DEVELOPMENT MATTERS:
A NICU Product Review Questionnaire
for Neonatal Professionals

FEATURED CATEGORY

Neurodevelopmental Positioning Aids

INTRODUCTION AND BACKGROUND:

As **NEONATAL THERAPISTS** we have a unique perspective within the neonatal intensive care unit (NICU). To better serve patients and colleagues, we use our collective education, experience and perspective to provide insight into the neurodevelopmental aspects of neonatal products.

Our intention is to provide valuable information at no cost to NICU staff, managers and directors so they can efficiently review existing and potential developmental features of neonatal products in addition to considerations such as safety, service, cost, educational support and efficacy.

Developmental characteristics are part of the picture, a part that deserves notice, support, and further investigation.

FEATURED PRODUCT DEFINITION, NEED AND UNDERLYING ASSUMPTIONS:

Definitions:

NEURODEVELOPMENTAL POSITIONING:
The practice of positioning infants in the NICU in a manner that supports not only the musculoskeletal and motor systems but aids and facilitates neurodevelopment.

Optimal positioning offers an experience that is safe, supportive and dynamic (versus static) while allowing the infant to be cared for by his/her family and caregivers.

NEURODEVELOPMENTAL POSITIONING AIDS:
Commercially available products that are used to position infants in the NICU and support neurodevelopment as a whole.

NEED:
Infants born prematurely are often deprived of the uterine crowding that occurs in the third trimester. This critical period of time encourages the development of physiological flexion, and supports neuromuscular development, self-soothing and behavioral organization.[1]

The uterine environment offers the developing fetus an environment of support, appropriate sensory input, containment, safety and sleep. This environment buffers the infant from noxious stimuli while supporting flexion in an anti-gravitational world. The uterine wall provides the perfect anatomical and sensory boundary for the development of muscle tone, movement and reflexes and supports muscles, tissues and joints.

Active extension and arching become dominant or unopposed motor patterns for preterm infants in the NICU. The forceful prenatal motor pattern of active extension as a fetus kicks and stretches in the womb is no longer counterbalanced by consistent uterine boundaries that allows a fetus to return to a flexed midline position. Extremely preterm infants at full term age equivalency usually appear motorically different than infants born at full term; their active extension is stronger, asymmetry is common and spontaneous movements are large excursion and poorly controlled.[3]

Inadequate positioning in the NICU forces infants to remain in flat, hyperextended and/or asymmetric positions which can contribute to: increased stress/agitation, decreased physiologic stability, uncontrolled or frenetic motor activity and energy depletion; difficulty with caregiving; iatrogenic postural deformities, reinforcement of atypical connections in developing neural pathways, strengthening of abnormal postures and movements including arching, and altered perception/interaction within the infant's environment.[2]

Neurodevelopmental positioning aids provide the premature or sick infant with optimal support that positively impacts continued growth and neurodevelopment.

Underlying Assumptions:

- Birth that occurs before optimal fetal musculoskeletal and neurologic maturation places premature infants at risk for atypical motor development.[4]
- The goals and key components of neurodevelopmental positioning have evolved.
- Neurodevelopmental positioning aids must reflect this ongoing evolution and be supported by the best available literature and research.
- Developmental effects of positioning are evident before NICU discharge.[5]
- Effective positioning can reduce asymmetry in preterm infants.[5]
- Neurodevelopmental positioning in physiological flexion includes not only flexion of the shoulders, hips, and knees but also midline orientation, scapular protraction and posterior pelvic tilt. This promotes proper joint alignment, symmetry and neuromuscular development, and promotes self-soothing and behavioral organization.[1,6]
- Relief of cranial pressure/prevention of cranial molding is inherently related to neurodevelopmental positioning and symmetry.
- Movement is a necessary component of normal development.
- Movement against a dynamic boundary promotes the development of normal movement patterns and muscle tone while facilitating behavioral organization.
- Concave nests formed from a blanket or sheep-skin draped over blanket rolls frequently are too wide and shallow to provide adequate containment, flexion, and/or midline orientation.[2]
- Sleep is vital to growth and development.
- Skin integrity and skin health positively contribute to the infant's overall well-being.
- In utero, preterm infant development is sequential and orderly.
- Experience affects brain development; cells have memory.
- Infants seek balance and homeostasis.
- Empowering parents to engage and care for their infant facilitates transition to home and positively impacts future development.
- Further research in this area is warranted.
- Infants must be provided with individualized, age appropriate care.

QUESTIONNAIRE: VITAL ASPECTS OF NEURODEVELOPMENTAL POSITIONING AIDS:

This questionnaire was developed primarily from the perspective (as best we can understand it) of the infant and his/her systems.

QUESTIONNAIRE DIRECTIONS:

Review each component of questionnaire as PART OF your product assessment. Some features are suggested for future considerations and do not, to our knowledge, exist yet in the market. This culmination of features will provide insight into the developmentally supportive features for this product category.

NEUROBEHAVIORAL:

Secure positioning promotes improved rest and neurobehavioral organization and an infant will be more calm and easier to care for.[2] A stable motor system and appropriate and continuous adaptations for sensory development support neurobehavioral organization. Therefore, neurobehavioral questions are represented within the sections below including:

- Sensory
- Neuromotor
- Musculoskeletal
- Sleep
- Accesibility/Ease of Use

SENSORY:

Tactile

Sensory system development in the preterm infant is a critical period of development. The infant's tactile system is the first to develop and receptors are found in the skin as early as 8 weeks gestational age. The tactile system includes touch, temperature, pressure,

proprioception and pain. The infant in the NICU experiences an overload of noxious stimuli to the skin such as unpleasant touch or procedural touch (IV's, tubes). A concentration of sensory receptors are found in and around the nose, mouth, palms and soles of the feet.

The skin and human and procedural touch play vital roles in neurodevelopmental positioning.

QUESTIONS:

1. Is the aid made of comfortable material?
2. Does the integrity of the material (and therefore comfort) withstand cleaning and/or laundering when cared for per manufacturer's guidelines?
3. Does the aid relieve pressure on boney prominences?
4. Does the aid need to be warmed or cooled to neutral thermal environment?
5. Is the material conducive to maintaining skin integrity?

Proprioception

DEFINITION: The ability to sense stimuli arising within the body regarding position, motion, and equilibrium.

QUESTIONS:

1. Does the aid provide opportunities for the infant to experience proprioceptive input via complete circumferential support?
2. Do the boundaries provide both passive support (at rest) and dynamic support during active movement?

Visual

Eyelids open around 24 weeks, the visual cortex is forming at its peak at 28 weeks and the pupillary response isn't fully intact until 36 weeks. The visual system goes on to develop after term up to 1 year of age. Caregivers must consider adaptation of environmental lighting and provide protection from abnormal levels of lighting.

QUESTIONS:

1. Can the aid provide protection against changes in environmental lighting?
2. Does aid allow parents to view the infant's face?

Vestibular

DEFINITION: A complex sense concerned with the perception of bodily position and motion, mediated by end organs in the vestibular system, and stimulated by alterations in the pull of gravity and by head movements.

QUESTIONS:

1. Does product protect against noxious vestibular input/absorb shock during transport?
2. Is the aid capable of mitigating noxious vestibular input?

NEUROMOTOR:

Posture, Tone, Movement and Reflexes

Physiological flexion is vital for the development of normal movement and control. Term infants are born with this type of flexor tone which further provides stabilization for movement, balance and development of muscle control. Infants in the NICU lack this kind of tone at birth.

Fetal movement and postures contribute to the shape of infant's skull, joints and spinal curvature. When infants in the NICU are not afforded freedom of movement or are restricted, they are at risk for further deformities. Allowing the infant to experience dynamic movements versus remaining static more closely mimics the intra-uterine environment while also supporting further neuromotor development.

Caregivers in the NICU have the opportunity to positively influence posture and movement while supporting the infant's tone and reflex development.

QUESTIONS:

1. Does the aid offer support to the resting and active posture of the infant in all positions? (supine, prone and sidelying and variations thereof)
2. Does the aid offer support of developing muscle tone by providing increased containment (or decreased) depending on individual needs of the infant?
3. Does the aid provide support that allows movement against a dynamic surface/boundary versus a static or restrained position?
4. Does the aid support developing reflexes such as sucking, upper and lower extremity recoil, and palmar/plantar grasp?
5. Does the aid provide circumferential support?
6. Does the aid return to its resting state after stretched/pushed against to continue to support flexion at rest? (i.e. is there recoil?)

MUSCULOSKELETAL:

Birth that occurs before optimal fetal musculoskeletal maturation places infant at risk for atypical motor development. Preterm infants are prone to flattened postures, cranial molding, head/neck asymmetry, shoulder girdle retraction, hip abduction and overall patterns of extension. Incomplete development of bones, with altered ossification and density creates a vulnerability to fractures. Restricted positions and prolonged joint compression can lead to further developing iatrogenic deformities such as muscle shortening, or skeletal deformation.[4]

QUESTIONS:

1. Can the aid support the infant's head in midline?
2. Does the aid support the shoulder girdle in protraction?
3. Does the aid support hands to midline/face/mouth?
4. Does the aid support the trunk in alignment and flexion?
5. Does the aid support appropriate hip flexion?
6. Does the aid provide appropriate pelvic tilt?
7. Does the aid support the knees and ankles in flexion and alignment?
8. Does the aid restrict the infant in any way that is not age appropriate or neurodevelopmentally appropriate?
9. Does the aid allow joint compression while providing freedom of movement?
10. Does the aid address prevention of cranial flattening?
11. Does the aid facilitate symmetry in the musculoskeletal system?
12. Does the aid allow individualized patterns of movement of the joints?

SLEEP:

Sleep is vital for growth and neurodevelopment. The average daily sleep needs for premature infants less than 37 weeks is 17-20 hrs/day.[7] Sleep in the NICU is interrupted numerous times per day due to environmental influences and practical provision of intensive care. Neurodevelopmental positioning aids can contribute to sleep by increasing comfort, decreasing motoric stress and increasing opportunities for self-regulation.

QUESTIONS:

1. Does the aid promote shoulder rounding and hand to face/mouth for self-regulation?
2. Does the aid support a return to flexion in the event that infant is startled?
3. Does the aid shield the infant's eyes from direct bright light?
4. Does the aid support deep sleep?

ACCESSIBILITY/EASE OF USE:

Infants are in constant interaction with their environment, seeking stability and homeostasis. The caregiver must be able to work within the macro and micro environment in a safe manner that supports efficient workflow while also meeting the needs of the infant and family. The aids chosen by caregivers or institutions must be age appropriate and support

care interactions. Environmental adaptations that support brain development are the responsibility of the caregiver. (Within limits of existing physical space.)

QUESTIONS:

1. Does the aid offer benefits to a variety of ages?
2. Is the aid compatible with a variety of diagnoses?
3. Is the aid easily adjustable or adapted with use of medical equipment? (IV, tubes, ventilators, etc)
4. Can the aid provide individualized support during caregiving or family activities (heel stick, intubation, x-ray, transfers, skin to skin holding)
5. Can the aid be used during transport?
6. Can the aid be used during xray?
7. Can the aid be used during MRI?
8. Does the aid allow immediate access to the infant?
9. Can the aid be used during resuscitation?
10. Does the aid allow caregiver to support the infant's upper or lower body separately during routine care and/or procedures? i.e. supports upper body during diaper change thereby supporting neurobehavioral organization via motor support
11. Is the aid intended for single-patient use only?
12. Is the aid reusable (multi-patient use)?

SUMMARY:

Non-separation or connecting the infant to the family is the ultimate goal. Yet how can we best achieve this in an intensive care environment? Which products facilitate connection and development while maintaining high level performance and supporting overall health and safety?

When you evaluate products or equipment from the infant's perspective, you begin to shift your thinking. You begin to think of every product as a means of supporting life, development, connection and safety.

As neonatal therapists, we're taught from the beginning to analyze the everyday activity of our patients. We're taught to assess the positive and negative effects of the environment and how to adapt the environment to maximize development. This questionnaire takes what you know and organizes it for your consideration and use.

Hopefully, having this information at your fingertips, already, reviewed and organized saves you time, energy and frustration while allowing you to advocate for the babies and families in your care.

It's a whole new world.

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