bowlby as cited in Peterson & Bredow, 2013). Maslow's Hierarchy of needs states that every human has basic requirements which need to be met (Ackerman, 2018). Infants learn that crying, cooing, smiling, and making eye contact are ways to have adults near them meet their basic needs (Ackerman, 2018). Peterson and Bredow (2013) suggest that caring for an individual promotes attachment. When an individual is cared for and their attachment needs are met, they are provided with a sense of predictability, availability, and sensitivity (Holmes, 2014; Peterson & Bredow, 2013). Secure attachments formed in childhood provide many favorable health-related conditions such as physical well-being, a sense of logical coherence, fulfilling social interactions, and feeling confident in all aspects of life (Ackerman, 2018; Peterson & Bredow, 2013). Lastly, it has been shown that forming a secure attachment

will decrease a person's risk for chronic illnesses, especially cardiovascular disease (Holmes, 2014; Peterson & Bredow, 2013).

The Rationale for Theory Choice

Bowlby's Attachment Theory was chosen because it explains the reasoning behind the need for consistent interactions between children and their caregivers. A consistent caregiver shapes a child's future interactions with human beings (Ackerman, 2018). Brain development relies on a child's basic needs being met by their caregivers (Ackerman, 2018; Holmes, 2014). This theory applies to neonatal neurodevelopmental outcomes based on the theory's identified themes and their correlation to the project inquiry (see Appendix E).

Methods

IRB Approval

The primary Institutional Review Board (IRB) for this project was the University Missouri—Kansas City. The IRB deemed this project as quality improvement project (see Appendix F). The project's main goal was to determine the volunteer cuddler program's efficacy on neonatal neurodevelopmental outcomes at a NICU in Missouri. Since the cuddler program was currently in place and this project was an evidence-based practice quality improvement, the subject matter was Not Human Subjects Research.

Ethical Issues

The primary research ethics were privacy, protection, confidentiality, and project leader biases. Children are considered a vulnerable population; therefore, their privacy was protected and maintained. The data collected did not include any names, medical record numbers, or any other patient identifiers. The comparison group was a retrospective chart review of all infants born at less than 32 weeks gestation admitted to the NICU between March through November

2020. Since these infants were considered Golden Hour babies, the NICU already identified and tracked data for these infants. The parents of the infants in the NICU permitted the NICU cuddlers to interact with their child, thus issuing informed consent. If the parents did not feel comfortable with their child interacting with the cuddlers, all cuddler interaction was ceased for the patient. There were not any negative consequences if parents did not feel satisfied with the cuddler interactions.

The NICU is a large, diverse, urban hospital setting. Patients admitted to the NICU have families of different ages, cultures, religious beliefs, socioeconomic statuses, backgrounds, and geographical locations. This diversity allowed for limited biases. The ethical principle of autonomy was maintained by allowing parents to consent to volunteer cuddler interaction with their child. Additionally, the ethical principles of beneficence, nonmaleficence, and justice were applied throughout the project because children are considered a vulnerable population.

Funding

The funding for this project was donated time. For items that were monetary and not donated, the project lead paid for these expenses (see Appendix G). The total cost of the project was approximately $150.

Setting and Participants

Setting. The project site identified was a local NICU in Missouri. The NICU is a 125-bed level IV unit. The NICU cares for over 900 sick infants annually. The NICU has various medical professionals: Neonatologists, Neonatology Fellows, Neonatal Nurse Practitioners, Pediatric Residents, nurses, pharmacists, dieticians, speech, physical, and occupational therapists that regularly collaborate for the care of the critically ill neonate. Currently, there is a volunteer

program with individuals specially trained to be NICU cuddlers. All volunteers were expected to participate in holding infants at least once per week, with a minimum of 75 hours annually.

Participants. The participants in the study were infants currently admitted to the NICU. The sample size for the retrospective chart review group was 50 infants, and the sample size of the intervention group was 24 infants. Inclusion criteria included infants born at less than 32 weeks gestation, current admission to the NICU, and the ability to interact with the volunteer cuddlers pending parental consent for this interaction. To be included in the retrospective chart review group, the infants were admitted to the NICU from March through November 2020 during the suspension of the cuddler program because of Covid-19. The exclusion criteria were congenital anomalies deemed incompatible with life and infants whose parents did not consent to cuddler interactions.

EBP Interventions

Evidence-based quality improvement is best described as improving the quality of a particular practice to promote superior patient outcomes (Melnyk & Fineout-Overholt, 2018). The project was facilitated and led by the project leader (see Appendices H, I, & J). Based on evidence found in the literature, human interaction is essential for positive neonatal neurodevelopmental outcomes. Often, parents cannot be present consistently while their child is in the NICU (Pineda et al., 2018). The volunteer program was developed to alleviate many patients' isolation during extended hospital stays. Currently, the local hospital has volunteers specially trained to interact with NICU patients. The cuddlers are allowed to hold the patients, provide containment, read books, sing songs, or provide comfort during painful procedures. Historically, the cuddlers did not log their interactions with patients volunteering in the NICU.

The documentation of cuddler interaction was dependent on the bedside nurses' charting the interactions which was not always charted.

The project lead educated the NICU cuddlers about the importance of using the interaction tool to log their interactions with the infants (see Appendix K). This log helped the project team leader collect data about the interactions between cuddles and NICU patients. The tool also helped determine cuddler interaction does improve neonates' neurodevelopmental outcomes at discharge. Due to Covid-19, the cuddler program was halted even though the project showcased that cuddler interaction improves neurodevelopmental outcomes. However, the project leader hopes the number of cuddlers will increase when cuddlers are allowed back in the NICU to interact with patients throughout their hospital course when caregivers are not present at the bedside.

Recruitment

The project leader focused on collecting data from infants born at less than 32 weeks gestation. The reason for this recruitment was infants born within this gestational age group have prolonged hospital stays and a higher risk for neurodevelopmental delays compared to infants with shorter hospital stays. Once the infants were identified, the project team leader discussed with the patient's parents to determine if they permitted cuddler interaction when they were not present at the bedside. Moreover, the team lead stressed to parents how important human interaction is to the neonate's future neurodevelopmental outcomes. Data was collected from the cuddler's interaction log and was analyzed to determine effectiveness on neurodevelopmental outcomes before discharge.

Intervention Protocol

The student investigator created the data collection tool. Next, the project investigator held meetings with the volunteer cuddlers about the tool's utility and where to submit their interactions. The project leader collected the cuddler's data collection slips weekly during January through March 2020 and inputted the type of interaction and time spent with the infant into a Microsoft Excel spreadsheet on a work password-protected computer. Baseline statistics collected included gestational age, gender, admission weight, length, and head circumference. The comparison statistics utilized in determining the effectiveness of the cuddler program were the patient's length of stay, differences between admission and discharge weight, length, head circumference, and the patients' HNE score. The collected data was input into a statistical analysis program to determine the quality of data and results of the evidence-based quality improvement project.

Before implementing this quality improvement project, cuddler interactions were not routinely charted. Additionally, the cuddler program was stopped between March and November 2020 due to Covid-19. The project investigator chose this timeframe because any infant admitted to the NICU did not have any cuddler interaction during that time. The project team leader performed a retrospective chart review to develop the comparison group. A list of all infants born at less than 32 weeks gestation admitted to NICU between March and November 2020 was provided to the leader. The project leader placed baseline statistics that included gestational age, gender, admission weight, length, and head circumference into an Excel spreadsheet on a work password-protected computer. The leader determined the patient's length of stay, differences between admission and discharge weight, length, head circumference, and HNE score as the baseline comparison on neurodevelopmental outcomes. The project team

leader then entered all of the collected data into a statistical analysis program and determined that the cuddler program can enhance neonatal neurodevelopmental outcomes.

Change Process and EBP Model

The Iowa Model was the Evidence-Based Practice (EBP) model that guided this project. This model was developed to allow medical professionals to implement change to provide quality patient care (Cullen & Adams, 2012; Cullen et al., 2018). The Iowa Model will enable nurses and other healthcare providers to pose questions to allow for a change in practice that equates to elevated patient care (Cullen & Adams, 2012; Cullen et al., 2018). Cullen et al. (2018) identify six steps to utilize the Iowa Model to provide higher quality patient care that includes: identifying a problem or trigger for improvement, recognize key supporting evidence of the claim, analyzing the evidence, crafting a practice change, implement the change in practice, and sustain the practice change.

The organizational model used was Rodger's Diffusion of Innovations theory since the Iowa Model is based on this organizational model (Roger, 2003). This model is based on a bell-shaped curve of how new change processes will be implemented and how it will diffuse through the innovators of the change (Roger, 2003).

This project is sustainable because a positive correlation between cuddler interaction and neonatal neurodevelopmental outcomes exists. Once cuddlers are allowed back into the NICU, the project team leader hopes to increase the number of volunteer cuddlers based on the results of this study.

Project Design

This project was a quasi-experientable quality improvement study design. There was a retrospective chart review of all of the patients admitted to the NICU who were less than 32

weeks gestation between March 2020 and November 2020. The project lead input the data collected of the differences between admission and discharge length, weight, head circumference, length of stay from patient data in the electronic health records, and their HNE scores performed by the student investigator. This population served as the comparison group. The intervention group was infants who had interactions with the NICU cuddlers. This group's data collected were the differences between admission and discharge length, weight, head circumference, length of stay, and the HNE score to evaluate neurodevelopmental outcomes. The outcomes measured were the NICU cuddler program has a positive effect on neurodevelopmental outcomes.

Validity

Internal

The aspects that promote data integrity, or internal validity, were using a standardized tool to document interactions between the cuddlers and the infants. The project leader educated the cuddlers on using this tool, location to place the completed forms, contacting the researcher if there are any questions regarding the collection form. The utilization of this tool was a concrete way to document the interactions between cuddlers and infants. Currently, volunteer cuddlers do not have access to patient electronic health records. When nurses fail to chart this interaction, there is no identifiable way to determine the amount of time spent or the types of interactions that took place between the cuddlers and patients. Covid-19 was a threat to the internal validity because it ceased the cuddler program for approximately nine months. Next, a threat to the internal validity was cuddlers' noncompliance with the data collection tool. Lastly, another threat was bedside nursing staff and parents not allowing interactions between cuddlers and infants.

External

The external validity of this project can be transferrable because NICUs can emulate the cuddler program within their institutions. The data suggest that human interaction improves neurodevelopmental outcomes (Welch et al., 2015). The results showcased that neonatal positive neurodevelopmental outcomes with cuddler interaction. The project team leader continues to hope there to be an increase in the number of volunteer cuddlers in the NICU to support neonatal neurodevelopment once the cuddler program is reinstated.

The HNE Tool allows caregivers to perform a series of exercises with infants to determine the prognosis of future neurodevelopment (Maitre et al., 2016; Romeo et al., 2009; Romeo et al., 2013; Tedla et al., 2014). When performed, the HNE Tool is a reliable and valid measurement in determining any neonatal neurodevelopmental abnormalities (Maitre et al., 2016; Romeo et al., 2009; Romeo et al., 2013; Tedla et al., 2014).

Outcomes

The primary outcome of this project was to determine if interactions between volunteer cuddlers and infants born at less than 32 weeks gestation improved neurodevelopmental outcomes. The use of the cuddler interaction tool allowed more documented information on the length of interaction and what type of interaction took place between the cuddlers and NICU patients. Initially, the project leader intended to have the secondary outcomes be better staff adherence to the cuddler program and an increase in the number of volunteer cuddlers present in the NICU. However, due to Covid-19, these secondary outcomes were not measured (see Appendix L).

Measurement Instruments

The primary measurement tool utilized in this project were the patient's length of stay, differences between admission and discharge length, weight, and head circumference. These measurements were a standard of care that is tracked throughout a NICU admission. This information was used to compare the infants who did not have routine interactions with the cuddlers during their NICU admissions due to Covid-19.

A second measurement tool utilized was the HNE Tool. This tool has positive predictive values for neurodevelopmental outcomes at the time of discharge from the NICU (Maitre et al., 2016; Romeo et al., 2013; Romeo et al., 2009; Tedla et al., 2014). This tool was not a standard of measurement at discharge from the NICU. It was used as an additional metric to evaluate the effectiveness of the cuddler program on neonatal neurodevelopmental outcomes.

The HNE Tool assesses many different domains surrounding neonatal neurodevelopment (Ricci et al., 2008). Those domains include tone patterns, reflex items, movements, abnormal signs, behavioral signs, vision, and hearing (Ricci et al., 2008). The infants are assigned a score based on the various assessments performed by the student investigator (Romeo et al., 2013). The scores range from a <40 to a 73 (Romeo et al., 2013). Infants that score <40 on the HNE at three months corrected gestational age do not have normal neurologic outcomes (Romeo et al., 2013). According to Romeo et al. (2013), a score of <57 has a 96% positive predictive value of the infant having cerebral palsy. The HNE tool is utilized on preterm infants at term corrected gestational age (Ricci et al., 2008).

The last measurement tool utilized was the cuddler interaction log. This log served as documentation of interaction between volunteer cuddlers and patients. The cuddlers placed the log in a secure location for the project team leader to collect and input the data from the collection tool.

Quality of Data

The project leader ensured the promotion of the quality of data through various methods. First, a power analysis calculating the G*Power through ANOVA: Repeated measures, between factors, using a medium effect size of .3, power of .8, and an alpha of .05 revealed a sample size of 56 was necessary (Heinrich-Heine-Universität Düsseldorf, 2020). However, the sample size of the comparison group and intervention group did not meet this G*Power calculated sample size. Both baseline statistics of admission and discharge length, weight, and head circumference were collected and compared (see Appendix M).

The project leader collected demographic data which included gender and gestational age of both the intervention and comparison groups. Data regarding length of stay and HNE score at discharge were collected and compared between the groups. Lastly, the DNP project's results were compared to various studies supporting human interaction and its effects on neonatal neurodevelopmental outcomes (Gonya et al., 2018; Lin et al., 2019; McGowen & Vohr, 2019; Pineda et al., 2018; Sanots et al., Smith et al., 2014; Vanderveen et al., 2009; Welch et al., 2015).

Analysis

Statistical analysis for this project was conducted using IBM Statistical Package for Social Sciences (SPSS) Version 26 (see Appendix N). A one-way ANOVA test was employed to determine the statistical significance between the length of stay, differences between admission and discharge length, weight and head circumference, and HNE score between the groups. The secondary measurement of nurse compliance in allowing cuddlers to interact with patients was not measured but will be collected, measured, and analyzed in the future once the cuddler program is reinstated. Demographic data, including gender and gestational age were collected and analyzed using descriptive statistics.

Results

Setting and Participants

The quality improvement project took place in a local NICU. This NICU is a 125-bed level IV NICU. Data for the project was collected from January 2020 through April 2021. Due to Covid-19, the cuddler program was suspended on March 15, 2020. Since the cuddler program was paused, the project leader established a comparison group of 50 participants. The mean gestational age of the participants in the group that did not receive cuddler interaction was 28 7/8 weeks gestation with a standard deviation of 2.11 weeks (see Appendix O, Table 1). The gestational age range was 22 5/7 weeks gestation to 32 weeks gestation (see Appendix O, Table 3). Sixty-four percent of the infants were male (n=32) and 36% (n=18) were female (see Appendix O, Table 2).

The group that received cuddler interaction was born from January 1, 2020, through March 15, 2020, at less than 32 weeks gestation. This timeframe resulted in 24 participants. The mean gestational age of the participants in this group was 28 3/7 weeks with a standard deviation of 2.44 weeks (see Appendix O, Table 1). The gestational age range was 22 5/7 weeks gestation to 32 weeks gestation (see Appendix O, Table 3) with 66.7% of the infants being male (n=16) and 33.3% being female (n=9).

The total number of participants was 74. Male infants accounted for 64.9% (n=48) of the participants in the quality improvement project (see Appendix O, Table 2). Female infants accounted for 35.1% (n=26) of the participants in the quality improvement project (see Appendix O, Table 2).

Intervention Course, Actual

Eligible participants were identified by using the inclusion and exclusion criteria previously stated. During this 15-month timeframe, the project leader collected baseline statistics on 50 participants. The baseline statistics collected were gender, gestational age, admission length, weight, and head circumference. Once admitted, the team leader followed the infants until discharged to either home or a long-term care facility. When the participants were close to discharge, the project leader completed a HNE on the patients. Following discharge, the participants' length, weight, and head circumference were calculated and compared to their admission statistics to determine how much they grew throughout their NICU admission. The project lead calculated the length of stay and corrected gestational age of the participants.

During the data collection from January to March 2020, the project head provided the parents with education about the cuddler program. It was essential to have parental buy-in to allow cuddler interaction. There were 24 infants born at less than 32 weeks gestation that received cuddler interaction. Bedside nursing staff received education from the project leader on the importance of the volunteers interacting with patients to help improve neurodevelopmental outcomes. As with the comparison group, gender, gestational age, admission length, weight, and head circumference were gathered. Once the infants neared discharge, the team leader completed their HNE. The length of stay and corrected gestational age were calculated. All of this information remained confidential, and all patient identifiers were removed to be HIPAA compliant.

Outcome Data

The primary outcome of this quality improvement project was to evaluate the effectiveness of the volunteer cuddler program on neonatal neurodevelopmental outcomes. The primary outcome was measured comparing the group of infants that received cuddler interaction

with the group that did not have documented cuddler interaction due to the program's suspension during Covid-19. Neonatal neurodevelopmental outcomes were measured by the difference between admission and discharge length, weight, and head circumference, the patient's length of stay, and their score on the HNE.

Descriptive statistics were run on the difference between the infants' admission and discharge length, weight and head circumference, and length of stay (see Appendix O, Tables 4, 5). A one-way ANOVA was conducted to determine the presence of a statistically significant difference in neurodevelopmental outcomes between the two groups (see Appendix O, Table 6). Finally, a Levene Statistic was calculated to determine if the two groups were homogenous (see Appendix O, Table 7).

The mean change in head circumference of the group that did not receive cuddler interaction was 8.26 cm with a standard deviation of 4.86 cm (see Appendix O, Table 5). The mean for the group who received cuddler interaction was 8.61 cm with a standard deviation of 3.23 cm (see Appendix O, Table 5). The difference in head circumference for the 74 participants was 8.38 cm, with a standard deviation of 4.38 cm (see Appendix O, Table 5). It was found that there was not a statistically significant difference between the two groups' change in head circumference ($p=.754$; see Appendix O, Table 6). The Levene Statistic showed a likeness between the two groups based on head circumference ($p=.167$; see Appendix O, Table 7).

The infants in the comparison group had a mean weight gain throughout their NICU stay of 2077 grams with a standard deviation of 1539.62 grams (see Appendix O, Table 5). The infants in the cuddler interaction group grew an average of 2276 grams with a standard deviation of 795.96 grams throughout their NICU admission (see Appendix O, Table 5). In total, the infants gained a mean average of 2141 grams while admitted to the NICU (see Appendix O,

Table 5). However, there was no statistically significant difference between the two groups regarding weight gain while in the NICU (p=.554; see Appendix O, Table 6). Lastly, a likeness was determined to be present between the two groups (p=.203; see Appendix O, Table 7).

Infants that did not receive cuddler interaction grew an average of 12.1 cm showing a standard deviation of 7.59 cm during their NICU admission (see Appendix O, Table 5). Infants receiving cuddler interaction had a mean growth of 11.5 cm with a standard deviation of 4.35 cm (see Appendix O, Table 5). As a total of 74 participants, they grew an average of 11.90 cm and a standard deviation of 6.69 cm (see Appendix O, Table 5). A statistically significant difference (p=.743) was not seen between the two groups regarding the difference between admission and discharge length (see Appendix O, Table 6). A test of homogeneity of variances was conducted, which revealed a likeness between the two groups (p=.215; see Appendix O, Table 7).

The average length of stay in the NICU for participants that did not receive cuddler interaction was 90 days with a standard deviation of 64.73 days (see Appendix O, Table 5). Infants stayed a mean of 87 days and a standard deviation of 29.46 days that interacted with the volunteer cuddlers during their hospital stay (see Appendix O, Table 5). In the two groups, 74 infants had an average hospital admission of 89 days with a standard deviation of 55.56 days (see Appendix O, Table 5). There was no statistically significant difference between the two groups (p=.851); however, there was a likeness between the two groups (p=.106; see Appendix O, Table 6; see Appendix O, Table 7).

The infants in the comparison group scored an average of 65 and a standard deviation of 7.05 on the HNE (see Appendix O, Table 5). The HNE scores of the infants in the intervention group were a mean of 64 and a standard deviation of 5.63 (see Appendix O, Table 5). As a whole, the infants scored a 64 on the HNE with a standard deviation of 6.59 (see Appendix O,

Table 5). No statistically significant difference was seen between the two groups based on the HNE scores (p=.841; see Appendix O, Table 6). The Levene Statistic (p=.344) revealed that the two groups were alike (see Appendix O, Table 7).

Discussion

Successes

The most critical success of this project is that the infants still displayed improved neurodevelopmental outcomes at discharge, despite no statistically significant difference between the two groups. The HNE Tool has a positive predictive value for neurodevelopment outcomes and infants discharged from the NICUs' chance of developing cerebral palsy (Romeo et al., 2009; Romeo et al., 2013). Additionally, this tool is performed at follow-up appointments until the infants are one year corrected gestational age (Romero et al., 2009; Romero et al., 2013). The average score on the HNE in this quality improvement project was 65 (see Appendix O, Table 3) and a score >57 predicts a decreased chance of developing cerebral palsy (Romeo et al., 2009; Romeo et al., 2013).

Study Strengths

The project site enhanced the strength of the study. Since the cuddler program was already in existence, the project leader wanted to improve the program and increase the number of volunteer cuddlers. The cuddlers were very receptive to the use of the cuddler interaction tool. The volunteers felt more valued about their time if people knew what they did and how long they spent with the patients were recognized. By having the cuddlers feel more valued, they were spending more time interacting with the patients was incredibly beneficial for the patients and their neurodevelopmental outcomes.

The volunteer cuddlers were accommodating to different meeting times when the project leader provided education about using the cuddler interaction tool. They were thankful the project leader brought to light how important the cuddler program is for the fragile patients in the NICU. Despite Covid-19 suspending the cuddler program for eight months, the cuddlers were eager to be back in the NICU for the six-week timeframe to interact with the patients. This dedication and enthusiasm for providing the tiny patients with the utmost care make the cuddler program such a success.

Lastly, the staff and families were vital to the success of the project. Without their buy-in, the cuddlers would not have been able to interact with the patients regularly. The families were receptive to the cuddler program because they wanted the best outcomes for their children once they were discharged from the NICU. Once education was provided to the staff about the importance of human interaction to neonatal neurodevelopmental outcomes, the nursing staff allowed more interaction between the patients and volunteers.

Results Compared to Evidence in Literature

As the synthesis of evidence revealed, there is no direct evidence associated with NICU patients' interactions with individuals outside of the family and its effect on neurodevelopmental outcomes. However, there is a vast amount of literature supporting parental and caretaker involvement improves neonatal neurodevelopmental outcomes (Beebe et al., 2018; Burke, 2018; Gonya et al., 2018; Kanagasabai et al., 2013; Lavallée et al., 2018; Lin et al., 2019; McGowan & Vohr, 2019; Petteys & Adoumie, 2018; Pineda et al., 2018; Santos et al., 2015; Silva et al., 2018; Smith et al., 2014; Vanderveen et al., 2009; Welch et al., 2015; Zeraati et al., 2017). Welch et al. (2015)'s randomized control trial showcased that preterm infants who received regular interactions with their families had higher cognitive and language functioning scores on the

Bayley III exam. Infants who had caretakers involved in their care throughout their NICU admission scored better on physical and mental components in various neurodevelopmental tools and exams (Vanderveen et al., 2009).

Several studies explained that human touch promotes developmentally appropriate care and decreases neonatal stress during care times and handling (Aucott et al., 2002; Laudert et al., 2007; Petteys & Adoumie, 2018; Silva et al., 2018). A decrease in stress imposed on neonates correlates with improving their neurodevelopmental outcomes later in life (Silva et al., 2018). The infants in this quality improvement project had a mean score of 64 on the HNE, suggesting that cuddler interaction will benefit patients.

Limitations

Validity Effects

A few threats to internal validity were present in this project. The first threat was the project leader was the sole individual collecting and inputting the data into data collection sheets. There is a greater chance of error in collecting and entering data when one person is responsible. Additionally, outside sources may feel that this could propose a bias to the project with only one person providing the education to the cuddlers and staff and collecting the data. Covid-19 was a threat to the validity of the project. The cuddler program was suspended due to Covid-19. The cuddle program suspension did not allow the project leader to collect as much data on participants who met the G*power sample size of 54.

Various project factors may threaten the generalization and transfer of this project intervention. The short timeframe and small sample sizes are the first components that threaten external validity. The cuddler program was suspended for such a long time, and the project leader missed opportunities to recruit infants to meet the inclusion criteria. This suspension

caused the sample size to be smaller than anticipated. By having a larger sample size, there could have been a possibility of seeing a statistically significant difference between the two groups.

Sustainability of Effects and Plans to Maintain Effects

The cuddler program being in existence before the implementation of this quality improvement project improves its sustainability. Once vaccination rates increase and Covid-19 cases decrease, the project leader hopes the cuddler program will return to the NICU. The project leader periodically reached out to the volunteer cuddlers by email to ensure they were still interested in volunteering in the NICU once the cuddler restrictions are lifted. This effort by the project lead will help the sustainability of the cuddler program. Staff and parental education about the importance of human interaction and improved neonatal neurodevelopmental outcomes add additional support for the program's sustainability.

Efforts to Minimize the Study Limitations

One of the limitations was parents declining cuddler interaction with their infant. To mitigate this limitation, the project leader talked with every parent whose child met inclusion criteria for the quality improvement project. The team leader provided education on how essential human interaction is to the patients' neurodevelopmental outcomes at discharge and continue to grow and meet other developmental milestones. In the event parents still declined cuddler interaction despite education, the project lead stressed the parents' importance and interaction with their child while in the NICU.

The second limitation to the study was staff adherence to allowing cuddler interaction with their patients. Many nurses do not allow the cuddlers to interact with their patients because it disrupts their workflow and is not conducive to their busy patient assignments. The project

leader tried to alleviate this limitation by providing education to the bedside nurses. Additionally, the project leader reached out to NICU leadership to remind staff to utilize the cuddlers throughout their shifts to allow patients to have human interaction.

Interpretation

Expected and Actual Outcomes

The expected and actual outcomes were similar. Infants who had regular cuddler interaction had an increase in their length, weight, and head circumference. These increases indicate adequate growth and brain growth. Sufficient brain growth will benefit long-term neurodevelopmental outcomes. Next, the duration of stay for infants that interacted with the cuddlers was shorter at 87 days than 90 days in infants that did not interact with cuddlers. A shorter length of stay in the hospital equates to improved neurodevelopmental outcomes (Pineda et al., 2018; Welch et al., 2015).

The most unexpected result in the quality improvement project was that there was no statistical significance between the two groups. The literature suggests that infants in the NICU who have regular human interaction with their families and caretakers have better neurodevelopmental outcomes than infants who do not interact with individuals daily. To adequately assess infants' unexpected results, further neurodevelopmental testing and follow-up will be essential. Patient follow-up is something the project leader could pursue in the future to evaluate the effectiveness of the quality improvement project's participants.

Intervention Effectiveness

The project showcased an improvement in neurodevelopmental outcomes in both the comparison group and the intervention group. The majority of the infants scored well on their HNE. These scores have a positive predictive value of the severity of cerebral palsy that could

affect infants' future (Romeo et al., 2009; Romeo et al., 2013). The existence of the cuddler program added to the effectiveness of this quality improvement project. The project leader did not have to create the cuddler program. Instead, the leader was able to enhance and improve the cuddler program. The cuddler program is easily replicated and can be used in other NICUs as long as there are volunteer services available in the hospital.

Intervention Revision

Although the project was a success, a larger sample size of the cuddler interaction group may have contributed to determining if the results were statistically significant. A longer timeframe of collecting data for the cuddler interaction group would have been helpful. However, this revision was unobtainable due to Covid-19 and suspension of the cuddler program. Parental consent was only talked about with the parents on one occasion. Perhaps if the team leader returned to parents that declined volunteer cuddlers to interact with their child and discussed the importance of this interaction, more families might have consented. If the sample size was larger, there might have been a statistically significant outcome between the two groups.

Expected and Actual Impact to Health Systems, Cost, and Policy

The expected results of this quality improvement project were to demonstrate that a volunteer cuddler program enhances neonatal neurodevelopmental outcomes at discharge. The results showcased that infants with regular cuddler interaction do have positive neurodevelopmental outcomes. Infants with better neurodevelopmental outcomes require less follow-up care as they grow and continue to meet various developmental milestones. Less follow-up care equates to a lower cost of healthcare for NICU families. Reduced medical costs have a positive impact on the healthcare systems. The estimated and actual budget of the

program was around $150. Since the cuddler program was already in place and cuddlers are volunteers, the cost was drastically cut for implementing this project and did not require any additional funding sources. This program's low cost helps to enhance its sustainability once the cuddlers are allowed to interact with NICU patients again.

Conclusion

Practical Usefulness of Intervention

Owing to medical and technological advances, premature babies' survival rates have improved over the years. Nevertheless, they are still at increased risk for cognitive, motor, language, and neurodevelopmental delays (Welch et al., 2015). Parental or caregiver contact and interaction remain vital in drastically improving neonatal neurodevelopmental outcomes (Goyna et al., 2018; Pettey & Adoumie, 2018; Pineda et al., 2018; Welch et al., 2015; Zeraati et al., 2018).

However, often, parents are unable to be at the bedside due to multi-factorial reasons. Volunteer programs were developed to combat the isolation and lack of human contact premature infants encounter throughout the entirety of their NICU course. This evidenced-based quality improvement project emulated the results published in the literature; cuddler interaction can enhance neurodevelopmental outcomes. Improved neurodevelopmental outcomes while inpatient allows for better-quality opportunities to meet developmental milestones throughout their lifetime.

Further Study of Intervention

The literature surrounding human interaction between neonates and individuals that are not their families and caretakers is severely lacking. There remain many opportunities for more studies to produce added outcomes on neonatal neurodevelopment. When the cuddler program is

reinstated, there could be further data collection over a longer timeframe and a larger sample size to determine statistically significant differences between infants with cuddler interaction and infants without cuddler interaction. This added information can contribute to the literature on neonatal neurodevelopmental outcomes and other NICUs across the country to create or enhance existing volunteer cuddler programs.

Premature infants continue to survive thanks to advancing modern medical technology. The impact prematurity has on families, healthcare providers, and the healthcare systems is astronomical. By improving neonatal neurodevelopmental outcomes while in the NICU decreases the length of stay, improves the neonates' quality of life, and significantly decreases the burden to families and healthcare systems.

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Appendix A

Definition of Key Terms

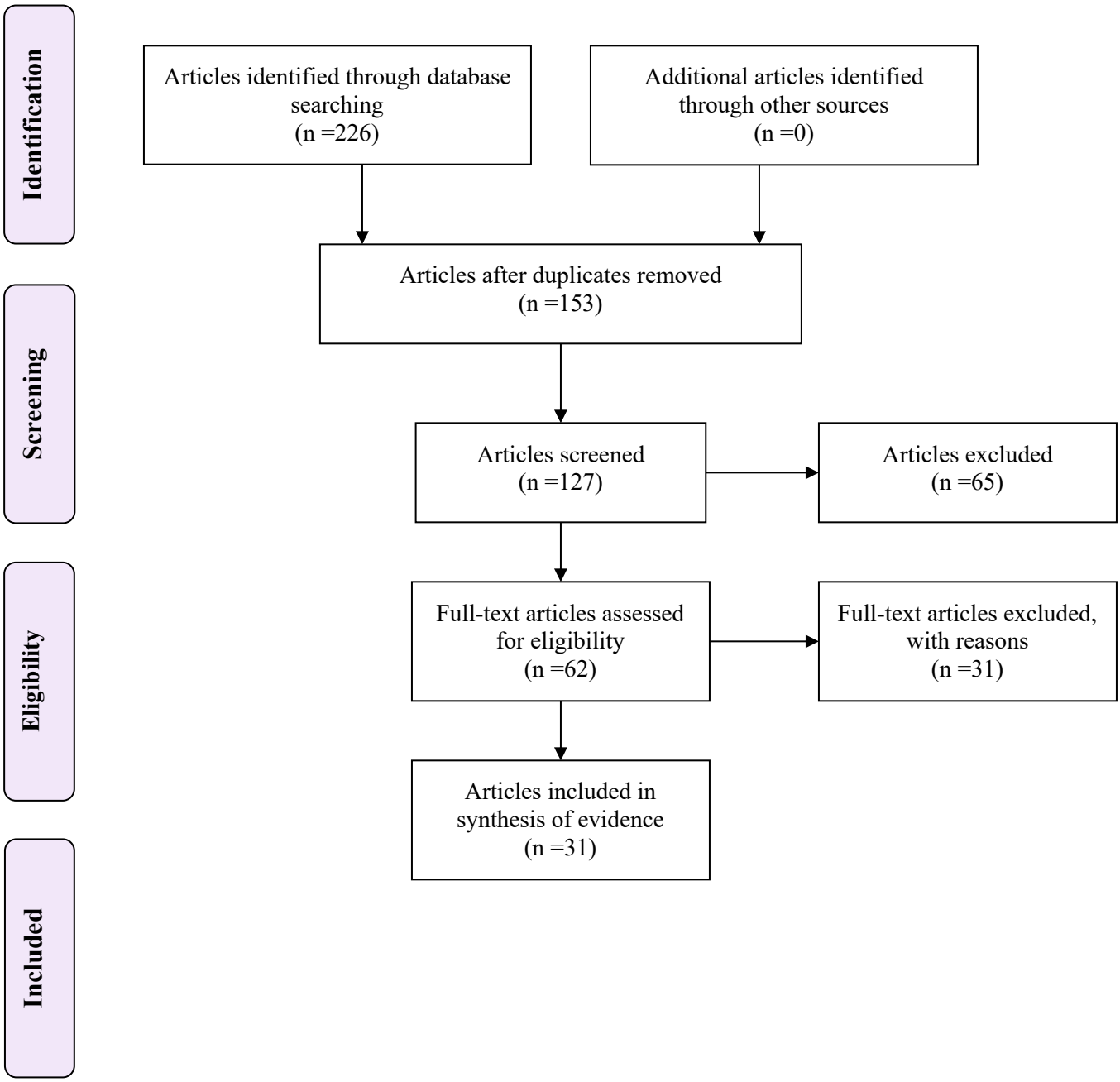
Prematurity: infants born at or before 37 weeks gestation (CDC, 2020).

Hammersmith Tool: assesses many different domains surrounding neurodevelopment. Those domains include tone patterns, reflex items, movements, abnormal signs, behavioral signs, vision, and hearing (Ricci et al., 2008)

Cuddlers: volunteers who interact with infants in the NICU at St. Louis Children's Hospital ("Volunteers" 2020)

Appendix B

PRISMA Diagram



Appendix C
Evidence Grid

Article (first author and date)	Human interaction and its effect on neurodevelopmental outcomes	Positioning and its effect on neurodevelopmental outcomes	Skin-to-Skin effect on neurodevelopmental outcomes	Massage of neonates and its effect on neurodevelopmental outcomes	Head circumference and its effect on neurodevelopmental outcomes	Pain and its effect on neurodevelopmental outcomes
Medina-Alva, 2019	X				X	
Figueiredo Silva, 2018	X	X	X	X		
Zeraati, 2018	X			X		
Suganthini, 2013	X	X	X			
Mitchell, 2013	X	X	X			
Beebe, 2018	X	X				
Welch, 2015	X	X	X	X		
Smith, 2014	X	X	X	X		
Raghuram, 2017					X	
Gonya, 2018	X					
Santos, 2015	X					
McGowan, 2019	X	X	X			
Petteys, 2018	X					
Laudert, 2007	X	X		X		
Painter, 2018	X	X				
Gonya, 2017	X		X			
Grunau, 2006	X	X		X		
Aucott, 2002	X		X			X
Lin, 2019	X					
Bucsea, 2019	X	X	X	X		
Pineda, 2018	X		X			
Lavallée, 2019	X	X				X
Pados, 2019	X	X	X			X
Lavallée, 2019	X	X	X	X		
Burke, 2018	X		X			
Pados, 2019	X		X			
Head, 2014	X		X			

Alvarez, 2017	X			X		
Abdallah, 2013	X			X		
Cong, 2017	X					X
Evereklina, 2017	X		X			
Vanderveen, 2009	X	X	X			

Appendix D

Synthesis of Evidence Table

First author, Year, Title, Journal	Purpose	Research Design[1], Evidence Level[2] & Variables	Sample & Sampling, Setting	Measures & Reliability (if reported)	Results & Analysis Used	Limitations & Usefulness
Sub-topic of Evidence: Human Interaction						
Lin, C., (2019). Neurodevelopmental outcomes at 2 and 5 years of age in very-low-birth-weight preterm infants born between 2002 and 2009: A prospective cohort study in Taiwan. *Pediatrics and Neonatology*	To determine the neurodevelopmental outcomes of VLBW infants at 2 and 5 years old, and the risk factors for poor neurodevelopmental outcomes at 2 and 5 years	A prospective cohort study Level IV **Variables:** sociodemographic, neonatal data, and neurological assessments at 2 and 5 years old	5407 VLBW in 21 NICUs in Taiwan	Outcome measures based on: sociodemographic, neonatal data, and neurological assessments at 2 and 5 years old	At 2 years of age the rate of CP was 6.31%, blindness was 0.54%, and moderate to severe hearing loss was 2.41%. At 5 years of age the rate of CP 6.80%, bilateral blindness was 0.28%, and moderate to severe hearing loss was 2.8%. Univariate and multivariant analysis was used	Limitations: non-compliance for follow up, study drop out, no early-intervention programs were used to help improve neurodevelopmental outcomes Usefulness: long-term neurodevelopmental outcomes were shown in this study
McGowan, E., (2019). Impact of nonmedical factors on neurobehavior and language outcomes of preterm infants. *NeoReviews*	To determine the effects of nonmedical factors on neurobehavior in neonates	Expert opinion Level VII **Variables:** N/A	N/A	Outcome measures based on: the impact of parental involvement, NICU, and social environment on early neurobehavior and language outcomes	Parental involvement and caretaking have a positive impact on early language development in infants	Limitations: expert opinion, no data collected with evidence shown based on RCTs Usefulness: the article depicts the importance of parental involvement in the future of the neonates' language development
Pineda, R., (2018). Parent participation in the neonatal intensive care unit: Predictors and relationships to neurobehavior and developmental outcomes. *Early Human Development*	To define predictors of parent presence in the NICU, and to determine the relationship between parental presence on early neurodevelopment and neurodevelopmental outcomes at age 4 to 5 years of age	Quasi-experimental study Level III **Variables:** parental participation and neurodevelopmental outcomes	81 preterm infants born at <32 weeks gestation at St. Louis Children's Hospital NICU	Outcome measures were based on: parent participation, medical factors socio-demographic factors, neurobehavioral outcomes, and developmental outcome	More parental holding whether in arms or skin-to-skin was related to better reflex development on the NICU Network Neurobehavioral Scale (NNNS), less asymmetry on the NNNS, and better gross and fine motor development at term equivalent and 4 to 5 years old.	Limitations include small sample size, single study site, use of multivariate analysis which decreases power and may have limited the ability to identify relationships. The location of the study was in an urban location with low socioeconomic status which not be reflective of other medical sites and their parent population. Finally, data was

					Linear regression models were used to in the relationship between medical and sociodemographic factors and parent presences and any holding of neonates. Parent presence and any holding were investigated for associations with neurobehavioral outcome at term equivalent age and developmental outcome at 4 to 5 years of age using univariate linear repression models as well as multivariate models.	strictly reliant on the nurse documentation of parental presence and holding. Usefulness: this study was easy to read and to follow the results. It is useful to explain why parental presence and holding is some important to a neonate's neurodevelopmental outcomes.
Beebe, B., (2018). Family nurture intervention for preterm infants facilitates positive mother-infant face-to-face engagement at 4 months. *American Psychological Association*	To determine if the Family Nurture Intervention improves mother-infant face-to-face communication at 4 months corrected gestational age	Randomized Control Trial Level II **Variables**: Mothers and infants in the standard group and mothers and infants in the family nurture intervention group	115 mothers and 150 infants at Columbia University Medical Center	Outcome measures were based on: infant gaze-mother touch, infant vocal affect-mother gaze, infant gaze-mother gaze, and infant vocal affect-mother touch	Mother gaze group p=.931 and infant gaze p=.128 (not statistically significant). Mother touch p=<.001 and infant vocal p=<.001 (statistically significant). Results were based on independent *t*-tests and Chi χ^2 tests	Limitations: no prior study similar to this one has been performed, small sample size, and lacking sufficient literature for comparison. Usefulness: validates that human interaction is essential for improving neurodevelopmental outcomes
Burke, S., (2018). Systematic review of developmental care interventions in the neonatal intensive care unit since 2006. *Journal of Child Health Care*	To analyze studies that improve neonatal neurodevelopmental outcomes, evaluate the effectiveness of the interventions, and to provide future recommendations	Systematic Review of RCTs Level I **Variables:** N/A	19 articles met inclusion criteria	N/A	Developmental care in the NICU has positive impacts on the neonates' neurodevelopment, specifically early intervention, holding/touching, and parent involvement.	Limitations: inclusion of only studies published in the English language, no gray literature was included, and 19 different outcome measures were used at various times in the neonates' lives. Usefulness: validates that human interaction and holding can promote positive neurodevelopment
Silva, N., (2018). Developmental care approaches for mitigating stress in preterm neonates in the neonatal intensive care unit: A systematic review. *Psychology and Neuroscience*	To analyze studies about the impact of developmental care approaches on indicators of stress in preterm infants	Systematic Review of RCTs and CCTs Level I **Variables:** N/A	22 articles met inclusion criteria	N/A	Stress to the neonate is toxic and can have detrimental effects on their neurodevelopment. By mitigating the stress by using skin-to-skin, massage,	Limitations: not all studies could be included based on the author's inclusion and exclusion criteria, there is no evidence of a single intervention that provides the

					developmentally appropriate interventions can have positive effects on the neurodevelopment throughout the neonates' NICU course.	best possible neurological outcomes, further research needs to be done Usefulness: validates that human interaction can have positive impact on neurodevelopmental outcomes
Gonya, J., (2018). Human interaction in the NICU and its association with outcomes on the Brief Infant-Toddler Social and Emotional Assessment (BITSEA). *Early Human Development*	To identify associations between care received in the NICU and BITSEA scores	Retrospective cohort study Level IV **Variables:** the amount of human interaction infants received while in the NICU based on EHR charting	50 premature infants	Outcome measures were based on: BITSEA scores post discharge	Infants who longer periods of human interaction scored higher (p=0.01) on social competence and lower on dysregulation (p=0.03) on the BITSEA scale Univariate analysis was used	Limitations: the use of a retrospective cohort study, inability to capture the quality of human interaction, use of a single BITSEA score as opposed to utilizing BITSEA over period of time, use of only extremely premature infants. Usefulness: positive correlation between improved neurodevelopmental outcomes and human interactions
Petteys, A., (2018). Impact on NICU parent stress and infant length of stay; A Randomized controlled Pilot Study. *Advances in Neonatal Care*	To evaluate the impact of mindfulness-based neurodevelopmental care on parent outcomes and infant length of stay (LOS)	Randomized Controlled Pilot Study Level II **Variables:** parents who participated in standard NICU care, and parents who received mindfulness-based neurodevelopmental training along with standard NICU care	55 infant and parent dyads	Outcome measures based on: parental responses on infant clinical information form, general demographic form, parental stressor scare: NICU, mother-to-infant bonding scare, parent satisfaction score	Infant LOS was significantly decreased in the group whose parents received mindfulness-based neurodevelopmental care (P=.026) Independent and paired *t* tests, χ^2 test, and Mann-Whitney U tests were utilized	Limitations: small sample size, pilot study, parents in both groups were admitted to the NICU at the same time so conversations between the two could have skewed data. Usefulness: this study validates that consistent human interaction can decrease the length of stay for NICU patients and enhance their neurodevelopmental outcomes
Lavallée , A., (2018). Part 2: Practice and research recommendations for quality developmental care in the NICU. *Journal of Neonatal Nursing*	To determine the best developmental care interventions that promotes the best neurodevelopmental outcomes for neonates	Systematic Review of qualitative articles Level V **Variables:** N/A	71 articles	Outcome measures based on: recommendations on family-centered care, sleep protection, assessing and managing pain, infant positioning, optimized infant-driven feeding, administration of human milk, environmental light and noise, light, and noise	Nurses and parents are key in providing developmentally appropriate care and protecting the neurodevelopment of preterm infants	Limitations: more RCTs are needed to evaluate the effectiveness of developmentally appropriate NICU are and its effect on neurodevelopmental outcomes Usefulness: explains how human interaction has a

						positive impact on neurodevelopmental outcomes
Zeraati, H., (2017). Effect of multi-sensory stimulation on neuromuscular development of premature infants: A Randomized clinical trial. *Iran J Child Neurol*	To determine the effects of multisensory stimulation on premature infants' neuromuscular development.	Randomized Clinical Trial Level II **Variables**: infants receiving multisensory stimulation for 12 mins a day and routine NICU care and infants only receiving routine NICU care	80 preterm infants in Jahrom Hospital, Jahrom Iran	Outcome measures were based on: before and after intervention New Ballard scale. Two trained individuals then assessed pain scores simultaneously	The New Ballard score significantly changed in the intervention group before and after multisensory stimulation (P=0.001). Results were based on ANOVA calculations	Limitations: small sample size, single institution, follow up timing was very short, additional studies are needed to continue to evaluate the effectiveness of multisensory stimulation on neuromuscular outcomes. Usefulness: this study explains that parental involvement with the multisensory stimulation had positive impact on neurodevelopment and realistic use within the NICU
Welch, M., (2015). Family nurture intervention in the neonatal intensive care unit improves social-relatedness, attention, and neurodevelopment of preterm infants at 18 months in a randomized controlled trial. *Journal of Child Psychology and Psychiatric*	To evaluate the effectiveness of family nurture interactions (FNI) on neonatal neurodevelopmental outcomes	Randomized Controlled Trial Level II **Variables:** infants receiving FNI in addition to standard NICU care, and infants receiving standard NICU care	115 mothers and 150 neonates at Morgan Stanley Children's Hospital NICU	Outcome measures were based on: a Bayley III exam performed on the infants at 18 months corrected gestational age and a Child Behavior Checklist (CBCL) filled out by the mother of the infant	FNI improved infants results on Bayley III if they scored >85 (p=.390 and p=.008). FNI infants had fewer attention problems on CBCL (p<.02) ANOVA and independent *t* tests were used	Limitations: small sample size, lack of 18 month follow up, need for further trials to determine effectiveness of FNI on neurodevelopmental outcomes Usefulness: results have a positive correlation between parental interaction and neurodevelopmental outcomes
Santos, J., (2015). Impact of hospital-based environmental exposures on neurodevelopmental outcomes of preterm infants. *Curr Opin Pediatr*	Summarizes the evidence between the NICU environment and neurodevelopmental outcomes	Systematic Review of qualitative articles Level V **Variables:** N/A	N/A	Outcome measures based on: chemical exposure, sound, light, social environment, and built environment	Optimizing the NICU experience for preterm infants can improve both short and long-term neurodevelopmental outcomes	Limitations: more research needs to be conducted Usefulness: the article shows positive correlation between human interaction and improved Bayley scores
Smith, J., (2014). Family-centered developmentally supportive care in the neonatal intensive care unit: Exploring the role and training of child life specialists. *Children's Health Care*	To determine the effects of Child Life Specialists one neonatal neurodevelopmental outcomes	Qualitative Descriptive Study Level VI **Variables:** N/A	69 Child Life Specialists (CLS)	Outcome measures based on: responses of CLS on surveys	CLS play a vital role in enhancing family-centered, developmentally supportive care to NICU patients	Limitations: small sample size and overrated responses in regard to the importance of their practice by CLS. Usefulness: this article supports the inquiry that human interaction improves patient outcomes

Kanagasabai, P., (2013). Effect of multisensory stimulation on neuromotor development in preterm infants. *Indian J Pediatr*	To investigate the effect of Auditory, Tactile, Visual, and Vestibular stimuli on neuromotor development	Randomized Control Trial Level II **Variables:** infants that received standard NICU care, and infants who received multisensory stimulation in addition to standard NICU care	50 infants randomized into control group and intervention group	Outcome measures were based on: initial New Ballard score and using Infant Neurological International Battery at term corrected to determine neuromotor development	Infants in the group who received multisensory stimulation throughout their NICU course had a higher neuromotor score p=0.001. Independent *t* test was used	Limitations: blinding of the two groups was not feasible, the INFANIB test is normally used at 3-22 months of age and not 0-18 months of age, further studies need to be performed to evaluate the long term neurodevelopmental outcomes Usefulness: showcases that human touch can have a positive impact on neuromotor development which in turn could have positive impact on neurodevelopment
Vanderveen, J. (2009). Early interventions involving parents to improve neurodevelopmental outcomes of premature infants: a meta-analysis. *Journal of Perinatology*	To determine if parental involvement in neonate's care in the NICU improves neurodevelopmental outcomes	Meta-analysis of RCTs Level I **Variables:** N/A	25 studies met inclusion criteria	N/A	Parents that are actively involved their child's care throughout their NICU course will have improved neurodevelopmental outcomes	Limitations: combining different therapeutic interventions, sample sizes, variety of measurement tools are used to determine neurodevelopmental outcomes Usefulness: support the inquiry
Aucott, S., (2002). Neurodevelopmental care in the NICU. *Mental Retardation and Developmental Disabilities*	To show a paradigm shift in NICU care that shifts towards adding developmentally appropriate care	Expert Opinion Level VII **Variables:** N/A	N/A	Outcome measures based on: non-nutritive sucking, family involvement, breastfeeding, kangaroo care, and pain	Family involvement and human interactions have one of the most profound effects on neurodevelopment	Limitations: expert opinion, older study Usefulness: correlates with inquiry
Sub-topic of Evidence: Skin-to-Skin Interaction						
Pados, B., (2019). Physiology of stress and use of skin-to-skin care as a stress -reducing intervention in the NICU. *Nursing for Women's Health*	To determine if the use of skin-to-skin care (SSC) in the NICU reduces neonatal stress and improves neurodevelopmental outcomes	Expert opinion Level VII **Variables:** N/A	N/A	Outcome measures were based on: SSC and the parent-child relationship, SSC and feeding, SSC and growth, SSC and physiologic instability, SSC and pain, effects of SSC on the microbiome, SSC and infection, and SSC and neurodevelopment	Infants who received regular SSC with their parents reduced their incidences of stress throughout their NICU stay, and had better neurodevelopmental outcomes	Limitations: expert opinion, no data collected with evidence shown based RCTs, more research needs to be done to determine optimal timing and length of SSC and neurodevelopmental outcomes Usefulness: supports human interaction has positive impacts on neonatal neurodevelopment

Pados, B., (2019). Systematic review of the effects of skin-to-skin care on short-term physiologic stress outcomes in preterm infants in the neonatal intensive care unit. *Advances in Neonatal Care*	To analyze studies about SSC vs incubator care and its effect on neonatal stress	Systematic Review of RCTs Level I **Variables:** N/A	19 articles met inclusion criteria	N/A	Infants who received SSC vs incubator care had decreased stress level as evidenced by reduced cortisol levels and increased oxytocin levels	Limitations: more research is needed regarding long-term follow up care to determine neurodevelopmental outcomes Usefulness: SSC decreases neonatal stress levels which could in turn improve neurodevelopmental outcomes
Gonya, J., (2017). Investigating skin-to-skin patterns with extremely preterm infants in the NICU and their effect on early cognitive and communication performance: a retrospective cohort study. *BMJ Open*	To determine the impact SSC has on early cognitive and communication performance in preterm infants	Retrospective cohort study Level IV **Variables:** EHR was examined to determine medical care of each neonate, SSC, and cognitive and communication outcomes	97 NICU patients at Nationwide Children's Hospital admitted between Jan 2010-Nov 2011	Outcome measures based on: cognitive and communication early performance outcomes on the Bayley Scares of Infant Development at 6 and 12 months follow up appointments	Infants who experienced SSC more had higher communication scores on the Bayley at 12 months ($p=0.05$). χ^2 test used and Fisher's exact test	Limitations: study was retrospective and a small sample size, and further research needs to be done Usefulness: there is positive correlation that SSC can have a positive impact on neurodevelopmental outcomes
Evereklian, M., (2017). The impact of kangaroo care on premature infant weight gain. *Journal of Pediatric Nursing*	To determine the effectiveness of kangaroo care on neonatal weight gain	Integrative Review Level VII **Variables:** N/A	9 articles met inclusion criteria	N/A	Infants who participated in kangaroo care had better weight gain compared to their cohorts	Limitations: samples were derived from non-critically ill patients, lack of reporting quality of kangaroo care, and adverse events related to kangaroo care Usefulness: regular use of kangaroo care showed improved neonatal weight gain which can equate to improved neurodevelopmental outcomes
Head, L., (2014). The effect of kangaroo care on neurodevelopmental outcomes in preterm infants. *The Journal of Perinatal and Neonatal Nursing*	To analyze the effectiveness of kangaroo care on neurodevelopmental outcomes	Integrative Review Level VII **Variables:** N/A	10 articles met inclusion criteria	N/A	Kangaroo care has been shown to have positive effects on the neurodevelopment of preterm infants	Limitations: further research needs to be conducted to evaluate long-term neurodevelopmental outcomes associated with kangaroo care Usefulness: human interaction does promote positive neurodevelopmental outcomes

Mitchell, A., (2014). Effects of daily kangaroo care on cardiorespiratory parameters in preterm infants. *Journal of Neonatal and Perinatal Medicine*	To determine the effects of kangaroo care and its effect on cardiorespiratory parameters	Randomized Control Trial Level II **Variables:** Infants placed in either standard care in the NICU or kangaroo care	38 infants between 27-30 weeks gestation	Outcome measures based on: bradycardia and oxygen desaturation events	Infants that received kangaroo care had fewer bradycardia episodes (p=0.048) and fewer oxygen desaturations (p=0.017) Tukey post hoc analysis	Limitations: small sample size, future research needs to be conducted to determine long-term neurodevelopmental outcomes Usefulness: kangaroo care decreases adverse events in the neonates which could have positive impact on their neurodevelopment
Sub-topic of Evidence: Positioning of the neonate						
Painter, L., (2019). Improving Neurodevelopmental Outcomes in NICU Patients. *Advances in Neonatal Care*	To determine the effectiveness of developmental positioning intervention on length of stay, weight gain, and tone/flexion compared with neonates without structured positioning.	Quasi-experimental with nonequivalent groups. Level III **Variables**: group of neonates receiving the structured positioning and retrospective chart review group.	A retrospective chart review of 50 neonates <34 weeks gestation, and a convenience sample of 27 inpatient neonates	Outcome measures based on: Infant Position Assessment Tool was used as a visual guide by researcher for intervention fidelity. Hammersmith scoring was completed by occupational therapists prior to discharge.	An independent *t* test and χ^2 were used to compare the gender, gestational age, birth weight between the two groups for significant differences. Independent *t* test was used to compare the outcome of interest: Hammersmith score, LOS, and weight gain. The dependent variable group had higher Hammersmith scores at discharge showing that structured positioning does have an impact on neurodevelopmental outcomes.	Limitations include a small postintervention sample size, obtaining parental consent was difficult to obtain, low census during the timeframe of the study, and nurse compliance to the structured positioning program. Usefulness: this study shows that infants born prematurely do have a disruption in their neurodevelopment. Developmental appropriate positioning that can be incorporated throughout NICUs and can have a positive impact on neurodevelopmental outcomes.
Lavallée, A., (2018). Part 1: Narrative overview of developmental care interventions for the preterm newborn. *Journal of Neonatal Nursing*	To highlight developmental care methods that have a positive impact on neurodevelopment	Integrative Review Level VII **Variables:** N/A	N/A	Outcome measures based on: protected sleep, pain, developmentally supportive activities of daily living, family centered care, and healing environment	Developmentally appropriate care interventions have a positive impact on neurodevelopmental outcomes	Limitations: narrative review Usefulness: positioning has positive impact on neurodevelopment
Sub-topic of Evidence: Massage of the Neonate						
Alvarez, M., (2017). The effects of massage therapy in hospitalized preterm neonates: A	To evaluate the effectiveness of massage therapy on neonatal development	Systematic Review of qualitative articles Level V **Variables:** N/A	23 articles met inclusion criteria	Outcome measures based on: anthropometric outcomes, behavioral and motor function, blood samples,	Massage therapy can have a positive impact on development in NICU patients	Limitations: further research needs to be conducted to assess long-term outcomes on massage therapy and

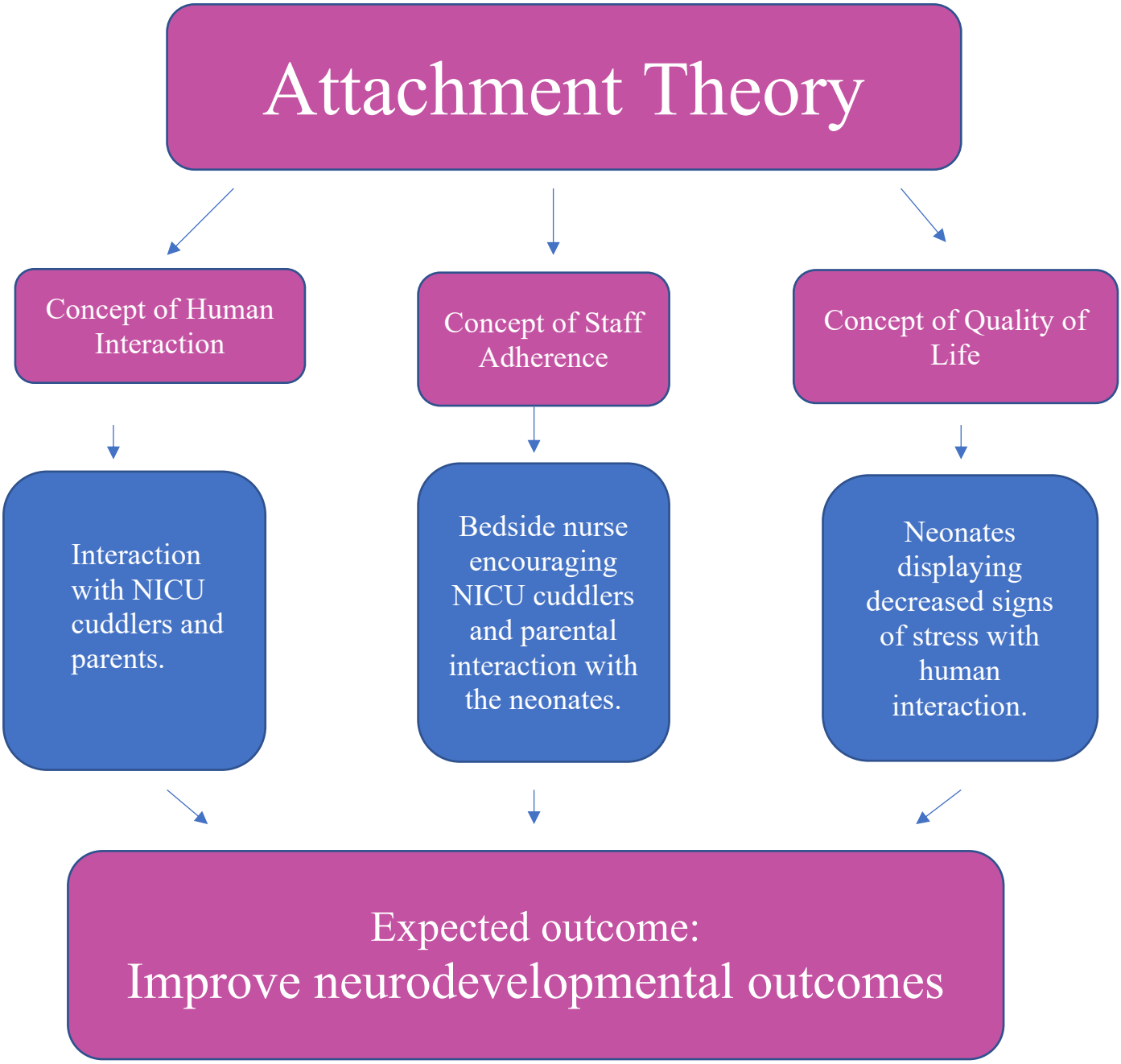
systematic review. *International Journal of Nursing Studies*				electrophysiological parameters, vital signs, and bone metabolism parameters		neurodevelopmental outcomes Usefulness: aligns with inquiry that massage and human interactions can have positive impacts on neurodevelopment
Abdallah, B., (2013). The efficacy of massage on short and long-term outcomes in preterm infants. *Infant Behavior and Development*	To determine short and long-term benefits of massage on preterm infants	Quasi-experimental Level III **Variables:** infants who received massage therapy from their mothers, and infants who did not receive massage therapy	66 preterm infants	Outcome measures based on: weight at discharge, pain response, length of stay, Bayley scores, and breastfeeding duration at 12 months of age	Infants receiving massage had lower pain scores (p=0.041) and higher cognitive scores on the Bayley exam (p=0.004) ANOVA, Chi square, post hoc Bonferroni-corrected *t*-tests, and paired *t*-tests	Limitations: lack of randomization Usefulness: results can be aligned with inquiry that massage and human interaction improves neurodevelopmental outcomes
Sub-topic of Evidence: Pain in the Neonate						
Bucsea, O., (2019). Non-pharmacological pain management in the neonatal intensive care unit: Managing neonatal pain without drugs., *Seminars in Fetal and Neonatal Medicine*	To emphasize the importance of pain control in neonates	Expert Opinion Level VII **Variables:** N/A	N/A	Outcome measures based on: The Development of Infant Acute-Pain Responding-Revised, and Attachment Theory	Infants who had caregivers present during painful procedures had better cognitive functioning and mental health outcomes	Limitations: no research is needed and RCTs on pain control in neonates Usefulness: can be aligned with the inquiry
Cong, X., (2017). The impact of cumulative pain/stress on neurobehavioral development of preterm infants in the NICU. *Early Human Development*	To investigate exposure to painful/stressful experiences and its impact on neonatal neurodevelopment	Prospective Exploratory Study Level IV **Variables:** N/A	50 preterm infants	Outcome measures based on: NICU Infant Stressor Scale (NISS), parental contact, and Neonatal Intensive Care Unit Network Neurobehavioral Scale (NNNS)		Limitations: exploratory study, small sample size, data collection based on chart review Usefulness: parental contact can help ease pain, and promote positive neurodevelopment
Grunau, R., (2006). Long-term consequences of pain in human neonates. *Seminars in Fetal and Neonatal Medicine*	To determine the consequences of pain experienced in neonates	Expert Opinion Level VII **Variables:** N/A	N/A	N/A	Repeated painful procedures throughout a NICU course can have detrimental effects on neurodevelopment	Limitations: long-term follow up is necessary, NICU patients never have the same medical course
Sub-topic of Evidence: Neonatal Head Circumference						
Medina-Alva, P., (2019). Combines predictors of neurodevelopment in very low birth weight preterm infants	To evaluate the effectiveness of using head ultrasounds, head circumference, and neurological exams to	Prospective Study Level IV **Variables:**	132 infants	Outcome measures based on: Hammersmith Neurological Exam, head circumference cranial ultrasounds, and Mullen	Excellent positive predictive values when all three exams were abnormal and high predictive value when at least one test was normal	Limitations: small sample size, multiple evaluators performing exams, loss of patients enrolled due to timing of follow up exams

	determine risk for neurodevelopmental delay			Scales of Early Learning (MSEL)	Bivariate analysis, Fisher's exact, test, Student's *t* test, and Mann-Whitney tests were utilized	Usefulness: head circumference is a variable going to be measured to evaluate the inquiry
Raghuram, K., (2017). Head growth trajectory and neurodevelopmental outcomes in preterm neonates. *Pediatrics*	To determine the effect of head circumference and head growth on neurodevelopmental outcomes	Retrospective Cohort Study Level IV **Variables:** N/A	1973 Infants admitted to a NICU between Apr 2009-Sept 2011 that received follow up at 16 and 36 months corrected gestational age	Outcome measures based on: head circumference on DOL 1, at discharge, and follow up appointments	Poor head growth is associated with poor neurodevelopmental outcomes Pearson's χ^2 test, Student's *t* test, Wilcoxon rank test, and analysis of variance F test	Limitations: additional research is needed to determine long-term consequences of poor head growth and its relationship to poor neurodevelopmental outcomes Usefulness: head circumference is a variable going to be measured to evaluate the inquiry

Appendix E

Theory to Application Diagram

Diagram of the attachment theory and its relation to the concepts of human interaction, staff adherence, and quality of life with this DNP inquiry (McEwen & Wills, 2019; Peterson & Bredow, 2013)



Appendix F

IRB Form

UMKC

Institutional Review Board University of Missouri-Kansas City

Dear Lyla Jo Lindholm,

5319 Rockhill Road Kansas City, MO 64110 816-235-5927 umkcirb@umkc.edu

A member of the UMKC Research Compliance Office screened your QI Questionnaire to project #2027111-QI entitled "Evaluation of a Neonatal Intensive Care Unit Volunteer Cuddler Program on Neonatal Neurodevelopmental Outcomes" and made the following determination:

QI Determination: The project has been determined to be a quality improvement activity not requiring IRB review.

If you have any questions regarding this determination, please feel free to contact our office at 816-235-5927, umkcirb@umkc.edu, or by replying to this notification.

Note Regarding Publications: It is appropriate to disseminate and replicate QI/program evaluation successes, including sharing the information external to an organization. This may include presentations and publications. The mere intent to publish the findings does not require IRB review as long as the publication does not refer to the activity as research.

Thank you,
UMKC Institutional Review Board

Appendix G

Cost Table

Category	Item Description	Quantity	Unit Cost	Anticipated Cost
Print materials	Paper to print cuddler log (provided by the NICU)	500	$0.00	$0.00
Equipment	Office supplies for cuddlers to use to log interactions with infants (provided by the NICU)	Various	$0.00	$0.00
Student Time	Time spent travelling to and from project site, data collection, data analysis, and interaction with hospital staff and cuddlers	600 hours	Donated time	$0.00
Cuddler Time	Volunteer cuddlers interacting with infants	Various	Donated time	$0.00
Miscellaneous	Candy for the cuddlers as a gift of appreciation	Various	Various	$150.00
Total				**$150.00**

Appendix H

Logic Model

Inputs	Intervention(s) *Activities*	Outputs *Participation*	Outcomes -- Impact Short	Outcomes -- Impact Medium	Outcomes -- Impact Long
Evidence, sub-topics 1. Neurodevelopmental Outcomes 2. Human Interaction 3. Skin-to-Skin 4. Massage 5. Pain 6. Head Circumference **Major Facilitators or Contributors** 1. NICU cuddlers 2. Bedside nurses 3. Parents **Major Barriers or Challenges** 1. Staff adherence 2. Cuddler adherence to the data collection sheets 3. Parental consent to allow the cuddlers to interact with their child 4. Covid-19	**EBP intervention which is supported by the evidence in the Input column (brief phrase)** 1. Human interaction has positive impact on neonatal neurodevelopmental outcomes **Major steps of the intervention (brief phrases)** 1. Design of cuddler interaction tracking tool 2. Cuddler education on use of the tool 3. Data collection 4. Performing Hammersmith Neurological Examination prior to study patient's discharge 5. Data analysis 6. Data interpretation 7. Presentation of results	**The participants (subjects)** Infants admitted to a NICU who were born at less than 32 weeks **Site** Local NICU **Time Frame** 15 months **Consent or assent Needed** Yes—parents of the patients allowing their child to be held by cuddlers **Other person(s) collecting data (yes,no)** NICU Cuddlers **Others directly involved in consent or data collection (yes/no)** No	**(Completed during DNP Project)** **Outcome(s) to be measured** Primary: Neurodevelopmental outcomes at discharge **Measurement tool(s)** 1. Difference between admission and discharge length, weight, and head circumference 2.Length of Stay 3. Hammersmith Neurological Evaluation **Statistical analysis to be used** 1. One-Way ANOVA 2. Descriptive Statistics	**(after student DNP)** **Outcomes to be measured** Increased number of cuddlers working in the NICU. Improvement in neurodevelopmental outcomes	**(after student DNP)** **Outcomes that are potentials** Increased number of cuddlers working in the NICU. Improvement in neurodevelopmental outcomes

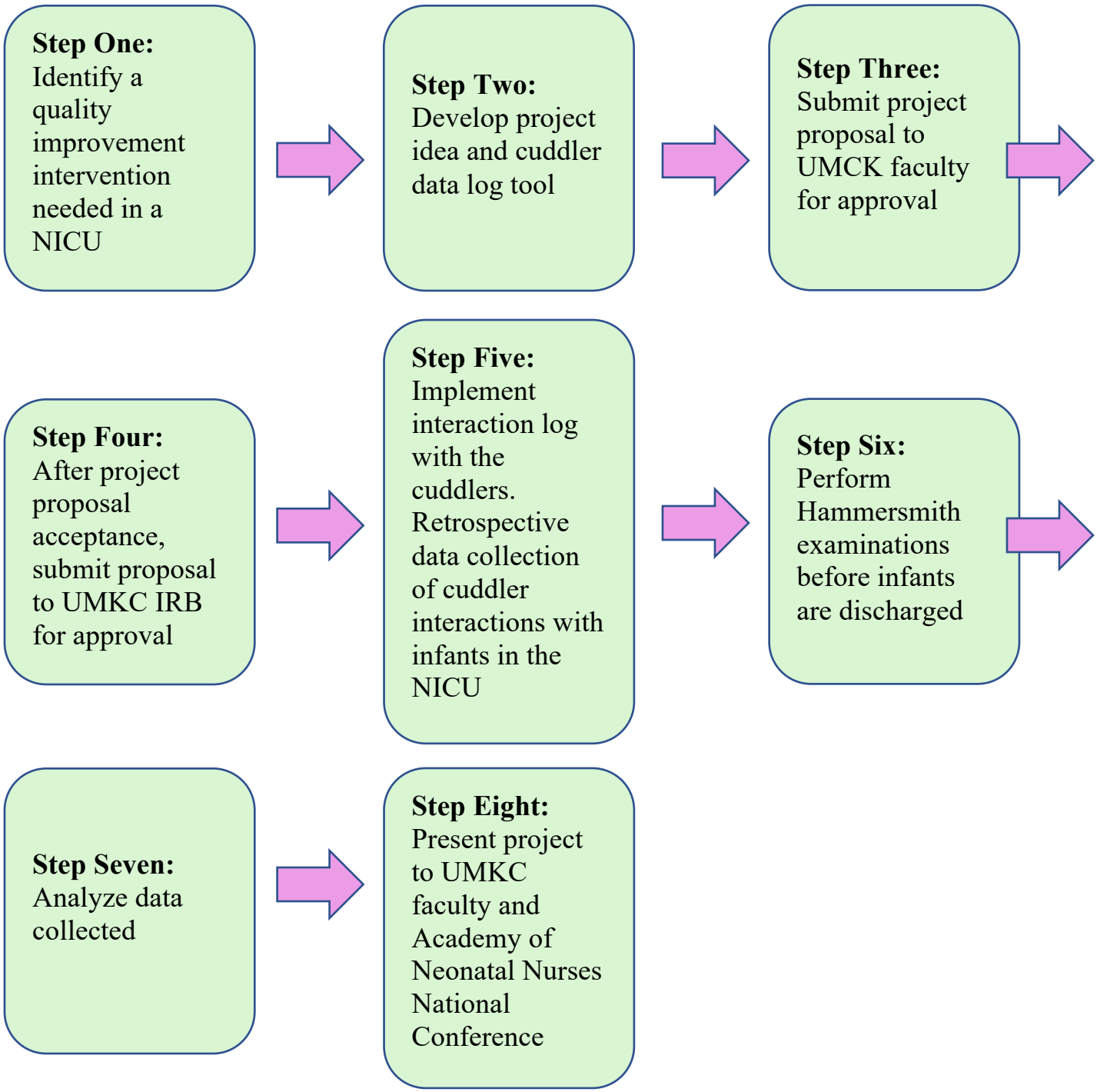
Rev. 7/09, 1/2015 http://www.uwex.edu/ces/lmcourse/interface/coop_M1_Overview.htm Logic-Model Worksheet content revisions by Lyla Lindholm for DNP Project. Not to be placed on web for public use. For UMKC DNP coursework only.

Appendix I

Project Timeline

Appendix J

Intervention Flow Diagram



Appendix K

Cuddler Data Collection, Interaction Log

	Room Number	Length of Interaction	Holding	Reading	Singing	Talking	Tummy Time	Containment	Playing with Toys
1									
2									
3									

Appendix L

Logical Flow of Outcomes Data

	State	Measurement Instrument Name	Tool validity and reliability	Permission Need	Statistical Analysis
Primary Outcome	Improved neonatal neurodevelopmental outcomes	Hammersmith Neurological Examination Tool, length of stay, differences between admission and discharge length, weight, and head circumference	Yes, in the literature	Yes, consent from parents to complete exam prior to discharge (not standard of care in NICU). Other items are standard of care and documented in EHR	Descriptive statistics, One-way ANOVA
Demographics	Gender, gestational age	Not applicable	Not applicable	Not applicable	Descriptive statistics
Participant Completion of the Measurement Tool (Procedure): Prior to implementation of the cuddler data collection tool, the volunteer cuddlers were educated on the use of the form, where to turn the form in, and who to ask to replenish the forms if they run out. A chart review will be conducted to determine length of stay, admission and discharge length, weight, and head circumference. Project leader will complete the Hammersmith Neurological Exam prior to discharge on infants to measure neurodevelopmental outcomes.					

Appendix M

Data Collection Table

ID #	Gestational Age at birth	Gender	Birthweight (g)	Weight at d/c (g)	OFC at birth (cm)	OFC at d/c (cm)	Length at birth (cm)	Length at d/c (cm)	Length of stay	Corrected Gestational Age	Hammersmith Neurological Examination Score

Appendix N

SPSS Variable

Untitled2 [DataSet2] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	Group	Numeric	8	2		{1.00, Contr...	None	8	Right	Nominal	Input
2	Gender	Numeric	8	0	Gender	{1, Male}...	None	8	Right	Nominal	Input
3	GA	Numeric	8	2	Gestational Age	None	None	8	Right	Scale	Input
4	OFC	Numeric	8	2	Change in OFC...	None	None	8	Right	Scale	Input
5	Weight	Numeric	8	2	Change in Wei...	None	None	8	Right	Scale	Input
6	Length	Numeric	8	2	Change in Leng...	None	None	8	Right	Scale	Input
7	LOS	Numeric	8	2	Length of Stay i...	None	None	8	Right	Scale	Input
8	HINE	Numeric	8	2	Hammersmith I...	None	None	8	Right	Scale	Input
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											

Data View Variable View

IBM SPSS Statistics Processor is ready Unicode:ON

Appendix O

SPSS Statistical Analysis Results

Table 1

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Gestational Age	Comparison	50	28.7980	2.10698	.29797
	Intervention	24	28.3583	2.44521	.49913

Table 2

Group * Gender Crosstabulation

			Gender		
			Male	Female	Total
Group	Comparison	Count	32	18	50
		% within Group	64.0%	36.0%	100.0%
		% within Gender	66.7%	69.2%	67.6%
	Intervention	Count	16	8	24
		% within Group	66.7%	33.3%	100.0%
		% within Gender	33.3%	30.8%	32.4%
Total		Count	48	26	74
		% within Group	64.9%	35.1%	100.0%
		% within Gender	100.0%	100.0%	100.0%

Table 3

Descriptive Statistics

	N	Minimum	Maximum	Mean
Group	74	1.00	2.00	1.3243
Gender	74	1	2	1.35
Gestational Age	74	22.50	32.00	28.6554
Change in OFC in cm	74	1.50	24.30	8.3757
Change in Weight in grams	74	360.00	9205.00	2141.6622
Change in Length in cm	74	2.40	37.80	11.8973
Length of Stay in days	74	20.00	377.00	89.2703
Hammersmith Infant Neurological Examination	74	44.00	77.00	64.9324
Valid N (listwise)	74			

Table 4

Statistics

		Group	Gender	Gestational Age	Change in OFC in cm	Change in Weight in grams	Change in Length in cm	Length of Stay in days	Hammersmith Infant Neurological Examination
N	Valid	74	74	74	74	74	74	74	74
	Missing	0	0	0	0	0	0	0	0
Mean		1.3243	1.35	28.6554	8.3757	2141.6622	11.8973	89.2703	64.9324

Median	1.0000	1.00	29.0000	7.5500	2000.0000	11.1000	81.0000	66.5000
Mode	1.00	1	31.00	12.80	1245.00[a]	13.00	58.00[a]	69.00
Range	1.00	1	10.50	22.80	8845.00	35.40	357.00	33.00

Multiple modes exist. The smallest value is shown

Table 5

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Change in OFC in cm	Comparison	50	8.2640	4.86284	.68771	6.8820	9.6460	1.50	24.30
	Intervention	24	8.6083	3.22705	.65872	7.2457	9.9710	2.40	13.70
	Total	74	8.3757	4.37952	.50911	7.3610	9.3903	1.50	24.30
Change in Weight in grams	Comparison	50	2077.1000	1539.62363	217.73566	1639.5438	2514.6562	360.00	9205.00
	Intervention	24	2276.1667	795.96186	162.47503	1940.0615	2612.2719	950.00	3745.00
	Total	74	2141.6622	1341.46712	155.94239	1830.8694	2452.4549	360.00	9205.00
Change in Length in cm	Comparison	50	12.0760	7.59472	1.07406	9.9176	14.2344	2.40	37.80
	Intervention	24	11.5250	4.35353	.88866	9.6867	13.3633	4.80	19.90
	Total	74	11.8973	6.68996	.77769	10.3474	13.4472	2.40	37.80
Length of Stay in days	Comparison	50	90.1200	64.73010	9.15422	71.7239	108.5161	20.00	377.00
	Intervention	24	87.5000	29.46332	6.01417	75.0587	99.9413	49.00	163.00
	Total	74	89.2703	55.56517	6.45932	76.3969	102.1437	20.00	377.00
Hammersmith Infant Neurological Examination	Comparison	50	65.0400	7.05361	.99753	63.0354	67.0446	44.00	77.00
	Intervention	24	64.7083	5.62973	1.14916	62.3311	67.0856	54.00	72.00
	Total	74	64.9324	6.58835	.76588	63.4060	66.4588	44.00	77.00

Table 6

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Change in OFC in cm	Between Groups	1.923	1	1.923	.099	.754
	Within Groups	1398.234	72	19.420		
	Total	1400.156	73			
Change in Weight in grams	Between Groups	642608.721	1	642608.721	.354	.554
	Within Groups	130723375.833	72	1815602.442		
	Total	131365984.554	73			
Change in Length in cm	Between Groups	4.923	1	4.923	.109	.743
	Within Groups	3262.236	72	45.309		
	Total	3267.159	73			
Length of Stay in days	Between Groups	111.315	1	111.315	.036	.851
	Within Groups	225275.280	72	3128.823		
	Total	225386.595	73			
Hammersmith Infant Neurological Examination	Between Groups	1.784	1	1.784	.041	.841
	Within Groups	3166.878	72	43.984		
	Total	3168.662	73			

Table 7

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Change in OFC in cm	Based on Mean	1.953	1	72	.167
	Based on Median	1.470	1	72	.229
	Based on Median and with adjusted df	1.470	1	58.383	.230
	Based on trimmed mean	1.648	1	72	.203
Change in Weight in grams	Based on Mean	1.816	1	72	.182
	Based on Median	1.559	1	72	.216
	Based on Median and with adjusted df	1.559	1	53.729	.217
	Based on trimmed mean	1.564	1	72	.215
Change in Length in cm	Based on Mean	2.977	1	72	.089
	Based on Median	2.523	1	72	.117
	Based on Median and with adjusted df	2.523	1	56.873	.118
	Based on trimmed mean	2.674	1	72	.106
Length of Stay in days	Based on Mean	1.703	1	72	.196
	Based on Median	1.266	1	72	.264
	Based on Median and with adjusted df	1.266	1	53.013	.266
	Based on trimmed mean	1.365	1	72	.246
Hammersmith Infant Neurological Examination	Based on Mean	.907	1	72	.344
	Based on Median	.578	1	72	.449
	Based on Median and with adjusted df	.578	1	64.623	.450
	Based on trimmed mean	.802	1	72	.374

Appendix P

Faculty Approval of Project Proposal

July 20, 2020

UMKC DNP Student, Brieann Lloyd

Congratulations. The UMKC Doctor of Nursing Practice (DNP) faculty has approved your DNP project proposal, *Evaluation of a Neonatal Intensive Care Unit Volunteer Cuddler Program on Neonatal Neurodevelopmental Outcomes*.

You may proceed with IRB application with faculty approval.

Sincerely,

Lyla Lindholm, DNP, RN, ACNS-BC
Clinical Assistant Professor, DNP Faculty MSN-DNP Program Coordinator
UMKC School of Nursing and Health Studies lindholml@umkc.edu

Cheri Barber, DNP, RN, PPCNP-BC, FAANP Clinical Assistant Professor
DNP Program Director
UMKC School of Nursing and Health Studies barberch@umkc.edu

DNP Faculty Mentors Lyla Lindholm, DNP and Dr. Reavey, PhD UMKC School of Nursing and Health Studies

UNIVERSITY OF MISSOURI-KANSAS CITY

2464 Charlotte • Kansas City, MO 64108-2718 • p 816 235-1700 • f 816 235-1701

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