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Transforming Trauma with Love, Safety, and Science

Mary Coughlin, MS, NNP, NCC-E, Yamile Jackson, PhD, PE, PMP

Background:

Mitigating the iatrogenic psychological effects of medical care in the Neonatal Intensive Care Unit (NICU) and beyond is a moral and ethical imperative for quality healthcare delivery. Research has long established the lifelong effects of early childhood adversity, toxic stress, and the critical role of pediatric clinicians in addressing these challenges (1, 2), and most recently, the American Academy of Pediatrics (AAP) published a clinical report and policy recommendations for the adoption of a trauma-informed paradigm across all child health services (3, 4). Provenzi and Montiroso (5) confirm that preterm birth is an early adverse experience characterized by exposure to toxic stress and reduced access to the buffering effects of maternal care. Understanding the concepts of infant medical stress and its association with alterations in brain growth and development highlights the biological relevance of a trauma-informed developmental approach to care in the NICU and beyond (6–8).

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Early life adversity, often mediated through relationships with caregivers, is associated with attachment disturbances, posttraumatic stress disorder (PTSD), and developmental trauma disorder (DTD) in survivors (9, 10). Experiences of maternal separation and cumulative toxic stress within the NICU have profound implications for infants, families, and the healthcare team (11, 12). Adversity during infancy is associated with significantly poorer health outcomes, risky health behaviors, and socioeconomic challenges (13, 14). Parents, too, experience significant emotional and psychological distress, which can persist for decades, further reinforcing the need for trauma-informed approaches to care (15, 16).

During sensitive and critical periods of development, the experiences associated with critical illness and hospitalization take on new meaning as they direct and disrupt biological processes in the wake of toxic stress. These biological processes, mediated by epigenetic mechanisms, have lifelong implications for an individual’s physiologic and psychological health and well-being (17–19). Maternal separation is the most significant trauma experienced by all newborn mammals, and preterm and critically ill newborns are no exception (20). Separation of mother and infant at just two days of age for 1 hour has been linked to a 176% increase in autonomic reactivity and an 86% reduction in quiet sleep (21). The experience of maternal separation in the NICU becomes the foundation for cumulative toxic stress exposures, ranging from inappropriate sensory stimuli to hazardous hospital routines that do not honor the personhood of the infant (12, 20). These early stressors compound, leading to long-term health and developmental challenges (11–12, 22–23).

Separation also has profound implications on the parent, leading to depression, anxiety, feelings of helplessness, loss of control, and posttraumatic stress, which may last for decades.

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These feelings can impact parenting behaviors and the capacity to partner with clinicians in caring for their infant. Understanding the interplay of physical and emotional health, economic and social resources, medical systems, and structural inequities is critical for co-creating compassionate, collaborative, and supportive relationships with infants, families, and clinicians in the NICU (16, 24–26).

Trauma-Informed Care:

A trauma-informed approach realizes the pervasiveness of trauma in everyday life, recognizes its signs and symptoms in patients, families, colleagues, and self, and responds to trauma

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by integrating knowledge and evidence-based best practices that mitigate and prevent trauma into policies, procedures, and language; and resists re-traumatization by ensuring consistency and compassion in service delivery (27). The core principles of trauma-informed care—safety, trust and transparency, healthy relationships and interactions, empowerment, voice and choice, equity, anti-bias efforts, and cultural/gender affirmation—guide all interactions in the NICU (28).

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Parenting is central to a trauma-informed approach, as caregivers play a fundamental role in mitigating the stress and trauma of early hospitalization. The research underscores the powerful buffering effect of parental presence, engagement, and nurturing care in reducing toxic stress responses and promoting infant resilience (29). When parents feel supported and empowered in their caregiving role, they experience lower stress levels, increased confidence, and enhanced bonding with their infant. This benefits the family’s emotional well-being during the NICU stay and has lasting implications for child development and attachment security.

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The short-term outcomes of a trauma-informed parenting approach include improved neurodevelopmental stability, reduced incidences of apnea and bradycardia, and better weight gain trajectories for preterm infants (30–31). Additionally, trauma-informed care has been linked to greater autonomic stability, reduced stress hormone levels, and improved sleep patterns, all contributing to enhanced physiological regulation and early developmental progress (32). These immediate benefits lay the groundwork for stronger immune function and better feeding outcomes, helping infants build the resilience needed for long-term health and well-being (7). Parents who are actively involved in their infant’s care through practices such as skin-to-skin contact and responsive caregiving exhibit lower levels of anxiety and depression, leading to a healthier emotional environment for both

the child and the family unit (33–35).

Long-term, trauma-informed parenting interventions significantly impact developmental trajectories, reducing the risk of cognitive delays, emotional dysregulation, and behavioral challenges in childhood (32, 36). Secure attachment formed during these early interventions fosters resilience, social-emotional well-being, and stronger parent-child relationships well into adolescence and adulthood. Studies have also linked early trauma-informed care to improved educational outcomes and a reduced risk of mental health disorders later in life (9–10).

Providing parents with the knowledge, tools, and emotional support necessary to engage confidently in trauma-informed caregiving is critical in shaping the health and well-being of NICU graduates (37–38). By prioritizing the parent-infant dyad and leveraging evidence-based interventions, trauma-informed care offers a transformative model that extends far beyond the NICU walls, laying the foundation for lifelong resilience and well-being. When parents are given the resources to understand their infant’s cues, respond sensitively, and participate actively in care, they develop a sense of mastery and confidence that translates into more substantial, more secure attachments. This engagement benefits the infant’s immediate well-being and fosters a more compassionate, informed approach to parenting that can positively influence future generations.

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Clinical Application of Trauma Informed Care:

Parent-driven interventions in the NICU center include parents as active participants in their baby’s care, fostering attachment and reducing trauma. One such intervention is *The Zaky HUG*[®], a therapeutic device designed to extend the parent’s presence by mimicking their hands’ touch, warmth, and scent (Fig. 1). Created by a Ph.D. engineer and former NICU and kangaroo mother, this tool emerged from a deeply personal experience of neonatal hospitalization and has since been developed to support sleep, neuroprotection, attachment, developmental care, pain management, and parental involvement. This device helps create a comfortable, warm, and predictable environment, allowing infants to rest and sleep more peacefully. It is designed to provide the benefits of multiple tools, including positioning, nesting, soothing, and attachment.

Initially motivated by the need to provide connection, continuous comfort, and reduce the association of touch with pain and her own infant’s stress, the creator of this hand-mimetic device applied principles of ergonomics and safety engineering to design a device that fosters secure attachment, supports positioning,

Figure 1. The human hand mimetic device for babies when they are not being held. Photos reprinted with permission from Nurtured by Design, Inc.

HUMAN HAND-MIMETIC DEVICE (When they are apart)

One universal size and weight for individualized care, it is ergonomically engineered to provide gentle, consistent, and customizable support, promoting comfort, attachment, security, and proprioception while facilitating neuroprotective care, non-pharmacologic pain management, and sleep with minimal disruption.



and enhances the baby's ability to self-regulate. This tool helps maintain a consistent, soothing environment in the NICU, reducing the disruptions caused by frequent repositioning and device changes. Studies evaluating this device have demonstrated its effectiveness in reducing infant stress behaviors and improving autonomic stability. A randomized controlled trial by Russell et al. (39) found that infants using this device exhibited significantly fewer episodes of apnea and bradycardia than control groups and zero episodes when the device was maternally scented. Additionally, integrating parental scent into the device has been shown to facilitate relaxation and improve sleep patterns (40–42).

This tool, designed with a human-centered and trauma-informed approach, significantly reduces maternal stress and trauma while fostering positive physiological and emotional outcomes for the baby (41, 43). Its intuitive design allows neonatal staff to seamlessly incorporate it into care routines, replicating the natural positioning and gentle touch that caregivers instinctively provide to fragile infants. By incorporating principles of therapeutic, developmental, neuroprotective, and family-centered care, this

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device acts as a critical buffer against the stressors inherent in the NICU environment, promoting physiological stability and emotional security. The device offers consistent olfactory, tactile, and proprioceptive input, which is essential for reducing infant stress, enhancing relaxation, and supporting neurodevelopmental progress. It is designed to capture and retain parental scent within its soft and warm fabric fibers; continuous multisensory engagement supports physical, emotional, and cognitive well-being, empowering parents with an effective tool to actively participate in their baby's care, even when direct physical contact is not possible (42). By bridging the gap between direct and indirect caregiving, this tool empowers parents to maintain their loving and protective role in the ICU, reinforcing their connection with their infant and fostering long-term emotional resilience.

Another critical innovation is The Zaky ZAK®—a unisex safety wrap designed to hold infants weighing 1–15 lbs securely, either skin-to-skin or clothed (Fig. 2). Featuring adjustable zippers for a customized fit, it ensures constant containment while enhancing safety, comfort, and accessibility. Given the need to mitigate kangaroo care risks such as injuries, accidental falls, and parental

fatigue, including falling asleep (44), the safety wrap promotes earlier, safer, longer, and more frequent sessions.

Developed by the engineer behind the hand-mimetic device, this zippered safety wrap was also designed in collaboration with NICU and PICU clinicians, parents, infection control, and other stakeholders to support trauma-informed care. This safety wrap improves safety and satisfaction for infants, parents, and healthcare teams while reducing the cost of care. Its design allows for silent, immediate access to healthcare and parental interventions, reducing injuries, maintaining proper positioning, and fostering a secure, consistent environment for infants and caregivers.

By integrating both products (the hand-mimetic device when the family is apart and the safety wrap when they are together) into standard care practices, hospitals can support trauma-informed developmental care that prioritizes attachment, neuroprotection, and parental involvement (8, 37). These tools provide immediate comfort and stability for infants and foster long-term developmental benefits by reinforcing parental bonding and engagement. As

Figure 2. Parents using the zippered skin-to-skin (kangaroo) care safety wrap. Photos reprinted with permission from Nurtured by Design, Inc.

SKIN-TO-SKIN (KANGAROO) CARE SAFETY DEVICE (When they are together)

Ergonomically engineered with zippers to fit perfectly every time and to securely support infants' weight, postural alignment, and proprioception, ensuring comfort, stability, and easy, immediate, and silent access for healthcare and parent interventions with minimal disruptions.



more NICUs adopt trauma-informed principles, incorporating such evidence-based solutions becomes essential in transforming care practices and improving patient outcomes. By valuing the science and the soul of caregiving, these interventions can bridge the gap between clinical expertise and the profoundly human need for connection and love in the NICU. These devices provide consistent, evidence-based solutions that enhance immediate and long-term outcomes for infants and families.

Applying the Five Core Measures in Trauma-Informed Care:

Examining these two devices through a trauma-informed lens begins with recognizing the fundamental human need for safety, belonging, and connection for babies and families, and they align with each of the core measures, reinforcing the essential role of parents in neonatal care (Fig. 3).

The five core measures for trauma-informed developmental care, endorsed by the National Association of Neonatal Nurses (NANN), the Canadian Association of Neonatal Nurses (CANN), and the Council of International Neonatal Nurses (COINN),

provide a framework for ensuring holistic, disease-independent care (8, 45–48).

The **healing environment** measure emphasizes the importance of a soothing, predictable, and developmentally supportive setting. These nurturing devices foster an optimal healing environment through direct skin-to-skin contact or limited parental presence. In cases where parents cannot be physically present, one pair of hand-mimetic devices serves as a bridge, providing infants with a familiar and continuous sensory presence through scent retention and gentle, supportive containment. This helps mitigate separation stress, promoting emotional security and neurodevelopmental stability even without direct parental touch. They provide a comforting and familiar sensory experience that helps regulate the infant's stress response, reinforcing a sense of security and stability even in the highly stimulating NICU environment. By integrating these human-hand mimetic devices, caregivers can extend the infant's experience of warmth, touch, and olfactory cues, enhancing their sense of security. Standardizing practices around such devices also ensures consistency in care, reducing human error and unnecessary disruptions while creating a more

Figure 3. Core Measures for Trauma-Informed Developmental Care. Reprinted with permission from Caring Essentials Collaborative, LLC. Photos reprinted with permission from Nurtured by Design, Inc.



predictable experience for the infant, family, and clinicians.

Protected sleep is critical for neurodevelopment and overall well-being. Sleep is a primary driver of brain maturation, memory consolidation, and emotional regulation in preterm and critically ill infants. Interruptions to sleep can disrupt these critical processes, leading to increased stress responses, metabolic instability, and impaired neurodevelopmental outcomes. Ensuring a supportive sleep environment requires balancing between providing necessary medical interventions and minimizing disruptions to natural sleep cycles. Frequent repositioning, environmental disruptions, and inconsistent containment can negatively impact an infant's sleep-wake cycles. Research by Russell et al. (39) has shown that because these nurturing devices are versatile and work for positioning, nesting, attachment, soothing, and sleep support, they reduce the need for frequent repositioning, offering a stable, soothing environment that promotes restful sleep both during kangaroo care and while in the incubator or crib. These devices help infants transition between sleep states more smoothly, reducing startle reflexes and excessive wakefulness by providing gentle, consistent containment and proprioceptive support.

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Additionally, they assist in creating a cocoon-like space that mimics the security of the womb, further enhancing sleep continuity and quality. Further, consensus guidelines advocate for supporting parents in providing frequent, safe, and prolonged skin-to-skin care, reinforcing the role of these interventions in achieving sleep protection (49–50). Research has also highlighted that skin-to-skin contact improves sleep patterns, stabilizes respiratory rates, and reduces cortisol levels, mitigating the physiological impacts of stress. When infants experience uninterrupted, restorative sleep, they exhibit improved feeding behaviors, enhanced weight gain, and greater autonomic stability, all crucial for their long-term development.

The **Pain and Stress Prevention and Management** measure prioritizes proactive pain mitigation strategies. By minimizing stress and discomfort, infants can better participate in essential activities of daily living, such as feeding and movement, which further support their growth and development. The integration of non-pharmacologic interventions such as kangaroo care, proprioceptive input, and containment through trauma-informed devices significantly enhances an infant's ability to self-regulate and cope with stress (39, 41, 51). Parents play a vital role in this process, providing direct comfort before, during, and after procedures. Studies show that utilizing familiar, comforting sensory stimuli, such as parental scent-infused devices, can effectively minimize procedural stress and discomfort, reinforcing the protective role of parental presence in the NICU (39, 52).

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Activities of Daily Living, including posture, nourishment, and hygiene, are essential to infant development. Establishing predictable and supportive care routines in these areas helps to create a sense of security and stability for infants, reducing stress and promoting optimal development. Ensuring infants receive proper postural support can facilitate musculoskeletal alignment, improve digestion, and reduce discomfort caused by medical interventions. Additionally, consistent caregiving routines help infants develop circadian rhythms, supporting sleep-wake cycles and overall well-being. Kangaroo care safety devices support proper postural alignment, promoting successful breastfeeding and early oral feeding behaviors (53–54) (Fig. 4). One pair of hand-mimetic devices further enhances postural stability, allowing for individualized positioning without restricting movement, facilitating optimal comfort and developmental support. These devices can also provide gentle containment, mimicking the boundaries of the womb, which is particularly beneficial for preterm infants adapting to extrauterine life. Furthermore, integrating nurturing devices in caregiving practices encourages parental involvement in routine care activities, reinforcing their role and confidence in caring for their baby even in a high-tech NICU environment.

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Finally, **Compassionate Collaborative Relationships** focus on emotional well-being, self-efficacy, and communication (8). Clinicians play a vital role in supporting these trauma-informed measures, ensuring that both parents and staff are equipped with the knowledge and tools to facilitate optimal trauma-informed developmental care. These trauma-informed interventions support

Figure 4. Pumping and breastfeeding during kangaroo care with the zippered safety wrap. Photos reprinted with permission from Nurtured by Design, Inc.

Pumping and breastfeeding during skin-to-skin (kangaroo) care with the zippered safety wrap



neurodevelopment and empower parents, reinforcing their role as primary caregivers. By enabling continuous sensory presence and minimizing separation, these devices help establish a sense of predictability, safety, and emotional security for infants and their families. The research underscores the long-term benefits of these interventions, showing reductions in parental stress and anxiety while fostering stronger attachment and advocacy skills (55–57).

By integrating trauma-informed devices and caregiving practices, neonatal teams can transform the NICU experience, bridging the gap between medical excellence and human connection. As neonatal care continues to evolve, integrating trauma-informed interventions into everyday practice is not just beneficial—it is imperative for fostering lifelong resilience in the most vulnerable patients. Prioritizing the five core measures for trauma-informed developmental care ensures that every infant and family receives care that is not only evidence-based but also deeply compassionate and developmentally appropriate.

Summary:

Recognizing the trauma experienced by babies and families in the NICU is the first step toward transforming and humanizing neonatal care. This recognition must be followed by meaningful action—

“Ensuring infants receive proper postural support can facilitate musculoskeletal alignment, improve digestion, and reduce discomfort caused by medical interventions. Additionally, consistent caregiving routines help infants develop circadian rhythms, supporting sleep-wake cycles and overall well-being.”

integrating trauma-informed practices, supporting parental involvement, and embracing innovative, evidence-based products and solutions that prioritize the holistic well-being of infants and their families. Trauma-informed interventions, particularly those that integrate parental involvement and ergonomic design,

provide a compassionate, evidence-based approach to mitigating the effects of early life adversity. By centering the voices of parents and clinicians while utilizing trauma-informed tools designed to enhance neurodevelopment and emotional security, we can reshape the NICU experience and the transition to home after discharge into one that fosters healing rather than deepens distress. By leveraging these nurturing strategies, clinicians can enhance infant and family well-being, improve healthcare outcomes and satisfaction, reduce the cost of care, and foster a culture of healing and resilience in the NICU.

This shift requires dedication from institutions, practitioners, and advocates who believe in the profound impact of early experiences. Investing in trauma-informed developmental care is not just a clinical imperative—it is a moral and ethical responsibility that holds the power to transform lives. The NICU should not only be a place of survival but also one of healing, connection, and love. Every baby, every family, and every clinician deserves an environment that nurtures the body and the soul, where science and compassion intersect to create the best possible start for our most vulnerable patients. Through thoughtful, evidence-based approaches, we can transform neonatal care into a support, compassion, and empowerment model for every infant and family. Now is the time to act—to advocate, to innovate, and to implement trauma-informed care that acknowledges the human experience behind every NICU admission. The smallest among us deserve the best care, and it is our collective responsibility to ensure that their earliest moments are filled with safety, love, and hope.

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