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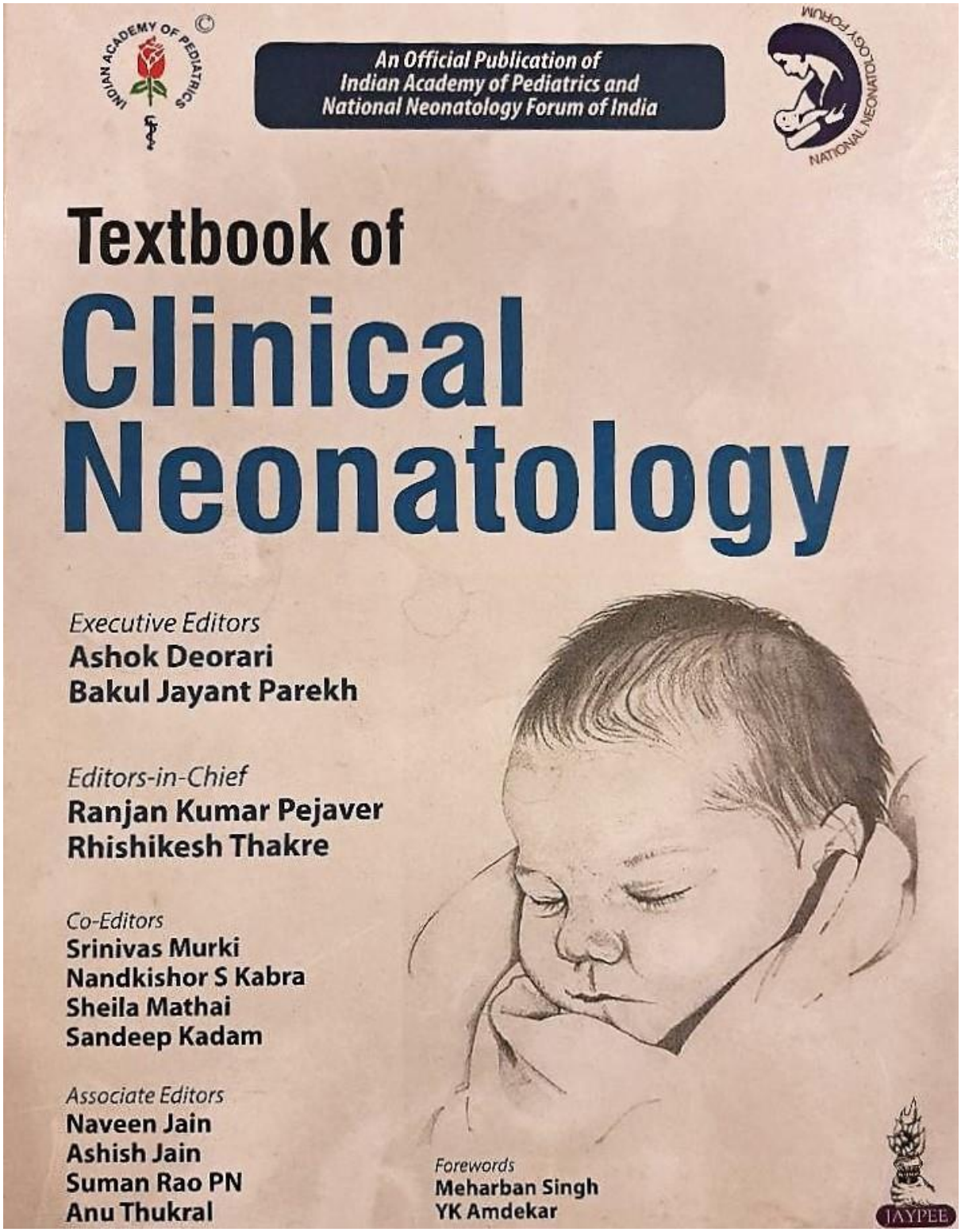

# Textbook of
# Clinical Neonatology

*An Official Publication of Indian Academy of Pediatrics and National Neonatology Forum of India*


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# 5.12 Developmentally Supportive Care

*Amitava Sengupta*

## BACKGROUND

Considerable advances in knowledge, technology, and antenatal/perinatal/neonatal care have led to improved survival of extremely low birth weight (ELBW, birth weight <1,000 g) infants. However, despite these brisk advances in care, morbidity rates of neurodevelopmental impairments in this population have not reduced significantly and remain a cause of major concern. Increased survival of ELBW infants comes at enormous physical, emotional, and financial costs. Premature infants may need to spend many weeks and months in the neonatal intensive care unit (NICU). It is now increasingly clear that newborn infants respond to and are affected by the environment around them.

## THE INTRAUTERINE EXPERIENCE

The maternal womb is favorable for early sensory experiences, which provide positive sensory inputs and are crucial for normal brain development in a growing fetus. The in-utero environment protects the developing fetus from harsh outside stimulation and provides a variety of sensory stimuli in an integrated multimodal manner.

The third trimester is recognized as a period of intense growth and evolution for the fetal brain and central nervous system (CNS). The intrauterine environment provides constant access to the mother and a unique blend of chemical, hormonal, and sensory input that is crucial for normal brain development. The nutritional needs of the fetus are fulfilled via the placenta.

The conceivable nature of intrauterine life supports fetal rapid eye movement sleep, which is critical for neurosensory, auditory, and visual maturation. Light and noise are filtered through the amniotic fluid and solid media, supporting a predetermined sequence of fetal sensory development in which hearing and vision are the last senses to mature. A spectrum of positive auditory stimuli includes maternal voice and heart sound with maternal bowel sounds and blood flow through the placenta and umbilical cord.

Boundaries of the uterine walls provide flexion and gentle secure containment promoting sleep cycle preservation and musculoskeletal development. Maternal movement and fetal activity within warm amniotic fluid offer vestibular, proprioceptive, and tactile stimulation. About 9 months within this nurturing environment prepare term infants for a variety of extrauterine experiences.

## THE NEONATAL INTENSIVE CARE UNIT EXPERIENCE

The NICU environment exposes the micropreemie to a hostile, noisy, and intimidating environment with an array of painful procedures, disturbance in sleep cycles, and separation from mother **(Fig. 1)**.

**Fig. 1:** Neonatal Intensive Care Unit (NICU) environment.
*Courtesy:* With permission from SP Senthil, DSC Foundation for Newborn and Children, India

The preterm infant's brain is extremely sensitive and has limited ability to buffer the enormous environmental inputs of the NICU. Negative sensory inputs in NICU replace positive intrauterine sensory inputs into the developing brain, which may alter normal brain development.

## NEUROPLASTICITY AND NEUROPROTECTION

The newborn brain can create both temporary and permanent changes in its synaptic neuronal connections, which are based upon sensory inputs from different environmental stimuli and experiences. This adaptive capacity is known as neuroplasticity and can either be positive or negative. Neuroprotection includes all strategies that support the developing brain, facilitating normal development, and reducing disability. Parents and caregivers should work together to minimize negative experiences for the preterm infant in the NICU. Various Developmentally Supportive Care (DSC) neuroprotective strategies for preterm are discussed in this chapter.

**What is Developmentally Supportive Care?**

Developmentally Supportive Care practices are evidence-based interventions that promote newborn brain and neurobehavioral development. They support autonomic stability, normal motor, sensory neurological, social, and emotional development with the promotion of behavior state organization. The neurobehaviors are classified across five subsystems: (1) Autonomic/physiologic, (2) Motor, (3) Attention/interaction, (4) States of sleep/arousal, and (5) Self-regulation.

## SYNACTIVE THEORY

The synactive theory provides a theoretical basis for DSC. It was first applied to the population of preterm infants by Als, Lester, and Brazelton in 1979.In this theory, a preterm infant is conceptualized within a dynamic system formed by the interaction among the infant, caregiver, and the environment. This system views the preemie as a developing being, coping with an environment for which he or she is not prepared physiologically or neurodevelopmentally. A central feature of synactive theory is the focus on the neurobehavioral capacity of the infant as the baby develops.

## SELF-REGULATION

The control of four underlying subsystems: (1) physiologic/autonomic, (2) motor, (3) attention/interactional, and (4) state of arousal with neurobehavioral stability evolve initially. These first four subsystems undergo progressive intrauterine refinement and lead to self-regulation (the fifth subsystem). The ability to actively cope with environmental demands and to interact with the environment manifest as self-regulatory behaviors and are used by the infant to maintain or regain a balanced or organized state. Primary examples include when a baby draws into a fetal position and/or sucks on a pacifier to calm. A well-organized/regulated infant with good neurobehavioral capacity maintains a stable temperature, color, heart rate, respiration, and oxygen saturation with good muscle tone. The neonate also maintains tucked flexion at rest and has smooth well-modulated movements during handling.

## ASSESSMENT OF SIGNALS FROM PREMATURE INFANTS

Neonatal caregivers need to understand and react to the individual needs of preterm infants. Als et al. researched preterm infants and identified three types of signals: (1) approach, (2) coping, and (3) avoidance (**Table 1**).

**TABLE 1:** Signals of premature infants.

| *Approach* | *Coping (self-regulation)* | *Avoidance (stress signs)* |
|---|---|---|
| These indicate a baby's well-being and state of happiness. The infant is ready for additional stimulation | These are manifestations of a baby who is trying to cope with various environmental stimuli. This process is also termed as self-regulation | These are manifestations of stress states in an infant |
| • Cooing<br>• Gentle locking<br>• Mouthing<br>• "Ooh" face<br>• Quiet, relaxed, and alert<br>• Smile<br>• Smooth facial expression | • Flexion posture<br>• Drowsy/light sleep<br>• Finger fold and fisting<br>• Finger grasping<br>• Hand on face<br>• Hand to mouth<br>• Hand/foot clasp<br>• Leg brace<br>• Suck search and sucking | • Back arching<br>• Eye floating and gaze aversion<br>• Gape face, grimace, and frown<br>• Finger splay and salute<br>• Flailing<br>• Sitting on air<br>• Spit up and gag<br>• Tongue thrust<br>• Limb extension<br>• Startle, twitch, and tremor |

Developmentally Supportive Care practices are designed to minimize the stress of the NICU environment and include elements such as control of external stimuli (auditory, visual, tactile, olfactory, and vestibular), clustering of nursing care activities to avoid disrupting sleep, positioning, and swaddling of preterm infants with calming technique.

## BENEFITS OF DEVELOPMENTALLY SUPPORTIVE CARE

When in the NICU neonates are under severe and often life-threatening stress, they have immature and fragile autonomic and nervous systems. DSC can give them more reserve to heal, minimize negative effects, and promote the normal development of the nervous system. It also decreases the length of hospital stay, improves weight gain, and shortens time to full enteral feeding with improved neurodevelopmental scores at 9–12 months age. DSC can be provided by anyone who is involved in the care of the newborn in the NICU **(Fig. 2)**.

Five core measures for DSC are depicted in **Flowchart 1**.

These five neonatal core measures were later recategorized and expanded to seven measures in the Neonatal Integrative Developmental Care Model **(Figs. 3 and 4)**.


Fig. 2: Providers of developmentally supportive care (DSC) in the neonatal intensive care unit (NICU).
*Courtesy:* With permission from DSC Foundation for Newborn and Children, India

## NEUROPROTECTIVE INTERVENTION MEASURES

Neuroprotective intervention measures are summarized in **Box 1**.

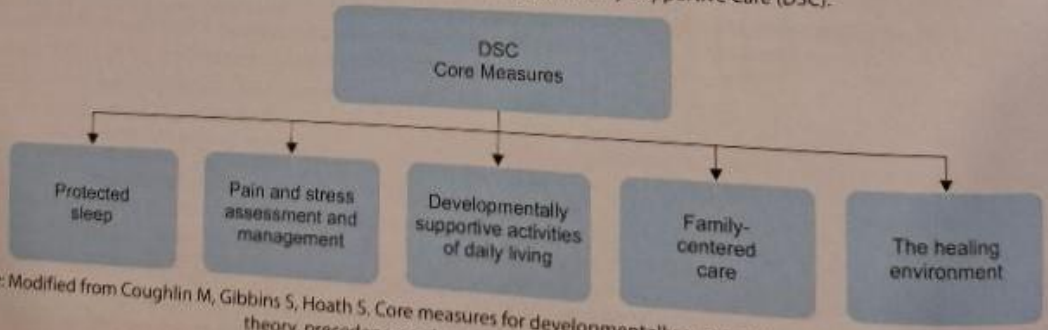
## DEVELOPMENTALLY SUPPORTIVE CARE TOOLS

Proper therapeutic positioning of high-risk infants promotes deep sleep, physiologic stability, normal body flexion, develops the calming ability, saves energy and calories, helps muscle tone, minimizes deformity, helps behavior state regulation, provides a sense of security, and protects the developing brain. **Figures 5 to 7** demonstrate an ideal way of supine, side-lying, and prone positioning techniques.

The following checklist and tool can be used to facilitate the positioning of a newborn in the NICU:

- Positioning checklist [DSC Foundation for Newborn and Children (India)]
- Infant Position Assessment Tool (IPAT) by PHILIPS Children's Medical Ventures **(Table 2 and Fig. 8)**.

**Flowchart 1:** Five Core Measures of Developmentally Supportive Care (DSC).




*Source:* Modified from Coughlin M, Gibbins S, Hoath S. Core measures for developmentally supportive care in neonatal intensive care units: theory, precedence and practice. J Adv Nurs. 2009;65:2239-48.

**BOX 1: Neuroprotective intervention measures.**

**Healing Environment**
- *Space:* Maintain adequate, safe, and private environment for the infant and family
- *Tactile:* Provide soft and gentle touch in all care-giving exchanges. Facilitate skin-to-skin care as soon as possible after birth and then daily by either parent (or caregiver designated by the parent). Provide a neutral thermal environment for the infant incorporating the following factors: In extremely low birth weight (ELBW) infants provide incubator humidity during the first 2 weeks after birth, if it is available. Provide care in an incubator until infant can regulate own temperature
- *Vestibular:* Change the infant's position gradually with no abrupt movements
- *Olfactory:* Maintain a scent-free and fragrance-free unit. Facilitate early, frequent, and prolonged skin-to-skin care. Provide the mother's scent when possible via breast pad, soft cloth, or Snoedel
- *Gustatory:* Position infant with hands near the face. Provide colostrum or expressed breast milk (EBM) oral care per protocol. Provide positive oral feeding experiences as outlined in the "optimizing nutrition" section
- *Auditory:* Minimize noise in neonatal intensive care unit (NICU) to 45–50 dB. Set alarms and phones as low as possible and silence alarms promptly. Use visual alarms. Talk softly at the bedside
- *Visual:* Provide adjustable light levels with dimmers (600 lux for observation; 1,500–2,000 lux for procedures). Cover the infant's eyes during every examination. Protect eyes during phototherapy. Cycling of light according to day and night

**Partnering with Families**
- Acknowledge where the family is regarding stages of grief and loss and provide individualized and appropriate resources as needed
- Actively listen to families' feelings and concerns (both verbal and nonverbal)
- Communicate the infant's medical and developmental needs in a culturally appropriate and understandable manner
- Facilitate early, frequent, and prolonged skin-to-skin care
- Educate parents on how they can participate in the care of their infant at the level they desire and whenever they desire
- Assist parents in becoming proficient in caring for their babies
- Encourage, educate, coach, and mentor parents as they develop confidence in their abilities to continue providing care for their infant after going home

**Positioning and Handling**
- Anticipate, prioritize, and support the infant's individualized needs during every caregiving. Contact to minimize stressors known to interfere with normal development
- Use a validated and reliable positioning assessment tool [such as Infant Positioning Assessment Tool (IPAT)] routinely according to hospital protocol
- Maintain a midline, flexed, contained, and comfortable position at all times using appropriate positioning aids and boundaries
- Provide appropriate prone support to ensure flexed shoulders and hips
- Assess the infant sleep–wake cycle to evaluate the appropriate timing of positioning and caring
- Reposition infant with cares and minimally every 4 hours
- Provide four-handed support during positioning and caring activities
- Provide swaddling when bathing and weighing
- Promote hand to mouth contact
- Educate parents about the principles and techniques of positioning, containment, and handling

**Safeguarding Sleep**
- Individualize all caregiving activities by clustering cares based on the infant sleep-wake cycle
- Pay close attention to infant signs of stress during clustered cares
- If necessary to arouse a sleeping infant, an approach using a soft voice followed by a gentle touch
- Facilitate prolonged skin-to-skin care to promote normal sleep patterns
- Use incubator covers to protect the infant from direct light
- Promote a quiet environment to ensure uninterrupted sleep
- Assure the infant can maintain normal sleep patterns during back-to-sleep well before discharge and role model this behavior
- Provide tummy time/prone-to-play time routinely for infants that are back-to-sleep
- Educate parents about the importance and rationale for back-to-sleep and tummy time

**Minimizing Stress and Pain**
- Provide individualized care in a manner that anticipates, prioritizes, and supports the needs of infants to minimize stress and pain
- Use a validated and reliable pain assessment tool routinely according to hospital protocol
- Provide nonpharmacologic support (positioning, containment, swaddling, pacifier, and sucrose) with all minor invasive interventions
- Use a pain assessment tool to evaluate the need for pharmacologic support
- Involve parents in supporting their infant during painful procedures if they choose by assisting with containment or by providing skin-to-skin holding
- Educate parents on how to read their infant's behavioral cues related to stress and pain and how to provide comforting interventions

**Protecting Skin**
- Provide individualized care in a manner that anticipates, prioritizes, and supports the needs of infants to optimize neuromotor development
- Use a validated and reliable skin assessment tool (such as Braden Q) on admission and routinely according to hospital protocol
- Provide humidity for ELBW infants during the first 2 weeks after birth
- Provide appropriate positioning using gel products to prevent skin breakdown
- Minimize the use of adhesives and use caution when removing adhesives to prevent epidermal stripping

Cont

**TABLE 2:** Modified Infant Position Assessment Tool (IPAT) 2020.

*Patient's name:* *DOB:*
*Gestational age:* *Birth weight:*
*Clinician performing assessment:*
*Date/Time of assessment:*

| *Infant position (circle):* | *Supine* | *Side-lying* | *Prone* | *Date* | | | *Date* | | | *Date* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *M* | *E* | *N* | *M* | *E* | *N* | *M* | *E* | *N* |
| *Indicator* | *0* | *1* | *2* | | | | | | | | | |
| Head | Head rotated laterally (L/R) greater than 45° from midline | Head rotated laterally (L/R) 45° from midline | Head positioned to less than 45° from midline (L or R) | | | | | | | | | |
| Neck | Neck hyper-extended | Neck neutral but poorly aligned with spine | Neck in neutral position and slightly flexed to align with spine | | | | | | | | | |
| Shoulders | Shoulder retracted | Shoulders flat/in neutral | Shoulders softly rounded forward | | | | | | | | | |
| Hands | Hands away from the body | Hands touching torso | Hands touching face<br>Hands on chest in midline | | | | | | | | | |
| Arms | Arms extended | Arms extended | Arms flexed | | | | | | | | | |
| Hip<br>Pelvic position | Hips abducted/ externally rotated and/or in extension | Hips in alignment but extended | Hips aligned and softly flexed | | | | | | | | | |
| Knees, ankles, feet | Knees extended, ankles and feet externally rotated | Knees, ankles, and feet extended | Knees, ankles, and feet are aligned in midline orientation and softly flexed | | | | | | | | | |
| | | | **Total Score** | | | | | | | | | |
| | | | **Heart Rate/Min** | | | | | | | | | |
| | | | **Respiratory Rate/Min** | | | | | | | | | |
| | | | **Oxygen Saturation ($SpO_2$)** | | | | | | | | | |

*Courtesy:* With permission from Philips Children's Medical Ventures.
*Sources:* Modified and prepared by Dr Amitava Sengupta, DSC Foundation for Newborn and Children, India, 2020; Adapted from Infant Position Assessment Tool (IPAT).

Six items are scored on an ordinal scale of 0, 1, and 2.
Minimum score: 0, maximum score 12.
Optimal IPAT core 10–12; ideal acceptable score ≥9.
If score ≤8: Infant needs correction in positioning.

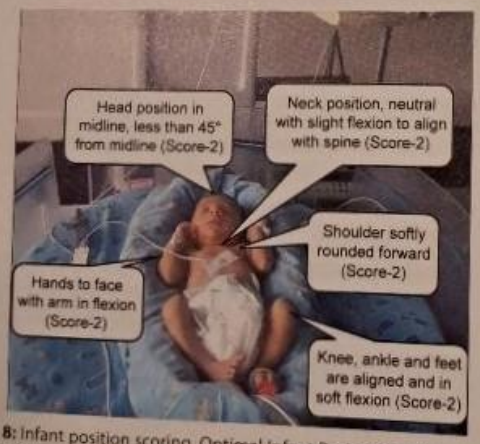



**Fig. 8:** Infant position scoring. Optimal Infant Positioning Assessment Tool (IPAT) score achieved—10/12.
*Photo courtesy:* With permission from Amitava Sengupta, DSC Foundation for Newborn and Children, India

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