



Optimizing Neurodevelopment in Severe Bronchopulmonary Dysplasia

The clinical utility of **BSRI** and **OSST** scores in the longitudinal monitoring and transition to the bedside chronic care model.

Interdisciplinary Presentation of the Neonatal Intensive Care Unit | Integration of Clinical Scores into NeoFast

Source: Susey et al., 2026 (AAP NeoReviews)

BSRI - Behavioral Signs of Respiratory Instability

OSST - Optimal State Scoring Tool

CCBPD - Comprehensive Center for Bronchopulmonary Dysplasia, located at Nationwide Children's Hospital (Columbus, Ohio).

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Other calculations and scores

Search

Reference values

Laboratory, vital signs and measurements by age

Recent

BSRI scale (Behavioral Signs of Respiratory Instability)

Tolerance of infants with severe bronchopulmonary dysplasia

OSST scale (Optimal State Scoring Tool)

Infants with severe bronchopulmonary dysplasia and its relation to linear growth

Silverman-Andersen score

Respiratory distress

Sodium deficit

Therapeutic hypothermia

AAP eligibility criteria

Calculations

Apgar Score

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BSRI scale (Behavioral Signs of Respiratory Instability) - Tolerance of infants with sev...

Interaction

Absent: no eye contact, inconsolable crying or deep lethargy during handling.

Intermittent interaction, rapid fatigue, seeks physical containment support.

Actively alert, sustains eye contact, responds positively to stimulation.

Midline alignment

Unable to bring hands or head to midline; severe axial hypotonia.

Seeks midline alignment but needs continuous manual facilitation and containment.

Brings hands to mouth and keeps the head centered spontaneously or with minimal facilitation.

Extensor movement patterns

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OSST scale (Optimal State Scoring Tool) - Infants with severe bronchopulmonary dys...

Baseline oxygen saturation

Respiratory · Range and stability of the patient's SpO2 at rest.

Yes

No

Active respiratory support

Respiratory · Mechanical ventilation parameters, inspiratory pressure levels or flow (L/min).

Yes

No

Work of breathing during activity

Respiratory · Intensity and severity of retractions during everyday activities.

**Infants with severe
bronchopulmonary dysplasia
are at an elevated risk of
neurodevelopmental delays.**

The **Burden of Impairment (NDI - Neurodevelopmental Impairment)**

- Prolonged delays that impact cognition, language, behavior, and vision.
- Significant motor impairment, encompassing cerebral palsy, postural asymmetries, and coordination disorders.
- Enduring sequelae that continue into adulthood, leading to sustained deficits in executive functions.
- Escalated social and familial expenses resulting from special educational needs and frequent hospitalizations.



Infants with severe bronchopulmonary dysplasia are at an elevated risk of neurodevelopmental delays.

Modifiable Risk Factors in the NICU

- **Chronic Intermittent Hypoxemia** induces rapid variations in oxygenation, leading to inflammation and oxidative stress.
- **Exposure to Sedatives:** Medications including systemic corticosteroids, opioids, and benzodiazepines are directly associated with NDI.
- **Stress and Environmental Distress:** Repeated painful procedures and elevated noise levels modify the brain's white and gray matter.
- **Suboptimal nutrition** elevates respiratory effort and extends the duration of mechanical ventilation, which is a significant predictor of NDI.

**The chronic care model
mitigates instability
and safeguards the
brain.**

Conventional Acute Model (Avoid)

- ✗ Aggressive, rapid, and frequent ventilator weaning predicated on brief blood gas parameters.**
- ✗ An unwavering emphasis on 'weaning at all costs' has resulted in significant episodes of clinical destabilization.**
- ✗ Reflexive escalation in respiratory effort, muscular fatigue, stress, and physiological distress.**
- ✗ Insufficient energy for rehabilitation: the infant expends all available reserves merely to maintain stability.**



Chronic Care Framework



Gradual, strategic, and interdisciplinary weaning, emphasizing sustained physiological stability.

Rational and judicious application of ventilatory support tailored to the chronically altered physiology of bronchopulmonary dysplasia (BPD).

Deliberate reduction of baseline respiratory effort, along with fluctuations and instances of hypoxemia.

Conservation of metabolic energy, fostering linear alveolar development and enhancing tolerance to therapies.

The BSRI scale assesses active respiratory tolerance during therapies in the intensive care unit.

Clinical Item (BSRI)	Score zero (Severe Instability)	Score 2 (Stability/Success)
1. Interaction	Inconsolable weeping, significant lethargy, and an inability to sustain eye contact during interaction.	Alert, engaged, and composed, maintains eye contact with caregivers and responds favorably to stimuli.
2. Midline Alignment	Significant difficulty in positioning the hands and head at the midline; flaccid axial hypotonia.	Brings hands to mouth independently or with minimal assistance, maintaining head alignment.
3. Extension Patterns	Rigid global hyperextension of the trunk and neck (opisthotonus); asymmetry accompanied by extension spasms.	Coordinated movements, comfortable active flexion devoid of atypical patterns of muscle hyperextension.
4. Tachypnea	Significantly increased respiratory rate (>80 breaths per minute) or instances of tachypnea succeeded by apnea.	The respiratory rate (RR) remained within the patient's normal baseline range during activity, typically below 60 breaths per minute.
5. Respiratory Effort	Significant sternal, subcostal, and intercostal retractions accompanied by persistent nasal flaring during manipulation.	Comfortable and stable respiratory effort, without the engagement of accessory muscles during management.

Scores ≥ 8 reflect high functional tolerance. Lower values serve as a warning to stop handling and restraint.

The OSST score assesses multisystem enhancement across four interrelated clinical domains.

1. Respiratory

- Basal resting oxygen saturation
- Level of ventilatory assistance and flow rates
- Intensity of baseline respiratory activity
- Right ventricular performance and pulmonary artery pressure.

2. Neuroregulation

- Management and regulation of waking states
- Quality and duration of typical sleep cycles
- Tolerance and resilience during activities
- Ability for self-regulation and self-soothing

3. Infection and Inflammation

- Exposure to growth-inhibiting corticosteroids
- Presence of multiple central venous access sites
- Assessment of systemic inflammatory markers
- Regulation of pulmonary fluid equilibrium (diuretics)

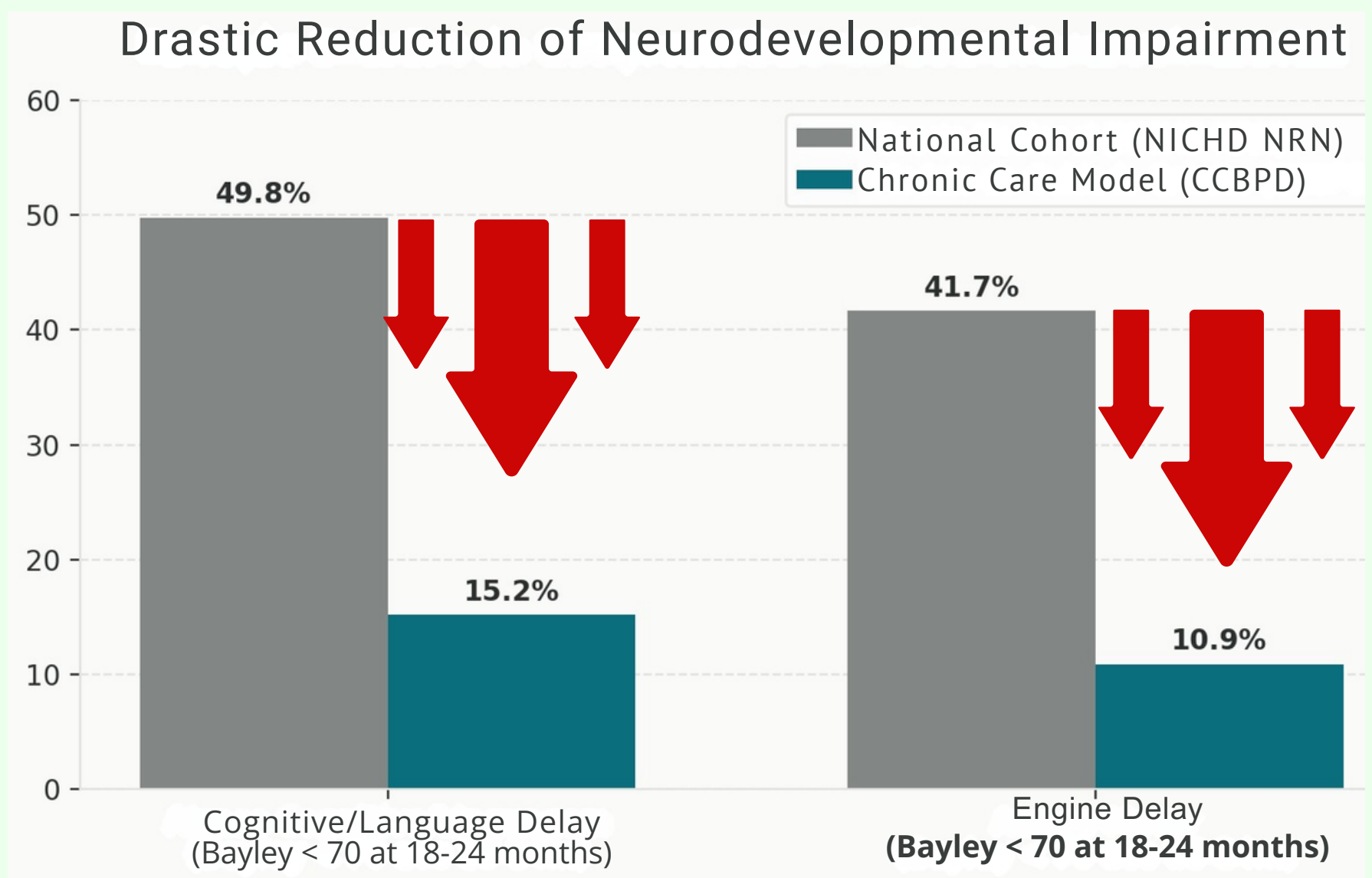
4. Nutrition and Growth

- Rate of weight increase (g/kg/day)
- Linear growth / weekly height (cm/week)
- Proportionality of the weight-to-length relationship
- Metrics of metabolic health and bone mineral density

The interdisciplinary CCBPD program has decreased severe developmental delays by over 60%.

Clinical Impacts of the Interdisciplinary Model

- **Reduction in Cognitive and Language Delay:** a significant decrease from 49.8% to merely 15.2% in the proportion of Bayley III scores below 70 at 2 years of corrected age.
- **Motor Skills:** a **significant decline** from 41.7% to 10.9% in the prevalence of **severe motor delay**.
- **Proven Safety:** The developmental intervention, which promotes touch, active positioning, and gradual stimulation, has not been demonstrated to elevate the rates of accidental extubation.



Immediate actions incorporate the scores into the routine and electronic medical record.

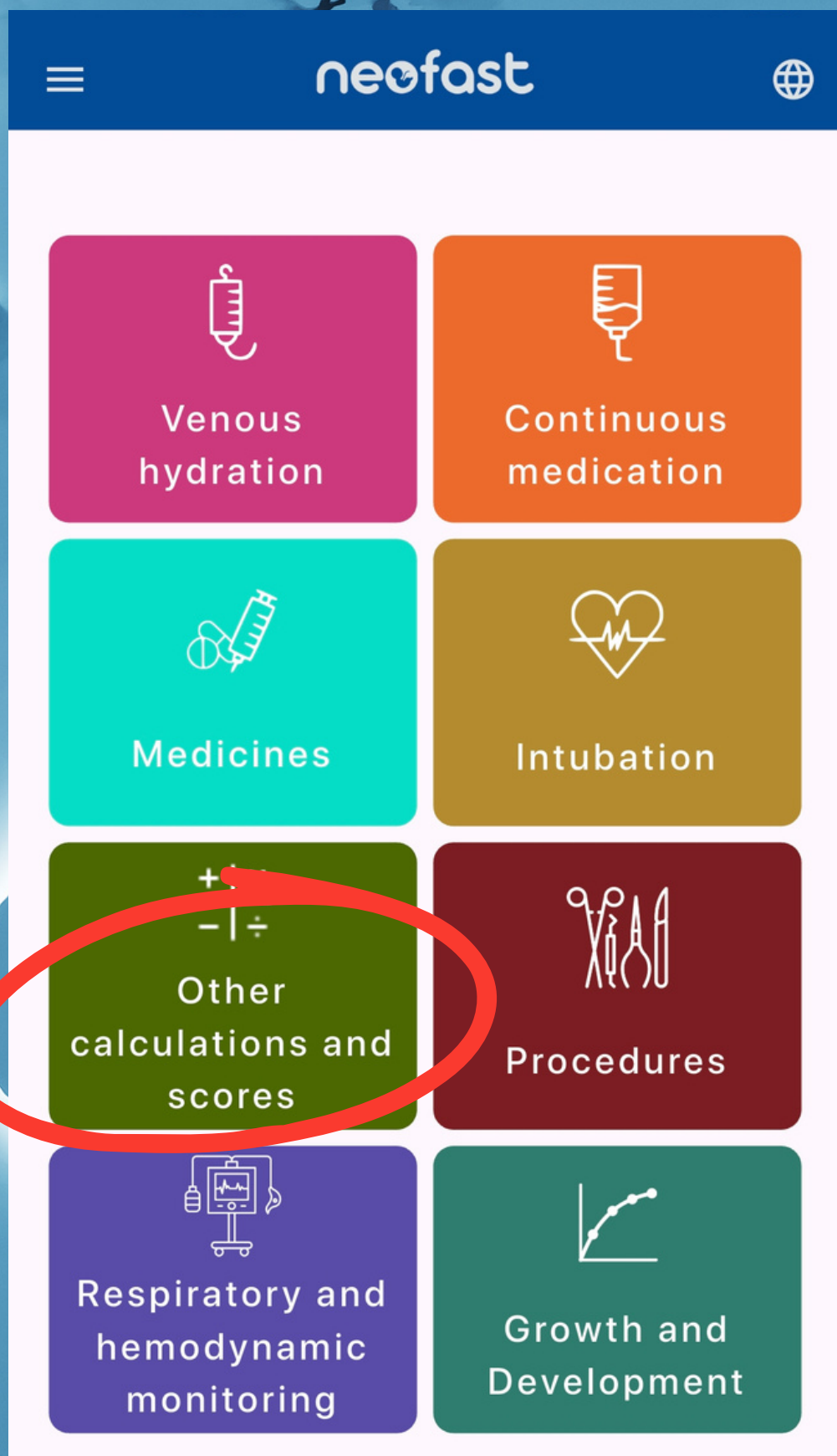
Training and Standardization

- Train therapists and nurses to administer and document the BSRI score during each motor stimulation session.
- Coordinate the medical and nutrition teams to conduct the OSST scoring on a weekly basis.
- Employ the notes in a cohesive manner during the weekly multidisciplinary rounds.

Clinical determinations

- Defining low OSST/BSRI scores as automatic impediments necessitating temporary weaning delays.
- Monitoring linear growth and fluid balance are essential criteria for clinical success and safety.
- Document the Bayley III results and scores acquired during the 2-year follow-up to produce comprehensive reports.

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