

Application of the Adverse Childhood Experiences Framework to the NICU

Kathryn J. Malin, PhD, RN, NNP-BC, APNP; Dorothy Vittner, PhD, RN, FAAN;
Umber Darilek, PhD, RN, IBCLC; Kelly McGlothen-Bell, PhD, RN, IBCLC;
Allison Crawford, PhD, RN; Rebecca Koerner, PhD, APRN, CPNP-PC;
Britt Frisk Pados, PhD, RN, NNP-BC, CLC, FAHA, FNAP; Diana Cartagena, PhD, APRN, CPNP-PC;
Jacqueline M. McGrath, PhD, RN, FNAP, FAAN; Ashlee J. Vance, PhD, MA, RN, RNC-NIC

ABSTRACT

Background: Infants and families requiring neonatal intensive care unit (NICU) care often experience significant stress and trauma during the earliest period of the infant's life, leading to increased risks for poorer infant and family outcomes. There is a need for frameworks to guide clinical care and research that account for the complex interactions of generational stress, pain, toxic stress, parental separation, and lifelong health and developmental outcomes for infants and families.

Purpose: Apply the Adverse Childhood Experiences (ACEs) framework in the context of the NICU as a usable structure to guide clinical practice and research focused on infant neurodevelopment outcomes and parental attachment.

Methods: An overview of ACEs is provided along with a detailed discussion of risk at each level of the ACEs pyramid in the context of the NICU. Supportive and protective factors to help mitigate the risk of the ACEs in the NICU are detailed.

Results: NICU hospitalization may be considered the first ACE, or potentially an additional ACE, resulting in an increased risk for poorer health outcomes. The promotion of safe, stable, and nurturing relationships and implementation of trauma-informed care and individualized developmental care potentially counter the negative impacts of stress in the NICU.

Implications for Practice and Research: Nurses can help balance the negative and positive stimulation of the NICU through activities such as facilitated tucking, skin-to-skin care, mother's milk, and active participation of parents in infant care. Future research can consider using the ACEs framework to explain cumulative risk for adverse health and well-being in the context of NICU care.

Key Words: ACEs, adverse childhood experiences, NICU, infant stress, trauma-informed care, parental attachment, parents, neurodevelopmental outcomes, toxic stress

Author Affiliations: College of Nursing, Marquette University, Milwaukee, Wisconsin (Dr Malin); Children's Wisconsin, Milwaukee (Dr Malin); Egan School of Nursing & Health Studies, Fairfield University, Fairfield, Connecticut (Dr Vittner); Department of Pediatrics (Dr Darilek) and School of Nursing (Drs McGlothen-Bell, Crawford, and McGrath), The University of Texas Health Science Center at San Antonio; University of Florida, Gainesville (Dr Koerner); Infant Feeding Care, Wellesley, Massachusetts (Dr Pados); School of Nursing, Old Dominion University, Norfolk, Virginia (Dr Cartagena); and Center for Health Policy and Health Services Research, Henry Ford Health, Detroit, Michigan (Dr Vance).

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Dorothy Vittner: <https://orcid.org/0000-0003-2417-741X>

Umber Darilek: <https://orcid.org/0000-0002-3446-2890>

Kelly McGlothen-Bell: <https://orcid.org/0000-0002-3331-6146>

Allison Crawford: <https://orcid.org/0000-0003-0296-675X>

Rebecca Koerner: <https://orcid.org/0000-0002-0482-4774>

Britt Frisk Pados: <https://orcid.org/0000-0002-8016-2370>

Diana Cartagena: <https://orcid.org/0000-0001-9294-3505>

Jacqueline M. McGrath: <https://orcid.org/0000-0002-1731-7181>

Ashlee J. Vance: <https://orcid.org/0000-0003-0284-3995>

Correspondence: Kathryn J. Malin, PhD, RN, NNP-BC, APNP, College of Nursing, Marquette University, Clark Hall 357, Milwaukee, WI 53233 (kathryn.malin@marquette.edu).

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The early months and years of life are vital to establishing a favorable developmental foundation for optimal health outcomes.¹ A healthy birth, positive early life experiences, and secure attachments to parents or caregivers are critical components in establishing a secure foundation. Infants and families requiring care in the neonatal intensive care unit (NICU) often experience significant stress and trauma during the early days and months of the infant's life, despite the advancements in NICU care.² It is now widely accepted that NICU hospitalization is associated with an increased risk for infant stress and poor parental mental health.^{3,4} As evidence continues to emerge supporting the short- and long-term associations between NICU hospitalization and risks for poorer infant and family outcomes, previous frameworks of stress and early life trauma are inadequate or underused. There is a need to fully explicate the complex interactions of generational stress, pain, toxic stress, parental separation, and lifelong health and development for premature and critically ill infants and their families requiring hospital care.

The original *Adverse Childhood Experiences (ACE) Study*, published more than 30 years ago, provided a groundbreaking explanation of the associations between ACEs and risk for poor health, risk

behaviors, and disease during adulthood.⁵ These adverse experiences are stressful life events that involve someone personally experiencing or witnessing physical, sexual, or verbal violence; parental incarceration; death; substance use; or divorce.^{6,7} Since this seminal research was published, the associations between stressful life events with later adverse health outcomes, ranging from cardiovascular and respiratory disease to poorer quality of life and risky health behaviors, have been described.⁸ The ACEs framework provides an ideal model to clarify and sharpen our understanding of the relationships between the stress and trauma exposure in the NICU and risks for future adverse health outcomes. Building on earlier work that identified infant medical trauma as a unique stress experience impacting infant resilience,⁹ we apply the ACEs framework in the context of the NICU to provide a usable structure to guide clinical practice and research focused on infant neurodevelopment outcomes and parental attachment.

ADVERSE CHILDHOOD EVENTS

ACEs include a constellation of events during an individual's early life and upbringing that can be a precursor to health disparities and may limit overall development.¹⁰ Approximately half (46%) of school-age children and adolescents younger than 18 years have suffered at least one ACE.⁶ According to the Centers for Disease Control and Prevention (CDC), 61% of people have experienced at least 1 ACE and 16% at least 4 ACEs by the time they reach adulthood. ACEs can also be present in those who experience neighborhood violence, refugee adversity, and terroristic threats.⁶ The frequency of ACEs is more prevalent in underserved populations, including racially and ethnically marginalized groups, women, those who have parents who are incarcerated, and people who are unhoused.^{7,11} ACEs trigger a physiological stress response, which in the absence of a safe and secure environment or other protective factors disrupts healthy neurodevelopment.⁷ Table 1 displays the different types of ACEs.

APPLYING THE ACE FRAMEWORK TO THE NICU

In the NICU, many infants and families requiring care will experience both physiological and

psychosocial stress and trauma,¹² resulting in what could be considered the first ACE, or potentially an additional ACE, given the maternal perinatal environment.^{13,14} While in the NICU, infants experience a multitude of stressors that may accumulate and overwhelm their ability to maintain physiological stability. Common stressful stimuli include high levels of noise, excessive light exposure, painful procedures, frequent assessments, social isolation, and separation from parents.¹⁵ These repeated and aberrant stressful experiences during the critical time of neuronal plasticity and brain growth then biologically embed the stress responses of the hypothalamus–pituitary–adrenal axis, altering long-term neurodevelopment.¹⁶ The risk for social, emotional, and cognitive impairment is higher for infants requiring NICU hospitalization than do other infants and is associated with poorer cognitive, motor, emotional, and behavioral development later in life.¹⁷ Furthermore, emerging evidence suggests that individuals born prematurely are at an increased risk for chronic health disorders and mortality in early and mid-adulthood.¹⁸ Although an NICU hospitalization may be unavoidable, and thus there is no way to prevent this ACE exposure, acknowledgment of this exposure can help families and providers to mitigate the long-term effects.

For many infants, the experiences in the NICU go beyond the risk associated with prematurity and illness, setting them up for future adverse health outcomes. Some infants in the NICU are born into families with deep generational trauma and adversity. Researchers recently found that women who report 6 or more ACEs are 9 times more likely to have an infant requiring NICU hospitalization.¹³ Furthermore, structural racism experienced both in and out of the NICU is associated with ACEs and poor health outcomes.^{13,14} For example, emerging literature suggests that quality of NICU care for Black infants and other infants is lacking and contributes to greater disparities in health outcomes for infants born preterm.¹⁹

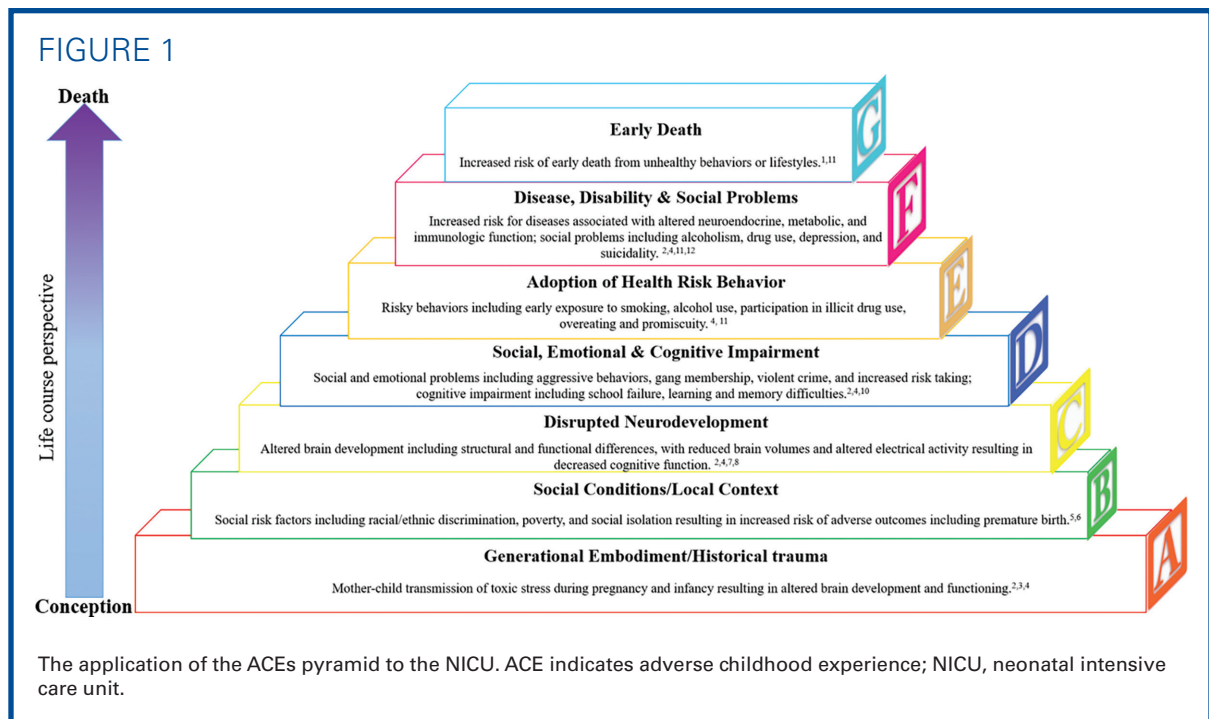
Although survival rates of extremely premature infants are steadily improving, the incidence of later developmental disabilities for these infants remains high.^{20,21} It has been optimistically yet incorrectly proposed that healthy preterm infants without major complications will eventually catch up developmentally to full-term infants.²² Developing and supporting protective factors to buffer stress and medical trauma must be a priority in all NICUs.

The ACEs Pyramid

Given the evolving evidence, the ACEs pyramid was developed by the CDC to provide a guiding framework for understanding the development of risk factors for disease and health across the life span.⁸ The pyramid also demonstrates the cumulative progression of risk for ACEs, exposure to ACEs, disrupted

TABLE 1. Types of Adverse Childhood Experiences

Abuse	Neglect	Household Dysfunction
Physical	Physical	Mental illness
Emotional	Emotional	Domestic violence
Sexual		Divorce
		Incarcerated parent
		Substance use



neurodevelopment, social, and emotional impairment, and risk for disease and early death.⁸ Application of the ACEs pyramid can help paint a picture of health and social consequences for our most vulnerable infants. In each of the following sections, we use this framework to explain how the NICU journey is often traumatic for infants and families (see Figure 1).

Generational Embodiment/Historical Trauma
Research has shed light on the complex mechanisms by which ACEs negatively influence health throughout the life span.⁸ Evidence suggests there is mother-fetal transmission of toxic stress that occurs during pregnancy, supporting a biological embedding of life experiences.^{2,3} In addition, exposure to maternal stress during infancy has been shown to contribute to epigenetic changes altering brain development and function leading to learning, memory, and behavior deficits later in life.^{23,24} This trauma often has lifelong effects.

Social Conditions/Local Context
Historically marginalized groups often experience intergenerational adversity due to racial/ethnic discrimination, poverty, and social isolation, predisposing them to health disparities and chronic disease.²⁵ These profound mechanisms of adversity and disadvantage are pervasive and often lead to poor maternal-child outcomes such as high rates of maternal mortality and premature births seen in the Black population.²⁶ For many infants who enter the NICU, this context is an aspect of their trauma.

Disrupted Neurodevelopment

Multiple studies demonstrate structural and functional differences in brain development associated with environmental stressors, including premature birth, low socioeconomic status, and caregiving neglect.^{23,24,27} For example, exposure to poverty and profound psychosocial deprivation has been associated with reduced brain volume and synaptic activity.^{23,27} Researchers interested in the long-term effects of maternal-childhood maltreatment studied brain development in the newborns of mothers exposed to maltreatment using magnetic resonance images.²⁸ Findings suggest an intergenerational effect on brain structure, with lower intracranial volume primarily due to gray matter differences in infants of mothers exposed to maltreatment in childhood compared with infants without maternal exposure to maltreatment.²⁸ Differences in brain structure are associated with decreases in cognitive function, primarily executive functioning.^{23,24} While NICU caregivers often assess for neurodevelopmental symptoms that are consequences of prematurity or insults in the NICU, influences from previous experiences may be less obvious.

Social, Emotional, and Cognitive Impairment

Childhood exposure to ACEs may result in a variety of social and emotional problems including difficulties in relationships with others, aggressive behavior, and increased risk taking.²³ Adolescents with higher risk-taking behaviors, such as smoking and illicit drug abuse, have an increased likelihood of school failure, gang membership, unemployment, violent

crime, and incarceration.²⁴ As described earlier, early life exposure to toxic stress increases the propensity for neurodevelopmental changes, causing cognitive deficits and resulting in learning, memory problems, and academic difficulties.^{23,24,29} Infants discharged from the NICU have been found to have higher social and emotional problems at later ages that may be linked to their NICU experiences.³⁰

Adoption of Health Risk Behavior

Participation in risky behaviors, including smoking, illicit drug and/or alcohol abuse, overeating, or promiscuity, is reportedly higher in adolescents and adults with a history of childhood trauma.²⁴ Exposure to a higher number of ACEs increases the likelihood of smoking by 14 years of age and drinking as a means of coping with stress at an early age.⁸ These maladaptive coping behaviors become unhealthy lifestyles that persist and, with prolonged use, contribute to many of the chronic diseases seen in adults.^{24,31}

Disease, Disability, and Social Problems

Extensive evidence suggests that experiencing ACEs can cause multiorgan physiological alterations that persist into adulthood and lead to serious physical and emotional disease and disability later in life.²³ These physiological manifestations can include disruptions in neuroendocrine, metabolic, and immunological functions^{23,24} and are known to be associated with cardiovascular disease, cancer, asthma, chronic obstructive pulmonary disease, diabetes, obesity, and depression.³¹ The strong impact of ACEs on adult health is cumulative and correlates with the intensity and number of ACE exposure. For example, a person with prior exposure to 4 or more ACEs has a 4- to 12-fold increased risk for alcoholism, drug use, depression, and suicide attempt compared with those who have experienced none.⁵

Early Death

Adoption of unhealthy lifestyles throughout the life span increases the risk for preventable early deaths seen in adults experiencing chronic illness. It is estimated that up to 40% of early deaths in the United States are related to unhealthy behavior or lifestyles.¹¹ In a seminal study conducted in 2019 by Felitti et al,⁵ the top 10 most common leading causes of death in the United States were associated with the number of ACEs, with those experiencing greater than 4 ACEs having a greater disease risk (dose-response relationship).

It is important to note that ACEs are frequently screened retrospectively by patient recall and self-report within adult populations or directly within pediatric populations by conducting medical record reviews, agency cross-reporting, or from child or guardian self-report.⁶ Historically, society at large

has not acknowledged the damaging effects that ACEs can have on one's life and overall health, but awareness is increasing.⁸ The societal costs associated with ACEs are alarming, costing society billions of dollars annually in its endeavors to combat the health disparities that arise.⁸ Approximately 1.9 million heart disease and 21 million depression-related events might have been avoided if not for the predisposition of ACEs in people's lives.⁸ Moreover, a small reduction (10%) in addressing ACE exposure would equate to approximately \$56 billion in health-related expenses saved within the United States per year.⁸

SUPPORTIVE AND PROTECTIVE FACTORS IN THE NICU

It is important to remember that even if the NICU event is classified as an ACE, there are protective factors that can mitigate the risk and harmful effects of the NICU. These protective factors can decrease stress, buffer infants from medical trauma, and increase resilience in both parents and infants. Recently, clinicians who recognize the profound impact of medical trauma have begun incorporating trauma-informed care (TIC) into their clinical practice and interactions with patients and families across healthcare settings, with growing attention in the NICU. TIC was first defined by the Substance Abuse and Mental Health Services Administration.³² The underpinning of TIC helps clinicians realize the substantial impact trauma has on individuals and provides strategies, creating a pathway to recovery. In this approach to healthcare and interactions with patients, clinicians are taught to recognize the signs and symptoms of trauma, regardless of the healthcare setting. For TIC to be most effective in the NICU, language supporting TIC must be integrated into the policies and procedures of the unit. NICU staff must also be educated about how to avoid retraumatization of both the infant and parents.³³ Since an NICU admission is often necessary, with no other alternative, it is essential that NICU staff be trained to provide TIC as a protective measure against the known risks of ACE exposure. Protective strategies, such as protecting infant sleep, implementing family-centered care, supporting healing environments, and fostering staff resilience are known to foster a trauma-informed NICU.² Table 2 displays the 6 key principles of TIC and examples of their application to the NICU setting.

There is growing evidence the premature infant's developing brain is influenced by the physical and social environment, especially during the vulnerable window of time when the infant is cared for in the NICU.³⁴ Evidence suggests that infant perception of stress, based upon genetic susceptibility, influences short-term neurodevelopmental outcomes.³⁵

TABLE 2 Principles of TIC and Application to the NICU^a

Principles of TIC		Application to the NICU
1.	Create a unit culture where parents and infants are safe.	Parents' needs and experiences are validated. Infants and parents are provided space to develop a safe and secure attachment to each other.
2.	Develop relationships where communication is trustworthy and transparent.	Parents concerns are addressed. Technologies (such as cameras and access to healthcare records) are applied to aid in transparency about the care of the infant. Parents are encouraged to participate in rounds and be present at the time of shift change. Nurses and other NICU staff are encouraged to understand their own attitudes and feelings about families and obtain assistance as needed so that families are treated equitably.
3.	Create opportunities for peer support.	NICU peer support groups are available to every parent from prior to known NICU admission to after discharge from the NICU.
4.	Parents are partners in the care of their infant.	Parents are treated as partners with the healthcare team. Parents are encouraged to develop in their new role as a parent through asking question, leading and participating in the care of their infant, and advocating during interactions with nurses and other NICU staff.
5.	Parents are empowered to use their voice and choose their role in their infant's care.	Application of a zero-separation and family-centered approach to care. A model of shared decision-making is implemented.
6.	Clinicians are sensitive to cultural, historical, and gender issues and biases so as to help avoid the pitfalls of implicit bias.	Nurses and other NICU staff are educated and demonstrate culturally effective care. Consistent auditing of measures for disparities in the NICU care is implemented.

Abbreviations: NICU, neonatal intensive care unit; TIC, trauma-informed care.
^aFrom Sanders and Hall² and Leitch.³³

Zero-separation between the infant–parent dyad is imperative as infants need parental contact for optimal physiological and emotional development and parents need meaningful relationships with their infants to establish their identities as parents.^{36,37} While zero-separation may seem impossible to support, given admission to the NICU, parents and infants benefit from the parent's awareness and responsiveness to the infant's behavioral capabilities and temperament. The parent's ability to interpret the infant's behavioral cues has been shown to strengthen parent–infant interactions during the first year of life.³⁶ Parental nurturing behaviors have been shown to correlate with decreased allostatic load in their children.³⁸ Specifically, when parents display emotionally attuned and nurturing attachment behaviors, their children are less likely to experience physiological alterations in response to too much stress (eg, blood pressure stability and cortisol levels).³⁸ Health professionals need to provide increased opportunities for parents to be truly emotionally attuned and nurturing with their infant. These activities need to be not only encouraged but also positively reinforced. Whenever possible, zero-separation should be the guiding principle underlying all care in the NICU.

Another crucial pathway to mitigating ACEs is integrating evidence-based practices that foster early relational health in the NICU. Relational health focuses on early relationships and experiences to foster healthy growth and development. Early parent–infant contact is the cornerstone of an infant's health and well-being; however, these early

relationships are difficult to establish in the NICU because of parent–infant separation and infant illness. The formation of the parent–infant attachment may also be hampered by the decreased synchrony or responsiveness during parent–infant interactions. Furthermore, the contribution of the subtle behavioral cues among premature infants can often be difficult to interpret.³⁶ Early dysfunctional interactions secondary to the infant's disorganized behavioral patterns during infant and parent interactions can also lead to poorer attachment and increased probability for behavioral problems in childhood.³⁹ Conversely, early responsive and synchronous contacts may positively influence cognitive and developmental outcomes for the child.³⁹ In 2021, the American Academy of Pediatrics (AAP) released a policy statement endorsing a solution-focused stance on fostering safe, stable, and nurturing relationships, shifting the paradigm away from a problem-focused discussion of toxic stress. Encouraging safe, stable, and nurturing relationships buffers children from ongoing adversity while giving the children the foundational experiences for building resilience that will protect them from adversity throughout the life span.⁴⁰ The AAP asserts that relational health needs to be integrated into all pediatric care environments and that screening for ACEs within the primary care setting is a priority. Safe, stable, and nurturing relationships are biologically crucial to protect children from the effects of toxic stress in a healthy developmental manner.⁴⁰ This shift also aligns with TIC care language in the recognizing of trauma and building empathy across patients, families, and providers.

Relational health interventions in the NICU have also been shown to improve brain architecture in hospitalized premature infants.⁴¹ Parents are the infant's ideal nurturer and co-regulator, enhancing the infant's competence and ability to build trust within the relationship.⁴² Therefore, early relational health support must be a cornerstone of all NICU environments. While many NICUs advertise family-centered care, there is significant variability among units in the delivery of this care. Specific evidence-based relational health practices should be incorporated into the standard of care in every NICU unit. One such practice is kangaroo care or skin-to-skin contact. This simple yet highly effective intervention promotes well-being for both parents and their infant. It is easily adoptable, safe, and feasible for all infants regardless of gestational age. Nurses are uniquely positioned to champion this practice and set the standard of care in their unit, where every infant experiences skin-to-skin contact consistently over the duration of their hospitalization.⁴³ Several evidence-based relational health interventions exist in the NICU, and each unit should evaluate the appropriateness of interventions for their context when choosing which to implement.⁴⁴ For example, family-integrated care goes beyond supporting family presence and insists that the parent be supported as the primary caregiver for the infant. Nurses become the parents' coaches and champions in caring for their infant, while only performing those tasks that require a licensed caregiver. Family-integrated care encourages consistent parent presence, interaction, and champions the parenting role while empowering the parents as primary members of the care team.⁴⁵

Finally, addressing parental mental health in the NICU is imperative. By addressing parental mental health and well-being, clinicians can help parents establish the safe, stable, and nurturing relationships their infant needs. Rates of postpartum depression among NICU parents are triple to quadruple that of the general postpartum population.⁴⁶ Parents experiencing acute anxiety and depression require intervention to be fully available to their infant. A parent cannot be the safe and stable presence the infant needs if the parent feels neither safe nor stable. Furthermore, when a parent with unaddressed mental health issues has an infant discharged from the NICU, they lose the safety net of NICU monitors and experienced medical professionals that had ensured the safety of their child. This stress may be untenable and leave the parent unable to function as the primary caretaker of the child.^{36,46} Finding resources in the community, such as counseling and peer support, can be crucial as families leave the protective environment of the NICU. Figure 2 displays the possible environments and outcomes during NICU hospitalization.

WHAT CAN WE DO?

Call for Application to Practice and Research

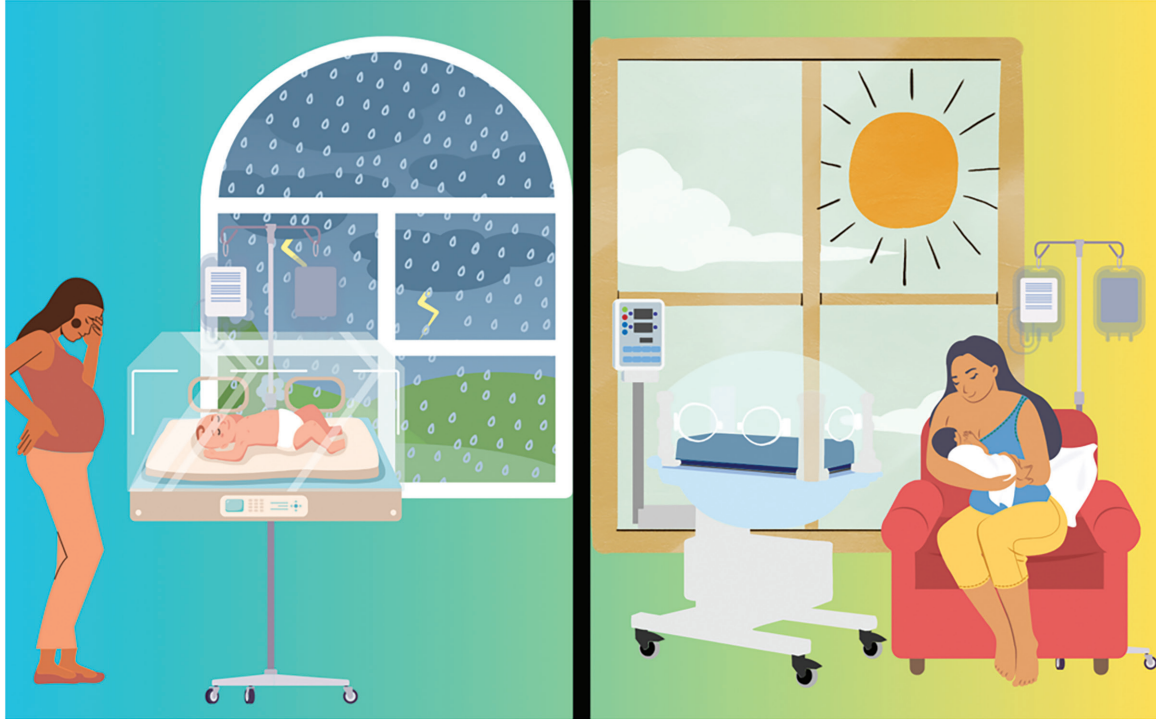
Some aspects of neonatal care are stressful and painful for the neonate, and many of these things cannot be reduced or completely eliminated. The neonatal nurse plays a critical role in advocating for the infant to reduce stress and discomfort whenever possible and to balance negative experiences with positive experiences. Balancing negative and positive stimulation has the potential to decrease the overall long-lasting effects of the painful experience on neurodevelopment.⁴⁷ Neurons proliferate when they are stimulated ("used"), and neuronal pruning (neuronal death) occurs when neurons are *not* consistently stimulated over time. For example, when there are consistent painful experiences, neuronal connections get stronger and more long-lasting over time. This is often noted with high numbers of heel sticks and the increased sensitivity in early childhood to grass or as evidenced by "toe walking." Toe walking has also been linked to tight heel cords, which have been noted to originate from postural/positioning influences in the NICU. While direct linkages do not exist between number of heel sticks and these events, there are increased associations for neuronal changes to be foundational for how these sensitivities occur. These early childhood experiences may impact an individual's ability to self-regulate and cope and may impact the overall development for the child.⁴⁸

Some actions performed in the NICU are not always thought as painful or stressful but have the potential to be when not provided with support and thoughtful care. Given what we know about neuronal development, we must acknowledge the potential for pain and stress that coincide with routine nursing interventions and actions. Healthcare professionals need to use an individualized approach to consider the question, "Is this intervention necessary for provision of optimal care for this infant? How can I support parental engagement in this intervention?" If the intervention is necessary, then we must ask, "What can be done to support this infant in a way that will reduce the level of discomfort or trauma that the infant experiences?" For example, when painful or stressful procedures are performed (eg, skin-breaking procedures), there is evidence that skin-to-skin holding,⁴³ non-nutritive sucking, especially with glucose or mother's milk,⁴⁹ and exposure to the odor of mother's milk⁵⁰ reduce pain and stress. Encouraging positive experiences while in the NICU can play an important role supporting the infant's emotional development to build trust. Early, prolonged, and frequent skin-to-skin care has been shown to have profound benefits to both the infant and the parent.⁴³ Positive auditory experiences, such as hearing the parents read⁵¹ or sing,⁵² have also been found to be beneficial to the infant and parents,

FIGURE 2

Adverse NICU Experience

Protective NICU Experience



- Toxic Stress in the NICU**
- ACEs
 - Overstimulation

- Parent-Infant Separation**
- Isolation
 - Illness

- Societal Stressors**
- Lack of support
 - Financial Concerns

- Trauma Informed Care**
- Trust with Providers
 - Transparent Communication

- Safe, Stable, Nurturing Relationships**
- Secure attachment
 - Parent Presence

- Parent Mental Health**
- Screening
 - Emotional Support

The possible environments and outcomes during NICU hospitalization. ACE indicates adverse childhood experience; NICU, neonatal intensive care unit.

both in the short and long terms. Infant development is positively influenced as parental confidence and competence are increased.⁵³ When skin-to-skin holding is not an option, facilitated tucking has also been shown to reduce stress and pain.⁵⁴ Even more important, when painful procedures, including endotracheal intubation or chest tube placement, are performed, advocating for pain management medications is essential and cannot be replaced with only nonpharmacological interventions.⁵⁵

Oral feeding is another action that should be a positive experience for both the infant and parents. While placing the infant directly at the chest for oral feedings is best, infants in the NICU often receive some feedings by bottle. When bottle-feeding, the flow rate of the bottle and the position of the infant need to be considered, and caregivers need to support the infant to safely coordinate their sucking, swallowing, and breathing to create positive feeding experiences. Whether when chestfeeding or bottle-feeding, the person providing the feeding must also closely monitor the infant's cues and respond

appropriately to ensure that feeding is a safe and positive experience.⁵⁶ The infant's parents are the ideal and optimal co-regulator to enhance neurobiological function, especially during oral feedings experiences. Parents need to be supported in this role so that it is a pleasurable experience for both the infant and parents. This support has the potential to increase the confidence and competence for the parents as well as decrease their trauma and stress related to the NICU admission of their infant.

In addition, considering parental stress during the NICU experience is vital. Parents of preterm and sick infants are more likely to experience mood swings and depression than parents of well full-term infants.³ Parents come to the new relationship with their infant processing beliefs related to their own earlier histories, which may include loss, current, and/or past trauma. Inadequate resources, addiction, teen parenthood, mental illness, recent displacement or migration, homelessness, or other social or psychological factors have the potential to complicate formation of a healthy nurturing relationship.

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TABLE 3. Recommendations to Help Mitigate Damaging Effects of ACEs at Each Level of the ACEs Framework

Level of ACEs	Recommendations to Help Mitigate Damaging Effects
Generational embodiment/historical trauma	Early and adequate prenatal care, trauma-focused counseling, culturally focused social support groups
Social conditions/local context in the NICU	Skin-to-skin holding, non-nutritive sucking with glucose or mother's milk during painful procedures, facilitated tucking, parental support during and after NICU hospitalization
Disrupted neurodevelopment	Pain management medications for painful procedures, developmentally focused care, promotion of human milk, implementations of bundles to decrease risk for sepsis
Social, emotional, and cognitive impairment	Early childhood interventions (such as developmental care follow-up and birth-to-three services), early interactive language exposure
Adoption of health risk behavior	Smoking cessations, family support services, early and adequate screening and treatments of mental illness (eg, depression and anxiety)
Disease, disability, and social problems	Continual screening for the history of NICU hospitalization/prematurity throughout life span

Abbreviations: ACE, adverse childhood experience; NICU, neonatal intensive care unit.

Possible interventions to consider in supporting parents include assisting parents in their interpretation of their infant's cues, encouraging parental skill development, and promoting mutual enjoyment and delight that foster attachment. Parent engagement is essential in the NICU; this dynamic process focuses on the acquisition of skills the parents need to actively participate in infant care activities.⁵⁷ Mindfulness interventions are also beginning to be explored as possible strategies to support parents. In addition, respect, positive reinforcement, and motivational interviewing can be strategies facilitating parental adoption of their role.

Particular attention needs to also be given to the overall culture of the NICU environment. Policies that are in place to support an inclusive NICU environment for all families, including the provision of equitable care for infants, are necessary. Hospitals and units need to put in place consistent auditing of measures for disparities in their NICU care quality as well as ensuring that their policies and procedures promote the family as essential caregivers. Clinical practice changes must also extend beyond the NICU. Healthcare providers in primary and acute care settings need to assess for the history of NICU hospitalization and consider this as a possible additive risk factor for social, emotion, and cognitive impairments as well as a risk for physiological morbidity and mortality. Identification of family strengths and promotion of secure attachment between parents and infants need to be prioritized in all healthcare settings. Table 3 displays recommendations that may mitigate the damaging effects of ACEs at each level of the ACEs framework.

Measurements of stress need to be expanded beyond just assessment of responses to painful procedures and consider the cumulative effect of

experiences in the NICU. Future research might consider using the ACEs framework to explain cumulative risk for adverse health and well-being in the context of NICU care. This research should also consider the community environment and the interconnectedness of the "adverse community environments" and "adverse child experiences" (the pair of ACEs).⁵⁸ In order to truly mitigate early toxic stress, the community settings in which families go home to everyday must also foster healthy childhood experiences. Research and clinical practice must focus on building strong and healthy environments connecting the NICU environment with other health systems, community groups, and family resources.⁵⁸ Furthermore, consideration of the stress associated with the social conditions and historical trauma of the family must also be included when assessing risk for adverse health outcomes. More longitudinal research is needed, measuring health and developmental outcomes of infants requiring NICU care beyond childhood and include more measures of cardiovascular health, parent–infant attachment, growth, and biological mechanisms of action. Finally, there is a need for additional nursing research focusing on promoting safe, stable, and nurturing relationships during an NICU hospitalization and sustaining them after hospital discharge. Inclusion of families and NICU nurses in the development of these interventions is paramount in ensuring successful optimization of the health and development of infants.

CONCLUSION

The ACEs framework provides an organizational outline of the risk for poor health and development secondary to ACEs while accounting for the

Summary of Recommendations for Practice and Research

What we know:	<ul style="list-style-type: none"> • NICU hospitalization is associated with an increased risk for infant and parental stress. • Early positive experiences and secure attachment help establish a healthy foundation for optimal growth and development. • The ACEs framework provides a scaffolding to conceptualize the potential impact of the NICU stress of future health and development.
What needs to be studied:	<ul style="list-style-type: none"> • The cumulative effects of stressful experiences in the NICU, in addition to the built environment, on the long-term health and development of infants. • Expansion of measurement of outcomes secondary to NICU stress, including cardiovascular health, parent–infant attachment, and growth. • Biological mechanisms connecting early stress in the NICU to alterations in long-term health and development.
What can we do today that would guide care-givers in the practice setting considering the use of this evidence for guiding practice:	<ul style="list-style-type: none"> • Support the development of safe, secure, and nurturing relationships between parents and infants. • Encourage positive NICU experiences, such as skin-to-skin care, positive auditory experiences, and facilitated tucking. • Foster early relational health between parents and infants through implementations of policies that support zero-separation between infants and parents and integrate families into the care of their infants. • Implement TIC practices in the NICU. • Support parents in identifying the need for and access to mental health support, both while in the NICU and after discharge to home.

biological embedding of stress from generational trauma as well as social conditions. Considering NICU hospitalization as a critical event within the ACEs framework is logical and considers the stress that many infants experience during this vital time of neurodevelopment. Within this framework, there are multiple points of access to intervene and counter these risks through support of safe, stable, and nurturing relationships as well as implementation of TIC. Healthcare providers must recognize the inter-connections of what happened to a family before entering the NICU, the stress experienced while in the NICU, and the risk for health and developmental impairment after going home from the NICU.

References

1. Belsky J, Jaffee SR. The multiple determinants of parenting. In: Cicchetti D, Cohen DJ, eds. *Developmental Psychopathology: Volume Three: Risk, Disorder, and Adaptation*. 2nd ed. Washington, DC: Wiley; 2015:38-85. doi:10.1002/9780470939406.ch2.
2. Sanders MR, Hall SL. Trauma-informed care in the newborn intensive care unit: promoting safety, security and connectedness. *J Perinatol*. 2018;38(1):3-10. doi:10.1038/jp.2017.124.
3. Deshwali A, Dadhwal V, Vanamail P, et al. Prevalence of mental health problems in mothers of preterm infants admitted to NICU: a cross-sectional study. *Int J Gynaecol Obstet*. 2023;160(3):1012-1019. doi:10.1002/ijgo.14466.
4. Bonacquisti A, Geller PA, Patterson CA. Maternal depression, anxiety, stress, and maternal–infant attachment in the neonatal intensive care unit. *J Reprod Infant Psychol*. 2020;38(3):297-310. doi:10.1080/02646838.2019.1695041.
5. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the Adverse Childhood Experiences (ACE) study [reprint]. *Am J Prev Med*. 2019;56(6):774-786. doi:10.1016/j.amepre.2019.04.001.
6. Carlson JS, Yohannan J, Darr CL, Turley MR, Larez NA, Perfect MM. Prevalence of adverse childhood experiences in school-aged youth: a systematic review (1990-2015). *Int J Sch Educ Psychol*. 2020;8(supp 1):2-23. doi:10.1080/21683603.2018.1548397.
7. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Violence Prevention. Fast facts: preventing adverse childhood experiences. <https://www.cdc.gov/violenceprevention/aces/index.html>. Updated 2022. Accessed April 5, 2023.

8. Petruccelli K, Davis J, Berman T. Adverse childhood experiences and associated health outcomes: a systematic review and meta-analysis. *Child Abuse Negl*. 2019;97:104127. doi:10.1016/j.chiabu.2019.104127.
9. D'Agata A, Young EE, Cong X, Grasso DJ, McGrath JM. Infant medical trauma in the neonatal intensive care unit (IMTN): a proposed concept for science and practice. *Adv Neonatal Care*. 2016;16(4):289-297. doi:10.1097/ANC.0000000000000309.
10. Finkelhor D. Trends in adverse childhood experiences (ACEs) in the United States. *Child Abuse Negl*. 2020;108:104641. doi:10.1016/j.chiabu.2020.104641.
11. Crouch E, Probst JC, Radcliff E, Bennett KJ, McKinney SH. Prevalence of adverse childhood experiences (ACEs) among US children. *Child Abuse Negl*. 2019;92:209-218. doi:10.1016/j.chiabu.2019.04.010.
12. Caporali C, Pisoni C, Gasparini LL, et al. A global perspective on parental stress in the neonatal intensive care unit: a meta-analytic study. *J Perinatol*. 2020;40(12):1739-1752. doi:10.1038/s41372-020-00798-6.
13. Jasthi DL, Lappen JR, Garber S, et al. Associations between adverse childhood experiences and obstetric outcomes in a predominantly Black-identifying and low-income pregnant population. *Am J Obstet Gynecol*. 2023;5(7):101008. doi:10.1016/j.ajogmf.2023.101008.
14. Ciciolla L, Shreffler KM, Tiemeier S. Maternal childhood adversity as a risk for perinatal complications and NICU hospitalization. *J Pediatr Psychol*. 2021;46(7):801-813. doi:10.1093/jpepsy/jsab027.
15. Weber A, Harrison TM. Reducing toxic stress in the NICU to improve infant outcomes. *Nurs Outlook*. 2019;67(2):169-189. doi:10.1016/j.outlook.2018.11.002.
16. Nist MD, Harrison TM, Steward DK. The biological embedding of neonatal stress exposure: a conceptual model describing the mechanisms of stress-induced neurodevelopmental impairment in preterm infants. *Res Nurs Health*. 2019;42(1):61-71. doi:10.1002/nur.21923.
17. van Dokkum NH, de Kroon MLA, Reijneveld SA, Bos AF. Neonatal stress, health, and development in preterms: a systematic review. *Pediatrics*. 2021;148(4):e2021050414. doi:10.1542/peds.2021-050414.
18. Crump C. An overview of adult health outcomes after preterm birth. *Early Hum Dev*. 2020;150:105187. doi:10.1016/j.earlhumdev.2020.105187.
19. Sigurdson K, Mitchell B, Liu J, et al. Racial/ethnic disparities in neonatal intensive care: a systematic review. *Pediatrics*. 2019;144(2):e20183114. doi:10.1542/peds.2018-3114.
20. Loeb DF, Imgrund CM, Lee J, Barlow SM. Language, motor, and cognitive outcomes of toddlers who were born preterm. *Am J Speech Lang Pathol*. 2020;29(2):625-637. doi:10.1044/2019_AJSLP-19-00049.
21. McGowan EC, Hofheimer JA, O'Shea TM, et al. Analysis of neonatal neurobehavior and developmental outcomes among preterm infants. *JAMA Netw Open*. 2022;5(7):e222249. doi:10.1001/jamanetworkopen.2022.22249.
22. O'Reilly H, Johnson S, Ni Y, Wolke D, Marlow N. Neuropsychological outcomes at 19 years of age following extremely preterm birth. *Pediatrics*. 2020;145(2):e20192087. doi:10.1542/peds.2019-2087.
23. Berens AE, Jensen SKG, Nelson CA 3rd. Biological embedding of childhood adversity: from physiological mechanisms to clinical implications. *BMC Med*. 2017;15(1):135. doi:10.1186/s12916-017-0895-4.
24. Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early

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- childhood adversity and toxic stress. *Pediatrics*. 2012;129(1):e232-e246. doi:10.1542/peds.2011-2663.
25. Braveman P, Barclay C. Health disparities beginning in childhood: a life-course perspective. *Pediatrics*. 2009;124(suppl 3):S163-S175. doi:10.1542/peds.2009-1100D.
 26. Manuck TA. Racial and ethnic differences in preterm birth: a complex, multifactorial problem. *Semin Perinatol*. 2017;41(8):511-518. doi:10.1053/j.semperi.2017.08.010.
 27. Noble KG, Farah MJ. Neurocognitive consequences of socioeconomic disparities: the intersection of cognitive neuroscience and public health. *Dev Sci*. 2013;16(5):639-640. doi:10.1111/desc.12076.
 28. Moog NK, Entringer S, Rasmussen JM, et al. Intergenerational effect of maternal exposure to childhood maltreatment on newborn brain anatomy. *Biol Psychiatry*. 2018;83(2):120-127. doi:10.1016/j.biopsych.2017.07.009.
 29. Hair NL, Hanson JL, Wolfe BL, Pollak SD. Association of child poverty, brain development, and academic achievement. *JAMA Pediatr*. 2015;169(9):822-829. doi:10.1001/jamapediatrics.2015.1475.
 30. Chiorean A, Savoy C, Beattie K, el Helou S, Silmi M, Van Lieshout RJ. Childhood and adolescent mental health of NICU graduates: an observational study. *Arch Dis Child*. 2020;105(7):684-689. doi:10.1136/archdischild-2019-318284.
 31. Merrick MT, Ports KA, Ford DC, Afrifi TO, Gershoff ET, Grogan-Kaylor A. Unpacking the impact of adverse childhood experiences on adult mental health. *Child Abuse Negl*. 2017;69:10-19. doi:10.1016/j.chiabu.2017.03.016.
 32. Substance Abuse and Mental Health Services Administration (SAMHSA). *Substance Abuse and Mental Health Services Administration SAMHSAs Concept of Trauma and Guidance for a Trauma-Informed Approach*. Rockville, MD: SAMHSA; 2014. HHS Publ No. (SMA) 14-4884.
 33. Leitch L. Action steps using ACEs and trauma-informed care: a resilience model. *Health Justice*. 2017;5(1):5. doi:10.1186/s40352-017-0050-5.
 34. Romberg J, Wilke M, Allgaier C, et al. MRI-based brain volumes of preterm infants at term: a systematic review and meta-analysis. *Arch Dis Child Fetal Neonatal Ed*. 2022;107(5):520-526. doi:10.1136/archdischild-2021-322846.
 35. D'Agata AL, Walsh S, Vittner D, Cong X, McGrath JM, Young EE. FKBP5 genotype and early life stress exposure predict neurobehavioral outcomes for preterm infants. *Dev Psychobiol*. 2017;59(3):410-418. doi:10.1002/dev.21507.
 36. Roque ATF, Lasiuk GC, Radunz V, Hegadoren K. Scoping review of the mental health of parents of infants in the NICU. *J Obstet Gynecol Neonatal Nurs*. 2017;46(4):578-587. doi:10.1016/j.jogn.2017.02.005.
 37. Cheong JLY, Burnett AC, Treyvaud K, Spittle AJ. Early environment and long-term outcomes of preterm infants. *J Neural Transm (Vienna)*. 2020;127(1):1-8. doi:10.1007/s00702-019-02121-w.
 38. Ortiz R. Building resilience against the sequelae of adverse childhood experiences: rise up, change your life, and reform healthcare. *Am J Lifestyle Med*. 2019;13(5):470-479. doi:10.1177/1559827619839997.
 39. Golds L, Gillespie-Smith K, Nimbley E, MacBeth A. What factors influence dyadic synchrony? A systematic review of the literature on predictors of mother-infant dyadic processes of shared behavior and affect. *Infant Ment Health J*. 2022;43(5):808-830. doi:10.1002/imhj.22011.
 40. Garner A, Yogman M; Committee on Psychosocial Aspects of Child and Family Health, Section on Developmental and Behavioral Pediatrics, Council on Early Childhood. Preventing childhood toxic stress: partnering with families and communities to promote relational health. *Pediatrics*. 2021;148(2):e2021052582. doi:10.1542/peds.2021-052582.
 41. Yrjölä P, Myers MM, Welch MG, Stevenson NJ, Tokariev A, Vanhatalo S. Facilitating early parent-infant emotional connection improves cortical networks in preterm infants. *Sci Transl Med*. 2022;14(664):eabq4786. doi:10.1126/scitranslmed.abq4786.
 42. Feldman R. Sensitive periods in human social development: new insights from research on oxytocin, synchrony, and high-risk parenting. *Dev Psychopathol*. 2015;27(2):369-395. doi:10.1017/S0954579415000048.
 43. Pavlyshyn H, Sarapak I. Skin-to-skin contact-an effective intervention on pain and stress reduction in preterm infants. *Front Pediatr*. 2023;11:1148946. doi:10.3389/fped.2023.1148946.
 44. Kim SY, Kim AR. Attachment- and relationship-based interventions during NICU hospitalization for families with preterm/low-birth weight infants: a systematic review of RCT data. *Int J Environ Res Public Health*. 2022;19(3):1126. doi:10.3390/ijerph19031126.
 45. Patel N, Ballantyne A, Bowker G, Weightman J, Weightman S. Family integrated care: changing the culture in the neonatal unit. *Arch Dis Child*. 2018;103(5):415-419. doi:10.1136/archdischild-2017-313282.
 46. Klawetter S, Cetin N, Ilea P et al. "All these people saved her life, but she needs me too": understanding and responding to parental mental health in the NICU. *J Perinatol*. 2022;42(11):1496-1503. doi:10.1038/s41372-022-01426-1.
 47. Matthews GA, Tye KM. Neural mechanisms of social homeostasis. *Ann NY Acad Sci*. 2019;1457(1):5-25. doi:10.1111/nyas.14016.
 48. Boyd SM, Tapawan SJ, Badawi N, Popat H. Protecting the brain of the micropremie. *Semin Fetal Neonatal Med*. 2022;27(3):101370. doi:10.1016/j.siny.2022.101370.
 49. Akbari N, Mutlu B, Nadali J. Effective of non-nutritive sucking during heel-stick procedure in pain management of term infants in the neonatal intensive care unit: a systematic review and meta-analysis. *Eur J Pediatr*. 2020;179(5):699-709. doi:10.1007/s00431-020-03640-5.
 50. Kim J, Choi SJ. Effect of olfactory stimulation with breast milk on pain responses to heel stick in premature infants: a randomized controlled trial. *Breastfeed Med*. 2022;17(7):605-610. doi:10.1089/bfm.2021.0374.
 51. Scala M, Seo S, Lee-Park J, et al. Effect of reading to preterm infants on measures of cardiorespiratory stability in the neonatal intensive care unit. *J Perinatol*. 2018;38(11):1536-1541. doi:10.1038/s41372-018-0198-4.
 52. Yakobson D, Arnon S, Gold C, Elefant C, Litmanovitz I, Beck BD. Music therapy for preterm infants and their parents: a cluster-randomized controlled trial protocol. *J Music Ther*. 2020;57(2):219-242. doi:10.1093/jmt/thaa002.
 53. Vance AJ, Pan W, Malcolm WH, Brandon DH. Development of parenting self-efficacy in mothers of high-risk infants. *Early Hum Dev*. 2020;141:104946. doi:10.1016/j.earlhumdev.2019.104946.
 54. Gomes Neto M, da Silva Lopes IA, Araujo ACCLM, Oliveira LS, Saquetto MB. The effect of facilitated tucking position during painful procedure in pain management of preterm infants in neonatal intensive care unit: a systematic review and meta-analysis. *Eur J Pediatr*. 2020;179(5):699-709. doi:10.1007/s00431-020-03640-5.
 55. Anne RP, Deshabhotla S, Ahmed SV, et al. A quality improvement initiative to improve management of procedural pain in preterm neonates. *Pediatr Anesth*. 2021;31(2):221-229. doi:10.1111/pan.14075.
 56. Pados BF. Milk flow rates from bottle nipples: what we know and why it matters. *Nurs Womens Health*. 2021;25(3):229-235. doi:10.1016/j.nwh.2021.03.006.
 57. Vittner D, Butler S, Smith K, et al. Parent engagement correlates with parent and preterm infant oxytocin release during skin-to-skin contact. *Adv Neonatal Care*. 2019;19(1):73-79. doi:10.1097/ANC.0000000000000558.
 58. Ellis WR, Dietz WH. A new framework for addressing adverse childhood and community experiences: the building community resilience model. *Acad Pediatr*. 2017;17(7S):S86-S93. doi:10.1016/j.acap.2016.12.011.

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