

# The NICU Network Neurobehavioral Scale (NNNS) Assessment: A Brief Overview

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# DISCLOSURE

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- ▶ I am a research assistant with UNC School of Medicine, UNC Horizon's OB/GYN department and have received training and certification for the NNNS assessment.
- ▶ I am not paid or endorsed by the authors to provide this presentation.
- ▶ This presentation is intended to give a brief overview of the NNNS assessment and is in no way to be used for any type of training purposes.
- ▶ Training and certification is required to use the NNNS assessment—information about training will be provided at the end of this presentation.

# The NICU Network Neurobehavioral Scale (NNNS)

- ▶ Developed by Barry M. Lester & Edward Z. Tronick the NNNS is a comprehensive neurobehavioral assessment designed for standardized administration & scoring with demonstrated reliability. The NNNS is intended to assess three components of a newborn which are:
  - ▶ **Neurological:** Motor reflexes (suck reflex, moro reflex, grasp reflex, etc.) , muscle tone (active and passive), neurophysiological function (skin tone, respiration, etc.)
  - ▶ **Behavioral:** Self-regulation, alertness, attention, consolability
  - ▶ **Signs of Stress/Abstinence:** Observations made throughout the exam indicating signs of stress/abstinence behavior and withdrawal, particularly useful for infants exposed to toxic substances

# What are the benefits?

- ▶ **RESEARCH:** The NNNS assessment and NNNS summary scores can be used as a comprehensive biomarker of infant neurobehavior.
- ▶ **HOSPITAL:** The NNNS can inform discharge planning and early intervention referrals.
- ▶ **HOME:** The NNNS can provide parents with a better understanding of how their newborn responds and regulates to stimulation (i.e. light, sound, touch) so that they can provide a more accommodating environment for their baby.

# When Is NNNS Appropriate to Administer?

- ▶ Appropriate for infants who are medically stable in an open crib/isolette.
- ▶ Age range: ~33 - 48 weeks (see manual for most recent changes)
- ▶ Modifications are required for preterm infants of early gestation i.e. 28-33 GA



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- ▶ One administration of the NNNS may not be the most accurate representation of the newborn and additional administrations may be helpful.
  - ▶ Repeated NNNS assessments may show change overtime or no change—indicating negative change and necessitating early intervention services.

# States 1-6

1. **Quiet Sleep (State 1):** Sleep with regular breathing, eyes closed, no spontaneous activity except startles or jerky movements at quite regular intervals; external stimuli produce startles with some delay; suppression of startles is rapid; state changes are less likely than from other states; and no eye movement.
2. **Active Sleep (State 2):** Sleep with eyes closed; rapid eye movements often can be observed under closed lids; low activity level, with random movements and startles or startle equivalents movements are likely to be smoother and more monitored than in State 1; responds to internal and external stimuli with startle equivalents, often with a resulting change of state. Respiration is irregular; sucking movements occur on and off. Eye opening may occur briefly at intervals.
3. **Drowsy (State 3):** Eyes may be open but dull and heavy lidded, or closed, eyelids fluttering; activity level minimal, may be reactive to sensory stimuli, but response often delayed. Movements are usually smooth though there may be startles. Infant has a dazed appearance and is minimally reactive even when his or her eyes are open. This is also considered to be “transitional” and is sometime difficult to score. Some infants may also show fuss/cry vocalizations in this state. When this happens, State 3 may be difficult to distinguish from State 5. The minimal movement in State 3 and considerable movement in State 5 is what distinguishes State 3 from State 5 when both are accompanied by fuss/cry vocalizations.
4. **Quiet Awake (State 4):** Alert, eyes open with bright look and appropriate changes in facial expression as stimulation is varied; focuses attention on source of stimulation, or a visual or auditory stimulus. Motor activity is minimal. There can be a glazed look that is easily changed into a brighter look with appropriate stimulation.
5. **Active Awake (State 5):** Eyes likely to be open, considerable motor activity, with thrusting movements of the extremities, and even a few spontaneous startles; reactive to external stimulation with increase in startles or motor activity, but discrete reactions difficult to distinguish because of general activity level. Brief fussy vocalizations can occur in this state. Some infants may transition directly from lower states (1,2, or 3) directly to State 5. These often are the cases described above in which fuss/cry vocalizations occur and State 5 and State 3 are difficult to distinguish unless the differences in motor activity are taken into account.
6. **Crying (State 6):** Characterized by intense, loud, rhythmic, and sustained cry vocalizations, which are difficult to break through with stimulation; motor activity is high. It is important to distinguish between crying as a state from the fuss/cry vocalizations that can occur in State 5 and even State 3. Some infants show repeated episodes of fuss/cry vocalizations in State 5 but may not reach State 6. This may also be a maturational issue, as some preterm infants may not have the energy reserves to sustain State 6. In general, State 6 can be distinguished from State 5 by the intensity and sustained quality of the crying (at least 25 seconds) and unavailability of the infant in State 6. Repeated brief episodes of fuss/cry in State 5 do not mean that the infant has moved into State 6. Premature administration of consolability and cuddling maneuvers may prevent the infant from reaching State 6 and provide an inaccurate assessment of the infant.

# Packages

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- A. Pre-Examination Observation:** Document the **Initial State Observation** without waking the infant
- B. Habituation** (State 1 or 2): Based on the infant's ability to shut down, suppress, diminish, or delay response to a stimulus (light, rattle, bell)
- C. Unwrap and Supine:** Posture (State 1-5), Skin Color (State 1-5), Skin Texture (State 1-5), Movement (State 1-4), Response Decrement to Tactile Stimulation of the Foot (State 1-3)
- D. Lower Extremity Reflexes** (State 3-5): Plantar Grasp, Babinski Reflex, Ankle Clonus, Leg Resistance, Leg Recoil, Power of Active Leg Movements, Popliteal Angle
- E. Upper Extremities and Face** (State 3-5): Scarf Sign, Forearm Resistance, Forearm Recoil, Power of Active Arm Movements, Rooting, Sucking, Grasp of Hands, Truncal Tone, Pull to Sit
- F. Upright Responses** (State 3-5): Placing, Stepping, Ventrical Suspension, Incurvation
- G. Infant Prone** (State 3-5): Crawling, Stimulation Needed, Head Raise in Prone
- H. Pick Up Infant** (3-5): Cuddle in Arm, Cuddle on Shoulder
- I. Infant Supine on Examiner's Lap** (State 4-5): Orientation Inanimate Visual (ball), Orientation Inanimate Auditory (rattle), Orientation Inanimate Visual and Auditory (rattle), Orientation to Animate Visual (face), Orientation to Animate Auditory (voice), Orientation to Animate Visual and Auditory (face & voice)
- J. Infant Spin** (State 3-5): Tonic Deviation of Head and Eyes
- K. Infant Supine in Crib** (State 3-5): Defensive Movements, Asymmetrical Tonic Neck Reflex (ATNR), Moro Reflex

# Scoring

## Scoring is comprised of 3 Parts:

- ▶ **Part I : Examination**-items are scored based on specific procedures that involve direct manipulation of the infant within the preferred order of administration (A-K).
- ▶ **Part II: Examiner Ratings**- The examiner's observations taken during the course of the examination.
- ▶ **Part III: Stress/Abstinence Scale**– records the presence of absence of each condition as observed of the entire examination.

-Lester, B. M., & Tronick, E. (2005). *Nicu Network Neurobehavioral Scale (Nnns) manual*. Baltimore: Paul H. Brookes Pub. Co

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- ▶ The examiner cannot score during the assessment.
  - ▶ The examiner must read and review the manual while scoring!



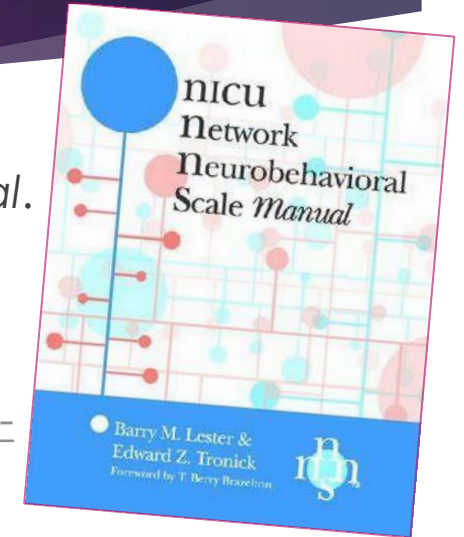


# Training and Certification

- ▶ Training and certification is required and essential to administer the NNNS, in which one must meet specified criteria in administration of the items and scoring.
- ▶ Trainees are available in Europe, South America, Southeast Asia, New Zealand, and the United States.
- ▶ The amount of practice depends on prior experience in handling newborns. Some people need 2 days, others may need several months and may need to practice with 20-30 infants.
- ▶ Training opportunities can be found throughout the world (see link for more information):  
<https://www.brown.edu/research/projects/children-at-risk/about/nnns-training-and-certification-program-0>

# Resources

- ▶ Lester, B. M., & Tronick, E. (2005). *Nicu Network Neurobehavioral Scale (Nnns) manual*. Baltimore: Paul H. Brookes Pub. Co.
- ▶ <https://www.jove.com/video/3368/assessment-evaluation-high-risk-neonate-nicu-network-neurobehavioral>
- ▶ <https://www.jove.com/pdf/3368/jove-protocol-3368-assessment-evaluation-high-risk-neonate-nicu-network-neurobehavioral>



- ▶ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3839620/>
- ▶ [https://pediatrics.aappublications.org/content/pediatrics/113/Supplement\\_2/641.full.pdf](https://pediatrics.aappublications.org/content/pediatrics/113/Supplement_2/641.full.pdf)

# Table of Contents

- ▶ Lester, B. M., & Tronick, E. (2005). *Nicu Network Neurobehavioral Scale (Nnns) manual*. Baltimore: Paul H. Brookes Pub. Co.
- ▶ Lester, B. M., & Tronick, E. Z. (2004). History and description of the neonatal intensive care unit network neurobehavioral scale. *Pediatrics*, 113(3), 634-640.
- ▶ Tronick, E., & Lester, B. M. (2013). Grandchild of the NBAS: the NICU network neurobehavioral scale (NNNS): a review of the research using the NNNS. *Journal of child and adolescent psychiatric nursing : official publication of the Association of Child and Adolescent Psychiatric Nurses, Inc*, 26(3), 193–203. <https://doi.org/10.1111/jcap.12042>