

# State Systems Development in High-risk Newborns in the Neonatal Intensive Care Unit

## Identification and Management of Sleep, Alertness, and Crying

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The state system is a fundamental component of newborn neurodevelopmental function and demonstrates the newborn's underlying neurologic and behavioral competence. The role of the state system in newborn developmental assessment reflects the newborn's ability to respond to the environment. This overview examines the importance of the state system as a significant developmental process, identifies specific variations in sleep and wakefulness, and describes behavioral patterns of state in full-term as well as high-risk newborns. Specific intervention techniques are outlined for caregivers and parents, which address consolability, adjusting the environment, handling, and interactions. This information contributes to the nurse's ability to identify and assess neurobehavioral integrity and provides appropriate behavioral individualized developmental interventions during neonatal care. **Key words:** *neurodevelopment of newborn, sleep behavior, state of consciousness*

Assessing newborn developmental function includes identifying conditions of risk, describing behavior patterns, and estimating developmental function in order to determine developmental outcome. The search for accurate indicators of newborn competence and newborn developmental delays or impairments occurs early in newborn care to determine as soon as possible which newborns are progressing normally and which newborns will benefit from special interventions. Toward this end, the assessment of newborn behavioral organization accompanies neurologic assessment and reflects the newborn's

underlying neurologic state.<sup>1,2</sup> Behavioral assessment identifies the newborn's current level of balance and smooth, integrated functioning as well as thresholds of disorganization.<sup>3,4</sup> Identifying and quantifying neurobehavioral organization and function in the newborn have become an essential component of comprehensive high-risk newborn care.

One component of newborn behavioral assessment and a fundamental developmental process are the development of the state system. Understanding the state system in the newborn is often thought to be difficult; however, understanding state enables nurses to understand how newborn behavior patterns impact the physiologic needs of neonates.<sup>4</sup> State is a fundamental construct, which results from a complicated series of biochemical reactions involving many parts of the brain, various kinds of cells, and the immune system.<sup>2</sup> Understanding newborn behavior in terms of the state system provides nurses with the ability to assess and interpret newborn behavior and provide appropriate individualized developmental interventions.

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State development includes the sleeping and waking cycles, clusters of behavior that tell caregivers about the newborn's level of arousal. State behaviors of sleep and wakefulness also indicate the individual newborn's responsiveness to the environment and the underlying activation of the central nervous system.<sup>2,3</sup> Reactions to various environmental stimuli (including caregiving) need to be interpreted according to the presenting state of consciousness in the newborn. Reactions to the environment may vary considerably depending on newborn state or level of consciousness at the moment. In other words, a newborn's behavior, function, and reaction to the environment will depend upon which state he is in and range from deep sleep to vigorous crying. Thus, if a healthy newborn is asleep and a bell sounds near his ear, he may not respond, but if he is awake, he may widen his eyes, startle, or cry, or turn and search for the sound. In addition, the newborn's ability to respond to stimuli and behavioral cues from caregivers will vary according to his state. The manifestation of a specific state and its quality will depend on a variety of factors, such as the last time the newborn was fed, and recent events (eg, blood tests, circumcision). Physiologic changes that may affect the newborn's responsiveness may include hunger, hydration, timing of where the newborn is in the sleep cycle, degree of illness, and competing environmental stimuli (such as in the neonatal intensive care unit [NICU]) that may be present at the same time.<sup>3</sup>

## STATE ASSESSMENTS

Various assessments of the state system have evolved on the basis of the purpose of the professional and the reasons why information about the state system is wanted. Early descriptions of sleeping and awake behavior were described by Gesell and Amatruda<sup>5</sup> in 1941. Neurologists require information about the state system to evaluate the motor system in coordination with EEG data.<sup>6</sup>

A well-known tool for the assessment of full-term newborn state behavior was developed by Brazelton,<sup>3</sup> who created a clear, and widely used assessment tool known as the Brazelton Neonatal Assessment Scale (BNAS).<sup>3</sup> The behaviors assessed in this scale range from 36 to 44 weeks (postmenstrual age, PMA), making its use limited for the newborns with perinatal complications. The BNAS assesses the range of individuality in the newborn within the context of interaction with the examiner. The newborn is scored on his best, not average, performance.<sup>3</sup> Information collected provides a profile about the newborn's ability to respond and

adapt to his or her environment. An important aspect of this assessment is the amount of facilitation it takes for the examiner to bring about the newborn's best performance, which is considered key to understanding the newborn's ability to organize behavior. Examiners are trained to be sensitive to the timing, interaction, and presentation of stimuli in order to bring out best responses.<sup>3</sup>

Assessment of the state system in the BNAS includes descriptions of 6 states, 3 sleep states, including *deep sleep*, *light sleep*, and *drowsy*, and 3 awake states including *quiet alert*, *active alert*, and *crying*. As the examination begins, observations of state are made for 2 minutes by observing spontaneous behavior, breathing patterns, eye movements, startles, and responses to the environment. The initial state and predominant states throughout the examination are scored. This assessment provides a full assessment of the range and quality of the newborn's state behaviors in healthy newborns as they use state to exert control over environmental input. To understand the newborn's ability to control state, one must note how the newborn moves from one state to another, maintains or "holds" the state, as well as evaluates the quality and clarity of each sleep or waking state.<sup>4</sup>

Als and associates<sup>4</sup> developed an instrument for assessing behavior in the preterm, as well as the high-risk full-term newborn. Als refined and expanded the BNAS to develop a more appropriate scale for high-risk newborns in order to quantify newborn skill and responsiveness to environmental stimuli.<sup>4</sup> Full-term newborns have a full range of sleep and waking states. They typically have no difficulty in achieving a robust, strong crying state, and can easily transition to alerting or to sleep. Over the first 2 weeks, the periods of alertness become increasingly solidified and by the age of 1 month, many full-term newborns spend up to an hour or more in alert, socially and cognitively available states.<sup>7</sup>

Not all newborns are readily able to increase their attention and interactive abilities. For less mature newborns and those underweight, achieving quality alerting and interaction may be a difficult task, one that impinges on the newborn's other systems of autonomic and motor function.<sup>4,7</sup> Als subdivided the ranges of the original 6 states from the Brazelton Scale to describe more than 13 states in order to capture the variations and unique patterns in state behavior of the less mature high-risk newborn (Table 1). The function of the state system is readily observable in the range of newborn states of consciousness (from sleep to alert, to aroused). The pattern of transition from one state to another is scored, as well as the clarity, definedness, and strength of energy in the state.<sup>4</sup>

**Table 1.** The state ranges and behaviors\*

	Stable/organized range	Stress/disorganized range
<b>Sleep behaviors</b>		
Deep sleep	Sleep w/regular breathing Relaxed, no activity	Sleep w/startles, jerks moves, tremors Irregular breathing, no eye movements
Light sleep	Sleep with REM, low-level activity, some startles, some sucking, mouthing	Sleep with REM, diffuse movement breathing irregular, whimpers, facial twitching
Drowsy	Drowsy with low activity/facial grimaces, vocalization, or could be fussy and active while still asleep	Drowsy w/glassy eyed dazed look, diffuse moves, many vocalizations, newborn sounds, grimacing
<b>Waking behaviors</b>		
Alert	Quiet awake; minimal activity bright focused attention low or minimal activity	Hyperalert: Awake, eyes wide open, panicked/frantic look/appears stuck on stimulus/very intense Lidded Alert: Awake/quiet, eyes glazed, dull, appears fatigued
Active alert	Awake/aroused/active movements (smooth)	Awake/active/distressed face/ in discomfort
Crying	Strong cry, rhythmic	Weak strained cry w/intense grimace

\*Adapted from Als et al.<sup>4</sup>

## DEFINITION AND CLASSIFICATION OF NEWBORN STATES

Newborn states, both full-term and preterm ranges, include behaviors of the sleeping and waking cycles with unique clusters of behaviors. Each state has a unique function.

### Sleep states

Brazelton<sup>3</sup> described that the full-term healthy newborn has demonstrated *deep sleep*, *light sleep*, and *drowsy*. Deep sleep is characterized by closed eyes, no body movement, no eye movements, and regular breathing. Isolated sucking or startles may be seen. Light sleep consists of low levels of activity with increased responsiveness to the environment. A key feature is the observation of REM sleep or rapid eye movements seen under the eyelids. The drowsy state has variable activity and is considered a transition state in which the newborn is moving from sleep to awake or from awake to asleep.<sup>3,8</sup> The healthy newborn demonstrates drowsiness with smooth movements and occasional mild startles. The eyes may open and close but appear dull and heavy lidded. Some reaction to the environment may be observed, but may be delayed.

These sleep states have added parameters if the newborn is immature or showing disorganized patterns of state behavior.<sup>4</sup> If an newborn appears to be in deep sleep demonstrating closed eyes, no rapid eye movements, with active startles, and the newborn has other parameters such as irregular breathing, or poor color, the newborn could be in a less organized deep sleep. Some newborn newborns fluctuate rapidly and often

from asleep to an awake state. This could be a sign of sleep disorganization, particularly if the newborn displays erratic or abrupt changes. Sleep states are also assessed by observing the range of states, that is, whether all 3 sleep states are present. States are evaluated on the basis of the clarity and definedness of the state (ie, whether it is clearly and easily readable as sleep or awake) and the ability of the newborn to manage the transition from one state to another (ie, from waking or to falling asleep).<sup>4,7</sup>

### Awake states

The 3 awake states are *quiet alert*, *active alert*, and *crying*. *Quiet alert* refers to the state of consciousness in which the newborn newborn is available for interaction with the environment. *Quiet alert* is defined as a brightening and focused appearance with attention directed at an available auditory or visual stimulus. The newborn can smoothly bring himself to a calm, quiet alert level of consciousness with a minimal amount of motor activity and with regular breathing.<sup>3</sup> This alert state provides the opportunity for newborns to interact with caregivers. Full-term healthy newborns and recovering premature newborns may exhibit these attentive states and can use this level of arousal to take in social and cognitive information from the environment. They elicit responses from caregivers in this state. Als<sup>7,9</sup> describes this state of attentiveness as a salient and most important agenda of the newborn. The *active alert* state presents with increased motor activity and heightened sensitivity to stimuli with the newborn still awake. This state could include periods of fussiness and restlessness. An

organized-term newborn may be able to readily calm himself from this level of activity by sucking on his hands or looking at an interesting stimulus, and return to the quiet alert or a calm sleep state. *Crying* is loud and strong in the full-term newborn and is accompanied by increased motor activity and skin color changes. The meaning of crying may vary in different situations and could be related to the amount of stimulation from the caregiver.<sup>10</sup>

Preterm newborns and less mature newborns will show varying patterns in the awake and crying states.<sup>4,8,11</sup> In the early weeks in the NICU, the premature or high-risk newborn may show predominantly physiologic signs of stress and disorganization.<sup>12</sup> There may be a minimal range of states including a light sleep, drowsiness, and very brief alerting. The unresponsive inactive sleep states of the very early born premature newborn are most likely appropriate, as this pattern may facilitate conservation of energy and maintenance of homeostasis. As the newborn recovers and matures, more clear sleep states become evident with deep sleep becoming more readily available.<sup>13</sup> An implication regarding caregiver support could include supporting the newborn to maintain and achieve deep restful sleep, which promotes growth and physiologic stability.

Important reminders for caregivers are to carefully observe each newborn's variable sleep and wake patterns. Note what supports achievement of deep sleep in NICU newborns and what disrupts their efforts to attend to their parents and environment. Perhaps structuring the daily cycles of care to be consistent with an newborn's periods of wakefulness or scheduling feeding to be during more organized states may facilitate more consistency in state development. Respect for each newborn's sleep-wake cycles will promote organized state function.

## WHAT IS STATE ORGANIZATION?

The highly complex behavioral organization of the newborn newborn has been demonstrated in several studies.<sup>7,8,14-16</sup> These studies suggest that newborns show individual differences in their capacity to adapt to the environment, achieve biological rhythms, regulate interactive sequences, and demonstrate emotional responses to caregivers. If caregivers are available to initiate and maintain interaction, newborns demonstrate their social capacities.<sup>17</sup> Many researchers describe an adaptive mutual regulatory system between newborns and caregivers that has as its aim compatible social experiences.<sup>18</sup> In other words, newborns are truly social.

The full-term healthy newborn demonstrates from birth an increasing ability to regulate state control working toward smooth function of sleeping and waking periods in order to gain predictable sleep patterns and a range of waking states. This requires the ability to tune out negative stimuli to maintain a deep restful sleep and achieve normal sleep cycles.<sup>4</sup> Newborns also work toward regulation of interactive and social behavior and demonstrate an understanding of the meaning of affective displays by caregivers.<sup>19</sup> The affective or emotional communications of the newborn and mother change the emotional experience and behavior of the other. Thus, during interaction, an newborn may shift, look down or away, and comfort himself of herself by sucking on a thumb during a face-to-face exchange with the mother. In response, the mother sees the behavior and waits. The newborn may signal readiness to resume the communication by regaining eye contact. The mother may then move closer to the newborn and touch or smile and reconnect, letting the newborn know that she is pleased with the newborn's return to the interaction. The caregiver has the power to change the newborn's negative experiences into successful ones.<sup>19,20</sup> The healthy full-term newborn begins a developmental journey equipped with a central nervous system that allows for looking, engaging, interacting, listening, feeling, and managing breathing, digestion and steady physiologic function concurrently. That is, the healthy full-term newborn is an active participant in social interactions with caregivers and the environment.

Preterm and less mature newborns may not be able to demonstrate their interactive capabilities so readily. Early born infants may have difficulty becoming alert initially and may be unable to maintain the alert state for any length of time. Some newborns in the NICU may be unable to filter out noxious stimuli and may be reactive and sensitive to their environment. This may be demonstrated by actively fussing or crying, or spending long periods of time in sleep.<sup>9,21</sup> As preterm newborns mature, they may have brief periods of quiet alert states but be unable to focus on a stimulus such as a face. It is helpful to assist parents in understanding the realistic range of possibilities in state development for the NICU newborn, to avoid disappointing interactions for parents. Brazelton<sup>22</sup> described the "cost of attention" as the amount of energy the newborn must expend to maintain an alert state. Some infants may attempt alerting and looking, but show fatigue or stress in the form of looking away, irregular breathing, or skin color changes. When caregivers wait and watch, carefully noting the newborn's abilities to process the environment and developmental nurses and staff demonstrate the reasons for the newborn's reactions,

parents learn to be more accepting of infant tolerance levels.

Signs of stress or fatigue may include changes in muscle tone (in limbs and even in the face), irregular respirations, apnea, irritability, lethargy, vomiting, arching, looking away, or increased activity.<sup>4,9</sup> Variations in the states could include a "tired alert" with lidged eyelids or hyperalert with overly wide eyes.<sup>4</sup> Recognition of these patterns helps caregivers discontinue inappropriate interactions and give newborns rest periods.

### Variations of State Development: Impacts on State Organization

State organization means that the newborn has the ability to manage or balance physiologic and behavioral systems in response to environmental stimuli without disruption. This means that the newborn may manage breathing, heart rate, and digestion, and maintain oxygenation and digestion *at the same time* as managing motor and sleeping and waking states. Thus, the newborn who is deemed *organized* may maintain stable breathing and skin color, steady digestion while maintaining smooth movements, tone and posture, and at the same time manage sleep and waking. In addition, the newborn will be able to console or self-calm by using various strategies of self-regulation such as sucking on a finger, feet bracing, grasping, and holding on. A mature newborn has the unique ability to regulate these parameters concurrently.<sup>3,4,7,9,22</sup>

The less mature or stressed newborn will show variations in the ability to handle environmental stimuli and demonstrate physiologic variations in breathing, skin color changes, and/or digestive difficulties in response to the environment or to handling. This newborn's ability to manage stimuli from the environment may result in stressful reactions in one or all systems that often initiate a chain reaction leading to irritability or physiologic instability.<sup>4,7</sup> For example, the reactions of the very young preterm newborn are frequently expressed physiologically, rather than interactionally.<sup>12,23</sup> Changes in very subtle behaviors in the newborn's physiologic patterns such as skin color, fluctuations in heart rate or respirations, or the presence of startles or tremors are clues to the appropriateness of stimulation. Interpreting these cues becomes an essential component of caregiving to effectively support newborns to regulate autonomic function in conjunction with maintenance of motor balance in working toward organized state function.

The Naturalistic Observation of Newborn Behavior created as an observation tool by Als<sup>24</sup> and incorporated into the Newborn Individualized Developmen-

tal Care and Assessment Program<sup>24</sup> provides a spectacular opportunity for cataloging the newborn's behavioral repertoire. By observing the newborn's behavior before, during, and after routine caregiving events in the NICU, the examiner is able to unobtrusively collect data on the newborn's ability to manage autonomic, motor, and state functions. The range of stable organized behaviors, as well as the range of stressed or disorganized behaviors, can be seen and evaluated providing caregivers in the NICU with information to readily organize newborn behavior at the bedside, a task that contributes to improved outcomes for high-risk newborns.<sup>14,25-27</sup>

For example, a NICU premature newborn who is being turned from his back to his side is able, with caregiving assistance, to curl his arms and legs close to his body, bring his hands together to his mouth, and achieve a calm sleep with regular breathing and stable color. This newborn thus demonstrates stability in his autonomic, motor, and state systems, and self-regulation. However, the premature newborn who, upon being turned to his side, arches, squirms, extends his arms and legs, claws the air with his hands, tremors, startles, becomes tachypneic and pale, shows diffuse increased activity, is becoming frantic. This newborn demonstrates a highly stressed reaction to his environment and to handling. This baby is not able to manage himself, and requires support from the caregiver in the form of sensitive slower handling and positioning. From such valuable information, caregivers may facilitate the management of environmental inputs for the newborn, to promote stable calm states and physiologic, motor, and state function stability. See Table 2 for questions to ask to guide ways to facilitate state organization in the newborn.

### IMPLICATIONS FOR CAREGIVING

Planning and carrying out developmentally supportive interventions requires attention to individual differences, attention to tolerance for sensory input, and awareness of the need to be flexible for each infant. Caregivers need to be attuned to newborn behavioral patterns, noting varying levels of sleep and wakefulness and be ready to adapt caregiving routines, procedures, and the environment to individual newborn needs and based on the newborn's moment-to-moment behavioral messages.<sup>14,28</sup> The best of intervention strategies will most likely be ineffective and potentially harmful to newborns if not appropriately structured or timed to avoid overtiring, overstimulating, or increasing stress in NICU infants. Timing procedures and handling to

**Table 2.** Questions to ask to facilitate state organization

1. Does the newborn show a full continuum of states, all 6 states, and demonstrates the ability to move smoothly and easily from deep sleep to light sleep, to a drowsy state, to quiet alertness, to an active aroused state, to upset and crying; or does the newborn typically move from sleep to aroused states and immediately back down to sleep again, skipping the alert state?
2. When the newborn is sleeping, is the sleep robust with patterns of deep sleep, steady breathing and calm restful sleep, or does the newborn have difficulty settling, showing facial movements, vocal sounds, and general restlessness for significant periods of time?
3. What is the quality of the newborn's alert state? Is the newborn's expression animated, with shiny-eyed alertness and gently "ooh" shaped mouth, ready for engagement and interaction? Or, is the newborn awake but looking away continuously appearing to be unable to look and listen or look and manage breathing at the same time?
4. Does the newborn quickly move to panicked wide-eyed arousal or barely seem to muster the energy to interact through a lidded, glass-eyed strained appearance?
5. Does this newborn move rapidly from sleep to wake, to sleep again in repeated cycles throughout the day?

suit individual newborns are fundamental to promoting self-regulation and providing individualized developmentally supportive care (Table 3).<sup>7,9,25</sup>

Recent studies have shown that supporting parents to participate in caregiving by implementing individualized developmental care reduces parental stress,<sup>14</sup> improves parent satisfaction,<sup>29</sup> and promotes mother-newborn closeness.<sup>30</sup> See Table 4 for suggestions for parent support. Caregiving events that *promote* state system development include addressing consolability or self-calming, environmental modifications, handling, supporting sleep, and promoting appropriate interactions for the newborn are important for both NICU staff and parents.

**SELF-CALMING**

The preterm newborn may be unable to organize or self-calm, and self-calming (consolability) may be nonexistent in the very sick newborn. Interventions that seek to facilitate self-calming strategies in these newborns may help less mature newborns maintain calm sleep and/or calm awake states. Keep in mind that the newborn who is only a few hours old has within the last 12 to 24 hours been in the womb using his own self-regulating strategies, which probably included sucking

**Table 3.** Interventions to support state organization

The following is a list of specific intervention strategies that support sleep and waking stability:

**Organizing sleep**

Environmental modifications

- Assessment/reduction of light and sound
- Modulating activity levels in neonatal intensive care unit
- Structuring the immediate sensory environment
- Positioning to provide boundaries

Handling and caregiving

- Gentle/slow/attuned handling of newborns
- Consistent observation of newborn behavior
- Provision of preparation and recovery before, during, and after caregiving events and procedures

**Direct caregiving interventions**

- Planned timing of caregiving events/procedures
- Provision of energy preservation
- Supportive containment before, during, and after care and procedures
- Provision of time for newborn to recover/rest after care
- Promoting self-regulation by noting newborn behavioral efforts to calm self and support maintenance of behaviors

**Alerting and attention**

Modulation of interaction during newborn alert periods

Providing support to facilitate alerting by:

- Avoiding unnecessary stimulation
- Providing one mode of stimuli at a time
- Reading cues for a time-out throughout care

on his fingers or thumb, holding his head or bringing his hand to his face, holding his own hands, bracing his feet against the uterine wall, tucking into a ball, grasping and holding on to the cord, which is continuously present. As he leaves the womb, he takes with him the ability to suck, grasp, hold on, brace, and tuck. During the days and weeks of illness, these behaviors, so important to the early self-regulatory development, may disappear as caregivers change and opportunities for the newborn to practice these fragile skills are unavailable or inconsistent. However, if caregivers and parents can support the newborn to be positioned to facilitate sucking, bracing the feet, tucking into curled postures, and facilitating grasping and holding on, the newborn will show what was learned in the womb. newborns who, through supportive sensitivity of their caregivers, have been able to resurrect these self-calming behaviors may continue to build them into a self-calming repertoire of successful strategies. It is never too late to begin to offer positions, or supports to aid the newborn to restabilize this range of behaviors. Learning to calm oneself is an important component in later emotional development and the earlier the support is offered, the more successful it can be.

**Table 4.** Guidelines for state management for parents in neonatal intensive care unit

The suggestions given below serve as a guide for parent expectations as parents become members of the healthcare team and are involved in their newborn's care:

1. Expect to participate with staff in modulation of light and noise at the bedside:
  - Discuss and review with staff ways to reduce light around bedside
  - Discuss and review with staff ways to reduce noise around bedside
2. Learn to observe your newborn's sleep patterns, noting how he or she falls to sleep, length of sleeping, and how he or she awakens:
  - Note pattern of light sleep (with rapid eye movements) and patterns of deep quiet restful sleep (with no rapid eye movements)
  - Review with staff possibility of use of containment to support the newborn to sleep and how to maintain sleep
3. Learn ways to support the newborn after nursing caregiving to help newborn transition to being held, or moving to restful sleep or calm awake periods.
4. As the newborn matures, learn ways to enhance periods of quiet awake, including when to interact and when to let the newborn rest.
5. Explore with staff ways in which the newborn can be held and appropriate timing for holding including skin-to-skin.

## HANDLING

The NICU patient is typically immature and extremely sensitive to environmental input including handling. Handling is necessary, but routine procedures and caregiving in the NICU may be overwhelming and place an extreme burden on the vulnerable central nervous system causing agitation, loss of caloric intake, and physiologic compromise. NICU newborns are also often stressed and overwhelmed by the intrusiveness of the NICU lights and noise.

To reduce the impact of stimulation and provide protection for the growing sensitive central nervous system in the high-risk newborn, altering caregiving events so that the newborn can tolerate and maintain physiologic balance is essential. Caregiving that includes touching, turning, pressure on the newborn's skin, stroking, and moving the newborn is inputs that can be potentially exhausting and stressful. Individualized developmental care provides a framework for evaluating the level of newborn arousal and stress and reading the newborn's body language and state changes for clues to the limits of tolerance. Avoiding the newborn's upper limits of stress and staying within the range of the newborn's coping skills are paramount.

Many NICU newborns become easily sensorily overloaded and express their stress in physiologic reactions. Individualized developmental care is designed to preserve energy, achieve physiologic homeostasis, provide appropriate levels of reduced stimulation in a nurturing environment, and increase self-regulation behaviors.<sup>28,31</sup> Individualized developmental care includes environmental modifications (including reduction of light and noise), minimizing disorganized responses, altering caregiving, and handling to promote stability in physiologic function, motor system, and state system function. In addition, the timing and sequencing of all handling events must be examined to reduce costly autonomic system responses.<sup>4,23,25</sup>

## SUPPORTING SLEEP

Sleep behavior includes active sleep and quiet sleep with an additional transition state in which the newborn is either moving into quiet sleep or waking from deep sleep and/or appears to be drowsy. In active sleep the breathing pattern is irregular and movement is minimal.<sup>3,4</sup> A key characteristic of active sleep is the presence of rapid eye movements. Active sleep is the most common sleep pattern from birth through infancy and is prevalent in the premature newborn.<sup>32</sup> The newborn has shifted into quiet sleep when respirations are regular and no body movements are present. An occasional startle may be noted but the newborn appears motionless. Quiet sleep is the state thought to be essential for rest and restoration, as well as healing.

Less mature and premature newborns show significant variations in sleep patterns. Quiet sleep may not appear as quiet, but may be accompanied by whimpers, newborn sounds, and irregular breathing.<sup>4</sup> The absence of REM sleep is one way to recognize quiet sleep in less mature newborns. The quality of sleep varies in the less mature newborn. Quiet sleep may include jerky movements, tremors, and isolated startles. Light or active sleep will demonstrate REM sleep accompanied by disorganized random movements, irregular breathing, facial twitching, whimpers, and grimacing. Als<sup>4</sup> describes this state behavioral range as "noisy." Drowsy may be even more active while asleep, or the newborn may fuss in sleep and demonstrate irregular breathing, variable activity, and movements.

The patterns of state behavior in immature or sick newborns show marked variations from the patterns of full-term healthy newborns.<sup>1,2,9</sup> It has been shown that the activity of routine nursing care, as well as exposure to the neonatal intensive care nursery, results in reduced amounts of quiet sleep.<sup>33</sup> Sleep is also affected by the experience of painful or uncomfortable

procedures.<sup>3,4</sup> Small for gestational age, newborns demonstrate patterns of disorganized active sleep and poor responsiveness during alerting as measured on the BNAS.

Interventions to facilitate stable organized sleep include supporting newborns into calm restful relaxed states with appropriate positioning to lead the newborn gradually into sleep. Staying with newborns until they are asleep and keeping a watchful eye on a sleeping newborn who has reached a sleep state helps maintain the sleep. Containment and support with your hands, as well as supportive blanket rolls, positioning aides and best of all, a parent's loving hands (and maybe voice) will help newborns maintain and achieve more stable restful sleep states. Most important would be observing newborns to learn their patterns of waking, transition into sleep, and patterns of sleep. Helping newborns awaken gradually, waiting for full emergence of arousal before beginning caregiving, especially before feeding, may help an newborn more smoothly transition to awake.

## INTERACTIONS

In addition to sleep, NICU newborns are gradually developing the attention and interaction system that manifests itself in the slowly emerging quality of the newborn's alert state, its availability, and the duration of the newborn's responsivity to external stimuli.<sup>4</sup> It becomes increasingly meaningful for parents who note the newborn's ability to use the alert state to offer beginning interactions with them. The newborn's attention will become more consistently available, however at first, there may be short, and variable alertness periods. Newborns may have periods of hyperalertness or "tired" alertness. Newborns also may demonstrate a range of "time out signals" that are avoidance reactions including looking away, closing the eyes, looking down, or even showing irregular breathing, and skin color changes.<sup>4,7,9</sup> Gradually as the newborn recovers in the NICU, attention becomes brighter, more focused, and more modulated with more active excursions with the eyes to look at the parent's face or aspects of their immediate environment. After weeks of being unable to be face to face in active interaction with their newborn, these moments of connecting, looking, and listening to each other are moments of ecstasy for parents.

## TRANSITION FROM HOSPITAL TO HOME: A GUIDE FOR CAREGIVERS

Full-term newborns who are healthy typically will spend the first 3 to 4 months at home learning how

to sleep in a regular pattern. By 4 months of age the majority of full-term healthy newborns are sleeping through the night. There are differences in patterns of sleep-wake cycles between full-term and preterm newborns, as well as newborns who have been hospitalized since birth and are transitioning home from the intensive care nursery.<sup>9</sup> These differences occur because of the premature newborn's immature central nervous systems, or they may occur because of medical problems. In addition, the increased nutritional demands and metabolic differences of sick newborns lead to variations in sleep patterns.

During the first 3 months at home, full-term newborns may sleep through noise and activity, screening these intrusions from their consciousness. Premature newborns and sick recovering newborns are likely to be sensitive to sounds and visual stimuli in their environment and may wake or fuss often during the night because the ability to "tune out" stimuli from the environment is not as well developed in a recovering newborn as it is in a full-term healthy newborn.<sup>22</sup> As a result, these newborns will be sensitive to multiple stimuli, become irritable in a room full of people, tire out quickly in the grocery store, and cry if placed in active noisy situations such as family parties or restaurants. The multiple sources of excessive stimuli feel overwhelming and stressful to the baby. Parents benefit from clear suggestions prior to discharge from the hospital, to help them avoid overstimulating activities and situations at home.

Some newborns become restless and irritable as they change environments from the NICU to home. At first, they may sleep longer than was observed in the nursery and may cry more than usual. These may be reactions to the change in environments, which for some newborns has been considerable. Usually after a week or 2 at home, the newborn begins to react more calmly and consistently to the new environment. Suggestions for supporting an NICU graduate to adapt to the home environment and transition to more consistent sleep patterns include reducing light and noise, especially during feeding and just before sleep times. Reducing light and noise may also facilitate smoother and brighter alert periods as well. During the first few nights at home, many NICU graduates may benefit from soft music in the background and a nightlight when they are put to sleep. (*Note:* Remember to fade out the use of night lights, music, and/or TV after the first week, to avoid conditioning the newborn to "need" the TV or radio to go to sleep.) Limiting the number of visitors minimizes the stress for newborns and helps them adapt. Feeding may become slow and tiring, and for the newborn may be energy depleting. Lengthy caregiving routines such as bathing, followed by diapering, drying,

and dressing along with a feeding may be too exhausting for a recovering newborn. Keeping a watchful eye on the newborn's behavioral reactions during handling and caregiving events (such as bathing and dressing) to look for signals, which may indicate fatigue or frustration is important. Such signals would include irregular breathing, pale skin color, or loss of energy in the limbs or trunk. Erratic fussiness and inconsolability also may be part of an exhausted or overly tired infant and interfere with establishing more regular periods of sleep.

If sleeping issues continue to be a problem for parents, referral to the newborn's pediatric primary care provider or to a developmental follow-up clinic through the hospital may be necessary for evaluation of the newborn's sleep patterns, particularly if rehospi-

talization occurs and/or the newborn continues to be sick.

State function includes modulation of the newborn's output in response to environmental events and involves a major form of communication between newborns, parents, and caregivers. State also plays a role in assessing the newborn's neurodevelopmental and behavioral status. State clearly plays a necessary and distinct role in the physiologic and behavioral development of NICU newborns. Nurses play a pivotal role in supporting the management of sleep-wake cycles in the NICU and provide guidance for parents as they transition from the hospital to home and take over complete care of their newborn.

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