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Pediatrics 2004;113;641-667
DOI: 10.1542/peds.113.3.S1.641

This information is current as of October 19, 2006

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located on the World Wide Web at:

<http://www.pediatrics.org/cgi/content/full/113/3/S1/641>

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The Neonatal Intensive Care Unit Network Neurobehavioral Scale Procedures

Barry M. Lester, PhD* and Edward Z. Tronick, PhD‡ in collaboration with T. Berry Brazelton, MD§

ABSTRACT. The procedures for the Neonatal Intensive Care Unit Network Neurobehavioral Scale includes a brief background, description of the examination, key concepts, a summary of the procedures, and order of administration of the items described in "packages," information about the testing kit, scoring issues, and summary scores. This is followed by presentation of the 115 items that are scored. Each item is described, including (where appropriate) specific procedures for how to manipulate or handle the infant. Rating scales with scoring criteria are provided for each item. With training and certification, users of the manual will be able to reliably administer and score the Neonatal Intensive Care Unit Network Neurobehavioral Scale. *Pediatrics* 2004;113:641-667; *NICU Network Neurobehavioral Scale, NNNS, manual, scoring criteria.*

ABBREVIATIONS. NNNS, Neonatal Intensive Care Unit Network Neurobehavioral Scale; CNS, central nervous system; ATNR, asymmetrical tonic neck reflex.

BACKGROUND

The Neonatal Intensive Care Unit Network Neurobehavioral Scale (NNNS) examines the neurobehavioral organization, neurologic reflexes, motor development, and active and passive tone as well as signs of stress and withdrawal of the at-risk and drug-exposed infant. The NNNS draws on prior examinations including the Neonatal Behavioral Assessment Scale,^{1,2} the Neurologic Examination of the Full-Term Newborn Infant,³ the Neurologic Examination of the Maturity of Newborn Infants,⁴ the Neurobehavioral Assessment of the Preterm Infant,⁵ and the Assessment of Preterm Infants Behavior.⁶

Early neonatal examinations emphasized neurologic assessment of tone and primitive reflexes based on the French school under André-Thomas,⁷ followed by the work of Saint-Anne-Dargassies⁸ and Amiel-Tisson.⁴ The examination developed by Prechtl³ provides a comprehensive evaluation of the classic reflexes. In a departure from previous work,

Brazelton^{1,2} developed an assessment with a behavioral orientation.

Various examinations were developed for different purposes. Prechtl³ wanted to document the condition of the nervous system. Brazelton and his colleagues^{2,6} wanted to document the behavioral repertoire of the term and preterm infant. The goal of the Neurobehavioral Assessment of the Preterm Infant is to describe the relative maturity of functioning in preterm infants.⁵ Examinations developed by Dubowitz et al⁹ and Ballard et al^{10,11} were designed as clinical assessments of the gestational age of the newborn infant.

The NNNS was developed for the National Institute of Child Health and Human Development (NICHD) Neonatal Intensive Care Unit Research Network as part of a multisite maternal lifestyle study of the effects of prenatal drug exposure on child outcome. The NNNS was designed to provide a comprehensive assessment of both neurologic integrity and behavioral function. We also wanted to document the range of withdrawal and stress behavior likely to be observed in a study of substance-exposed infants. Traditionally, scales that measure neonatal abstinence such as the Neonatal Abstinence Score¹² are treated separately from neurologic and behavioral evaluation, although there is some overlap in what is assessed. We felt that a stress/abstinence scale could be incorporated into a neurobehavioral scale by recording signs of stress and withdrawal observed during a neurobehavioral examination. Thus, in addition to using the behavioral items developed by Brazelton,¹ the NNNS provides a neurologic examination and a separate stress/abstinence scale.

The NNNS is applicable to term, normal healthy infants, preterm infants, and infants at risk due to factors such as prenatal substance exposure. The examination should be performed on infants who are medically stable, preferably in an open crib or Isolette. Although a precise lower gestational age limit cannot be set, the complete examination is probably not appropriate for infants <30 weeks' gestational age. The upper age limit may also vary depending on the developmental maturation of the infant. A reasonable upper age limit is 46 to 48 weeks (corrected or conceptional age, ie, weeks' gestational age at birth plus weeks since birth).

Key Concepts

With the development of several infant examinations, a number of key concepts emerged that en-

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Received for publication Apr 28, 2003; accepted Oct 8, 2003.

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hance our understanding and assessment of the neurobehavioral organization of the newborn. Many of these concepts are included in the NNNS.

Infant State

The concept of infant state described variously by Wolff¹³ and Precht¹³ has become a cornerstone for the administration of reflexes³ and behavior.¹ In the NNNS, an appropriate state or range of states is specified for each item, and the item can be administered only when the infant is in the predefined state. Thus, state becomes the precondition or matrix within which items are administered.

Rapport

To be sensitive to the infant, the examiner must develop a certain level of rapport with the infant. The examiner establishes an interactive relationship with the infant based on the individual qualities of the infant, and within that relationship the infant's performance can be evaluated. This is an issue of "style" and has implications for training as well as the possibility of introduction of examiner effects in the examination.

Semistructured

In an unstructured examination, a number of problems arise. The primary problem is that different examiners may do the examination differently and elicit different behavioral qualities in the infant. The infant's scores can be affected by these stylistic differences. Thus, the scoring reflects the examiner-infant interaction rather than the infant's performance when faced with a standard challenge. The solution is not a rigidly standard examination, because an inflexible examination does not always elicit the infant's full behavioral capacities. The NNNS attempts to overcome this problem in several ways. First, it carefully defines and limits when items can be administered based on the infant's state. This state-dependent administration is inherently structured and sensitive. Second, it has a relatively invariant sequence in which items are administered. By "relatively" invariant, we mean that the specified sequence is one that is strongly preferred by experienced examiners because it can be achieved by most infants; nonetheless, it allows for modification in the service of achieving best performance if infant state requirements are not met. In addition, the order of administration and deviations from the standard sequence are recorded, and individual differences in examiner style are minimized by training and ongoing reliability assessments of administration and scoring.

Packages

In the NNNS, items are grouped into packages that produce a standard sequence with which to challenge the infant. The preferred sequence has the advantage that whenever the infant's position is changed, as many items as possible are administered in that new position so as to reduce unnecessary manipulation and state changes. In the following, the terms in uppercase letters refer to the packages de-

scribed in the next section (see "NNNS Procedure"). After the PREEXAMINATION OBSERVATION and HABITUATION items, the infant is unwrapped and placed in a supine position (UNWRAP AND SUPINE). LOWER EXTREMITY REFLEXES are administered, followed by reflexes of the UPPER EXTREMITIES AND FACE ending with PULL TO SIT. The UPRIGHT RESPONSES, including placing, stepping, and incurvation, are then administered, followed by putting the INFANT PRONE for crawling. The next maneuver for the examiner is to PICK UP INFANT and cuddle in arm and on shoulder. For many infants, the examination can be administered smoothly in this sequence up to this point. All of these items can be administered in or around the crib given that the infant was in a sleep state at the beginning of the examination. The examiner then places the INFANT SUPINE ON EXAMINER'S LAP for the Orientation items, followed by the INFANT SPIN responses, which include tonic deviation of head and eyes and nystagmus. Finally, the examiner places the INFANT SUPINE IN CRIB for the defensive response, the asymmetrical tonic neck reflex (ATNR), and the Moro reflex. Consolability is administered when appropriate.

Neurologic Status

The selection of neurologic items chosen for the NNNS was based on several considerations. First, items were selected to provide a valid assessment of the neurologic integrity and maturity of the infant. Second, items were selected based on their demonstrated clinical utility and empirical validation. Third, neurologic items were chosen to represent the various "schools" such as the French angles method⁴ and the primitive reflexes method.³ Many items were omitted because they were redundant with other items or they have shown little utility in research studies. We also limited the number of neurologic items to balance this part of the examination with the behavioral part of the examination so that the examination could be completed within 30 minutes and not cause undue fatigue or stress for the infant. The state of the infant is specified for each reflex. The optimal response, if it is applicable, is in bold type for reference. This does not mean that nonbolded responses are abnormal. For most responses there is a wide range of normal. The optimal response is only meant as a point of reference.

Muscle Tone

Muscle tone refers to the "slight constant tension of healthy muscles which contribute a slight resistance to passive displacement of a limb."¹⁴ Muscle tone exerts a continuous background influence on both passive and active movement. In the NNNS, tone is assessed under both active and passive conditions. Active tone is assessed while observing spontaneous motor activity, including efforts at self-righting. Passive tone can be assessed during the posture, scarf sign, popliteal angle, and forearm and leg recoil. Both active and passive tone may be influenced by the state of the infant, the position of the infant (ie, prone, supine, or supported upright), or

the effects of postural reflex activity. When assessing muscle tone, both the distribution (proximal versus distal) and the type (extensor versus flexor) of tone should be described, because in the developing infant, proximal tone in the neck and trunk may differ from distal tone in the extremities.

Stress/Abstinence Scale

Most work documenting signs of stress in drug-exposed infants involves the use of signs of abstinence or withdrawal in infants of narcotic-addicted mothers. These are usually infants born to heroin-addicted or methadone-dependent mothers. Less-potent opiates have been identified as precipitating a neonatal opiate abstinence syndrome, and some non-opiate central nervous system (CNS) depressants have also been implicated.

In work to date with cocaine-exposed infants, neonatal abstinence symptomatology does not seem to be increased.^{15,16} However, abstinence may occur as a result of the depressants and narcotics that the mother may have used concomitantly with cocaine. In addition, cocaine-exposed infants may show signs of stress other than those associated with the abstinence syndrome, which may include signs of stress unique to cocaine-exposed infants or signs of stress similar to those observed in preterm and high-risk infants.

The Stress/Abstinence Scale in the NNNS is a checklist that includes traditional items that reflect neonatal abstinence described by Finnegan.¹² In addition, we added other signs of stress that have been described in cocaine-exposed infants as well as signs of stress typical of other high-risk infants including preterms.⁶ It is scored after the examination along with the other items.

Summary

The NNNS is designed to provide a comprehensive examination of the normal and at-risk neonate. The examination includes 3 parts: 1) the more classical neurologic items that assess active and passive tone and primitive reflexes as well as items that reflect CNS integrity; 2) behavioral items including state and sensory and interactive responses; and 3) stress/abstinence items particularly appropriate for high-risk infants. The NNNS enables us to describe developmental and behavioral maturation, CNS integrity, and the kinds of stress responses that infants show when examined.

NNNS Procedure

As discussed earlier, NNNS items are administered in packages, with each package beginning with a change in position or focus of the examination. The order of administration of packages and items is meant to be relatively invariant. The following is a summary of the packages and their respective items in the preferred order of administration (Table 1; see Appendix 1, later in this issue, for the scoring form).

Alternatives to this order may be required with some infants. For example, if the infant is not in an alert state or cannot be brought to an alert state when supine on the examiners lap, it may be necessary to

TABLE 1.

Package	Items
A. Preexamination Observation	Initial state observation (infant asleep and covered)
B. Habituation	Response decrement to light Response decrement to rattle Response decrement to bell
C. Unwrap and Supine	Posture Skin color Skin texture Movement Response decrement to tactile Stimulation of the foot
D. Lower Extremity Reflexes	Plantar grasp Babinski Ankle clonus Leg resistance Leg recoil Power of active leg movements Popliteal angle
E. Upper Extremities and Facial Reflexes	Scarf sign Forearm resistance Forearm recoil Power of active arm movements Rooting Sucking Hand grasp Truncal tone Pull-to-sit
F. Upright Responses	Placing Stepping Ventral suspension Incurvation
G. Infant Prone	Crawling Stimulation needed Head raise in prone
H. Pick up Infant	Cuddle in arm Cuddle on shoulder
I. Infant Supine on Examiner's Lap	Orientation (order not predetermined): Animate visual and auditory Animate visual Animate auditory Inanimate visual and auditory Inanimate visual Inanimate auditory
J. Infant Spin	Tonic deviation of head and eyes Nystagmus
K. Infant Supine in Crib	Defensive response Asymmetrical tonic neck reflex Moro reflex
L. Postexamination Observation	Postexamination state observation

administer the Orientation items at a later point during the examination when the infants is alert. For some infants, the examiner may need to rearrange the packages but can maintain the preferred sequence within the packages, whereas for others, the items must be administered without regard for the preferred order of either packages or items within packages. Finally, although every effort should be made to start with a sleeping infant, in some cases this is not possible and the Habituation items cannot be administered first. These alternatives are recorded in "Order of Administration" (item 65).

Stress/Abstinence Scale

The NNNS also includes a stress/abstinence scale divided into 7 categories: physiologic, autonomic, CNS, skin, visual, gastrointestinal, and state. These

items are noted if they occur, and their occurrence is noted, for the most part, regardless of the state of the infant. The following items are scored with definitions included later in the procedures (see Table 2).

Equipment and Supplies

For the NNNS, the following equipment is needed: standard 8-inch flashlight, red ball, red rattle, bell, foot probe, head supports, watch, and the NNNS scoring form. Before starting the examination, the examiner should make sure that all equipment and supplies are ready and in working order. It is not necessary to change or even check the infant's diaper before or during the examination unless a dirty diaper is clearly interfering with the administration of

the examination. Changing the diaper requires additional handling and may disrupt the examination.

Order of Examination Items in the Procedures

The examination items first described in the procedures score specific procedures in the preferred order of administration (items 1–45). The next group of items are summary scores made during the course of the examination (items 46–65). The final group of items is the Stress/Abstinence Scale, with which the examiner records the presence or absence of each condition over the entire examination (items 66–115). The NNNS scoring form is organized similarly except that the examination items are scored in "Part I: Examination," and the stress/abstinence items are scored in "Part II: Stress/Abstinence Scale." Both the procedures and scoring form specify the appropriate state(s) in which the assessment of each item can be made.

TABLE 2.

Package	Items
M. Physiological	Labored breathing Nasal flaring
N. Autonomic	Sweating Spit-up Hiccoughing Sneezing Nasal stuffiness Yawning
O. CNS	Abnormal sucking Choreiform movements Athetoid postures and movements Tremors Cogwheel movements Startles Hypertonia Back arching Fisting Cortical thumb Myoclonic jerks Generalized seizures Abnormal posture
P. Skin	Pallor Mottling Lividity Overall cyanosis Circumoral cyanosis Periocular cyanosis
Q. Visual	Gaze aversion during orientation Pull-down during orientation Fuss/cry during orientation Obligatory following during orientation End point nystagmus during orientation Sustained spontaneous nystagmus Visual locking Hyperalertness Setting sun sign Roving eye movements Strabismus Tight blinking Other abnormal eye signs
R. Gastrointestinal	Gagging/choking Loose stools, watery stools Excessive gas, bowel sounds
S. State	High-pitch cry Monotone-pitch cry Weak cry No cry Extreme irritability Abrupt state changes Inability to achieve quiet awake state (state 4)

Missing Data Codes for Specific Procedures Items

Codes 95 to 99 are used to identify reasons why an item cannot be scored. Each item contains only those codes that are logical outcomes of the specific manipulation or observation. Code 95 indicates that the item was started but discontinued because the infant's response lasted too long (eg, Habituation items). Code 96 indicates that the item was not administered because the infant did not respond after gentle prodding (eg, Habituation items). Code 97 indicates that the item was started but discontinued because the infant changed to an inappropriate state. Code 98 indicates that the item was not administered because the infant was in an inappropriate state. Code 99 indicates that the item was inadvertently skipped by the examiner (eg, items 1–45). To accommodate the special format of the skin-texture item (item 7), missing data due to examiner error should be indicated by using an error/edit code for permanently missing data.

Scoring of Asymmetries During Reflexes

For many reflexes, the left and right sides of the infant are evaluated separately. The scoring system is designed to reveal systematic asymmetries across items. Whenever possible, the optimal response is in bold type for reference. When an asymmetric response occurs, the examiner should score both sides separately.

Summary Scores

Summary scores include Habituation, Orientation, Amount of Handling, State, Self-Regulation, Hypotonia, Hypertonia, Quality of Movement, Number of Stress/Abstinence Signs (which also can be computed by system), and Number of Nonoptimal Reflexes. Summary score definitions and calculations are shown in Appendix 2 (later in this issue).

Preparation Before the Examination

If the infant is asleep, he or she should not be undressed. The Preexamination Observation and Habituation packages should be administered before undressing the infant. If the infant is in a state 6, the

infant should be consoled before starting the examination. If the infant cannot attain a lower state than 6, the examination cannot be administered. If the infant is not in a sleep state and Habituation items cannot be administered first, the examination should begin with item 5, posture. A postural adjustment can be elicited by turning the head to the side and repositioning in midline.

State

Because an infant's reactions are state-related, it is extremely important that observations of state be considered as a starting point from which all other observations are made. Before starting the examination, a careful assessment must be made of the state of the infant. The infant should start off in a sleep state that has been maintained for at least 45 minutes if at all possible. The examination should never be started just after the infant has fallen asleep. The ideal time to administer the examination is when the infant is asleep and midway between feeding cycles. A configuration of behavioral and physiologic characteristics must last at least 15 seconds to be considered a state.

Scores

Sleep States

1. 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; no eye movements.
2. State 2: Sleep with eyes closed; rapid eye movements can often 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.

Awake States

3. State 3: Drowsy or semidozing; 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, although there may be startles; infant has a dazed appearance and is minimally reactive even when eyes are open. This state is considered to be "transitional" and is sometimes 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 (below). What distinguishes state 3 from state 5 when both are accompanied by fuss/cry vocalizations is the minimal movement in state 3 and considerable movement in state 5.
4. State 4: Alert, eyes open with bright look and appropriate changes in facial expression as stim-

ulation 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. 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 are 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 are often the cases described above in which fuss/cry vocalizations occur and states 5 and 3 are difficult to distinguish unless the differences in motor activity are taken into account.
6. State 6: Crying; characterized by intense, loud, rhythmic, and sustained cry vocalizations that 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, because 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 15 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. Examiners need to give the infant the opportunity to show 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.

Initial State

In the 2 minutes before stimulation is begun, an assessment of the infant's state is made by observing spontaneous behavior, respiration, eye movements, startles, and activity. When the examiner begins administration of the items, the last state that the infant was in for at least 15 seconds is recorded as the "initial state." If the infant is changing states within the 2-minute observation period, the examiner should try to begin the Habituation items when the infant is in state 2. Observation of the infant's activity during these 2 minutes also serves as the baseline for observing the infant's reactivity to the Habituation items.

Predominant States

At the end of the examination period, the examiner records the predominant state and second-most predominant state that the infant has been in over the course of the examination (excluding the Habituation items in both cases). Because the most important influence on the infant's scores will be the state in which the infant is observed, it is important to have an idea of the range and variety of states in this

period and the amount of time spent in each one. The duration of each state is an important component to consider when scoring.

Postexamination-State Observation

After the last item of the examination (Moro reflex), the examiner places the infant in the crib and records the infant's state.

PART I: EXAMINATION

A. Preexamination Observation

The examination should start with the infant covered and asleep in state 1 or 2 if at all possible. Record the Initial-State Observation without waking the infant.

1. Initial-State Observation

Scores:

1. State 1
2. State 2
3. State 3
4. State 4
5. State 5
6. State 6

B. Habituation

Habituation or response decrement is assessed on the basis of the infant's ability to shutdown, suppress, diminish, or delay responses to the repeated presentation of a stimulus. A response involves a movement of the limb or whole body, eye blinks with a full facial grimace, writhing movement, or other gross or discrete limb movements. There may be startles, and diminution and delay should be considered in scoring. However, do not count eye blinks, changes in respiration, or small and slow finger or hand movements as responses.

Evaluate the infant's performance after 10 presentations unless the response has been successfully shutdown before that. The scores of 5 to 9 are reserved for infants who shutout their responses successfully. Score according to the last presentation to which there was a response. For scores of ≤ 4 , there is no complete response decrement. Use scores 95 through 99 to describe why the item was not administered or discontinued.

For each trial, allow 5 seconds from the cessation of the response to the presentation of the next stimulus. Up to 10 presentations are given if no response decrement occurs. The criterion for shutdown is 2 trials without a response for 5 seconds. If the infant reaches criterion for shutdown, discontinue the stimuli and move onto the next item.

If the infant shows no response to the first stimulus, gently loosen wraps, and try again. If the infant responds to the next presentation, count it as the initial presentation. If there is still no response to the stimulus, gently shake the infant and present the stimulus again. If there is still no response, go on to the next Habituation item. If the infant wakes up (changes to state 3, 4, 5, or 6), discontinue administration of the Habituation item.

If the infant's response to a stimulus continues for >45 seconds, go on to the next Habituation item. Make sure that the infant has stopped moving for 5 seconds before administering the next Habituation item. If the infant continues to respond for >1 minute, do not present the next Habituation item, and code it as 98.

2. Response Decrement to Light (States 1 and 2)

This item measures the response decrement that occurs when a flashlight is repeatedly shined on the infant's eyes. Hold a standard 8-inch flashlight 12 inches from the infant, shine the light directly into his or her eyes for 2 seconds (a 2-count), and observe the response.

Scores:

1. No decrement in response over 10 stimuli.
2. There is no response decrement, but there is some delay in the responses over the 10 trials.
3. There is some response decrement over the 10 trials, but shutdown is not complete.
4. There is some response decrement and delay in the responses over the 10 trials, but shutdown is not complete.
5. Shutdown of responses after 9 stimuli.
6. Shutdown of responses after 7 to 8 stimuli.
7. Shutdown of responses after 5 to 6 stimuli.
8. Shutdown of responses after 3 to 4 stimuli.
9. Shutdown of responses after 1 to 2 stimuli.
95. Item started but discontinued because the infant responds for >45 seconds to a stimulus.
96. Item not administered because the infant does not respond after loosening wraps and gentle shaking.
97. Item started but discontinued because the infant changes to a state 3 or higher.
98. Item not administered because the infant is not in state 1 or 2.
99. Item not administered due to examiner error.

3. Response Decrement to Rattle (States 1 and 2)

The next 2 items are designed to measure the infant's ability to shutout a disturbing auditory stimulus. Hold the rattle 12 inches from the infant and shake it briskly 2 times in succession as in a 2-count.

Scores:

1. No decrement in response over 10 stimuli.
2. There is no response decrement, but there is some delay in the responses over the 10 trials.
3. There is some response decrement over the 10 trials, but shutdown is not complete.
4. There is some response decrement and delay in the responses over the 10 trials, but shutdown is not complete.
5. Shutdown of responses after 9 stimuli.
6. Shutdown of responses after 7 to 8 stimuli.
7. Shutdown of responses after 5 to 6 stimuli.
8. Shutdown of responses after 3 to 4 stimuli.
9. Shutdown of responses after 1 to 2 stimuli.
95. Item started but discontinued because the infant responds for >45 seconds to a stimulus.

- 7b. Excoriations: abrasions.
- 7c. Loose skin.
- 7d. Deep creases around eyes and nose: marked and substantial.

8. *Movement (States 1–4)*

This is a description of the amount of baseline motor activity, not a judgment of the quality of movement. The item is meant to capture excessive movement even during sleep. Eye movements are not included.

Scores:

- 1. Infant shows very little or no movement.
- 2. Infant shows normal movement appropriate for the infant's state (ie, startles and jerky movements in state 1, low activity level in state 2, etc).
- 3. Movement is excessive, virtually continuous, or continuous. Some level of motor activity is always present and may not fit with other state-related criteria. The infant may seem insulated by or at the mercy of this ongoing motor activity. Even holding and partial swaddling does not eliminate the movement.
- 98. Item not scored because the infant is not in an appropriate state.
- 99. Item not administered due to examiner error.

9. *Response Decrement to Tactile Stimulation of the Foot (States 1–3)*

Place the infant's head in midline by using head supports. With 1 hand, hold the infant's leg just above the ankle between your thumb and index finger and flex the leg at the knee and hip until the inside knee angle is 90°. Avoid holding the back of the leg. Press the heel of the foot gently but firmly with the sterile plastic stick. Hold the leg loosely and allow the infant to move. Five seconds after the movement has ceased, press the same heel again. Stop the item if the response is localized to the foot. The infant gets credit for decrement at the trial on which successful localization of response occurs. A maximum of 5 trials is administered. This item is not repeated with the other foot.

In some infants, the opposite foot withdraws and the whole body responds as quickly as the stimulated foot (a demonstration of the all-or-none aspect of an immature organism). The degree, rapidity, and repetition of this "spread" of stimulus to the rest of the body is measured here. The other aspect scored is the infant's capacity to shutdown this spread of a generalized response. When responses continue in an obligatory, repetitive, or increasingly active manner, the infant rates a low score. When responses to the stimulus are suppressed and the state changes to a more-alert, receptive one, the infant deserves a high score. Many infants demonstrate some but not all of this behavior. Scores 95 through 99 describe reasons why the item was not administered or discontinued.

Scores:

- 1. Response generalized to whole body and increases over trials.

- 2. Both feet withdraw together; no decrement of response.
- 3. Variable response to stimulus; response decrement but not localized to stimulated leg.
- 4. Response decrement after 5 trials; localized to stimulated leg; no change to alert state.
- 5. Response decrement after 5 trials; localized to stimulated foot; no change to alert state.
- 6. Response limited to stimulated foot after 3 to 4 trials; no change to alert state.
- 7. Response limited to stimulated foot or complete decrement of response after 1 to 2 trials; no change to alert state.
- 8. Response localized and minimal after 2 trials; change to alert state (4).
- 9. Complete response decrement; change to alert state (4).
- 95. Item started but discontinued because the infant responds for >45 seconds to a stimulus.
- 96. Item not administered because the infant does not respond after loosening wraps and gentle shaking.
- 97. Item started but discontinued because the infant changes to a state higher than 3.
- 98. Item not administered because the infant is in a state higher than 3.
- 99. Item not administered due to examiner error.

D. Lower Extremity Reflexes (States 3–5)

Position head at midline by using head supports. Administer the reflexes in the sequence listed below with the infant supine. Once a package has been started, attempt to administer all the items in the package. The reflexes should be administered gently but firmly and in a smooth, even flow, disturbing the infant as little as possible. Administer most of the reflexes separately on the left and right side to look for asymmetries. Unless otherwise indicated, if a normal reflex response is observed, reflexes do not have to be administered more than once. Score both sides, which effectively tracks any asymmetries. Avoid getting "bogged down" in this part of the examination.

If the infant is in a sleep state, these items can serve to rouse the infant to achieve the appropriate state. If the infant is in a state 6, use consolability maneuvers including a pacifier to bring the infant to an appropriate state. However, the pacifier must be removed when the reflexes are administered, because the presence of the pacifier will alter the reflex response. Items not administered in the appropriate state have to be readministered with the scores based only on performance in the appropriate state.

10. *Plantar Grasp*

Press thumb against the ball of the infant's foot. Do each foot separately. The infant should respond with plantar flexion of all toes.

Scores:

- 1. No response.
- 2. Weak and unsustainable flexion of the toes; may not return to original position.

3. **Good sustained plantar flexion of toes followed by relaxation and return to original position.**
4. Very strong, prolonged flexion of toes with long latency to relaxation or no return to original position.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

11. Babinski Reflex

Start from the toes and scratch the lateral side of the infant's foot toward the heel with a thumbnail. Pressure on the foot rather than a scratch may elicit the plantar grasp and not the Babinski reflex. Do each foot separately. Look for extension of the big toe and spreading of the smaller toes.

Scores:

1. No response.
2. Weak extension and some spreading of the smaller toes.
3. **Good extension with marked spreading of toes, including some flexion of big toe followed by relaxation and return to original position.**
4. Prolonged response with long latency to relaxation and/or return to original position.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

12. Ankle Clonus

Hold the infant's leg just below the knee with the leg relaxed. Using 2 or 3 fingers placed on the ball of the foot, dorsiflex the foot with a rapid, brisk, pulsating movement. Repeat with the other foot. Clonus is seen as a quick dorsiflexion of the foot or it is felt as "beats." The maneuver is somewhat like "bobbing" a ball in the water (ie, trying to keep the ball submerged each time it breaks the surface). It is normal for clonus not to be present in the newborn; therefore, an optimal score is not provided.

Scores:

1. No clonus.
2. One beat only.
3. Two or more beats; up to 4 or 5 if gradual decrease in intensity.
4. Prolonged and sustained.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

13. Leg Resistance

Hold both feet of infant's legs near the ankles with 1 hand, with your index finger between the feet. Fully flex hips and knees with thighs and legs together. Extend thighs and legs and release. Observe amount of resistance to passive extension and the speed and amount of thigh and lower leg recoil at hips and knees. This maneuver is used to score both leg resistance and the next item, leg recoil.

Scores:

1. No resistance.

2. Little resistance.
3. **Moderate resistance.**
4. Strong resistance.
5. Extremely strong resistance: legs remain flexed; whole body slides in direction of pull.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

14. Leg Recoil

Scores:

1. No recoil.
2. Some recoil but slow (after 1/2 second).
3. Some recoil but fast (within 1/2 second).
4. Complete recoil: slow.
5. Complete recoil: fast.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

15. Power of Active Leg Movements

Assess the power of active leg movements by providing gentle resistance to lower extremities when the infant is moving. Grasp moving foot above the ankle between index and middle fingers and apply gentle resistance. This item can be assessed during the infant's movements immediately after the leg resistance or popliteal angle.

Scores:

1. No active movements against gravity.
2. Minimal: active movements against gravity overcome barely perceptible resistance or no resistance.
3. **Moderate: active movements overcome minimal resistance.**
4. Strong active movements overcome moderate resistance.
5. Extremely strong: active movements overcome strong resistance.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

16. Popliteal Angle

This is an assessment of passive flexor tone of the knee joint, assessed by resistance to extension of the lower extremity. With the infant supine, unstrap 1 side of diaper. With the pelvis flat on the examining table, the thigh is held on the infant's abdomen in the knee-chest position with the knee fully flexed. Wait for the infant to relax into this position, and then grasp the foot at the sides with 1 hand. Use the other hand to support the side of the thigh without exerting pressure on the hamstrings. Extend the leg until a definite resistance to extension is felt. The angle formed at the knee by the upper and lower leg is measured by using Fig 2.

Scores:

1. Angle of 180° to 160°.
2. Angle of 150° to 140°.

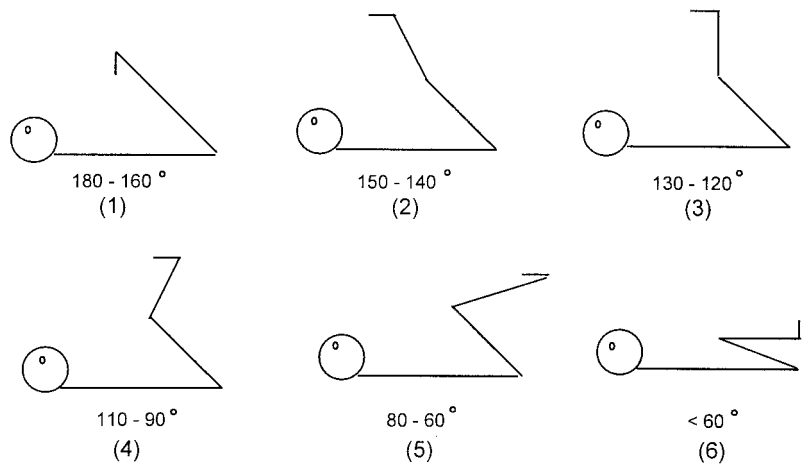


Fig 2. Infant leg positions for scoring of popliteal angle.

3. Angle of 130° to 120°.
4. **Angle of 110° to 90°.**
5. Angle of 80° to 60°.
6. Angle of <60°.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

E. Upper Extremities and Face (States 3–5)

17. Scarf Sign

This is a test of passive tone of the shoulder-girdle musculature. Place the infant's arm just above the chest with 1 hand. Place your other hand on infant's trunk to prevent trunk rotation, your thumb on the infant's elbow. Gently push the elbow across the chest so that the arm comes across the neck like a scarf. Look for resistance to extension of the shoulder-girdle flexor muscles. Use Fig 3 to identify and score the point on the chest to which the elbow moves easily before significant resistance. Please note that higher scores indicate smaller angles.

Scores:

1. Elbow reaches opposite axillary line or beyond.
2. Elbow reaches any point between opposite axillary line and chest midline.
3. **Elbow reaches nipple or midline.**
4. Elbow does not reach nipple.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

18. Forearm Resistance

With both hands, hold the infant's arms at the wrist and fully flex the arms at the elbow. Extend forearms and release 1 arm within 1 second and the other arm 1 second later. Observe the amount of forearm resistance and speed and amount of recoil. Use this maneuver to code both forearm resistance and the next item, forearm recoil.

Scores:

1. No resistance.
2. Little resistance.
3. **Moderate resistance.**
4. Strong resistance.
5. Extremely strong: arms remain flexed; whole body slides in direction of pull.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

19. Forearm Recoil

Scores:

1. No recoil.
2. Some recoil: elbow flexed $\leq 120^\circ$ but slow (after 1/2 second).
3. Some recoil but fast (within 1/2 second).
4. Complete recoil: slow.
5. Complete recoil: fast.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

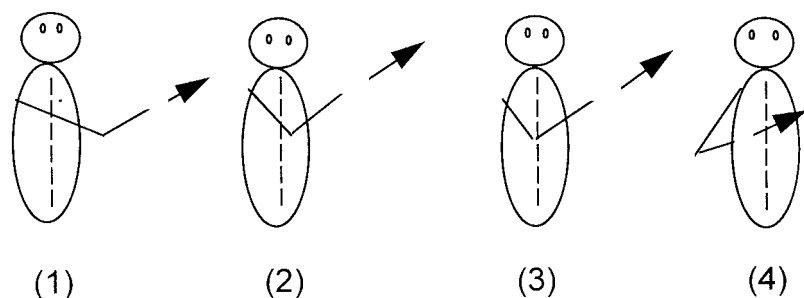


Fig 3. Infant elbow positions to resistance for scoring scarf sign.

20. Power Of Active Arm Movements

The power of active arm movements is assessed by offering gentle resistance to active movements of upper extremities. Grasp the wrist of the moving hand between your index and middle fingers, and apply gentle resistance to the infant's movement. This can be performed during the movement immediately after the administration of scarf sign or forearm resistance.

Scores:

1. No active movements against gravity.
2. Minimal: active movements against gravity overcome barely perceptible resistance or no resistance.
3. **Moderate: active movements overcome minimal resistance.**
4. Strong active movements overcome moderate resistance.
5. Extremely strong: active movements overcome strong resistance.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

21. Rooting

Stroke the perioral skin at the corners of the mouth. With your other hand, hold the infant's hands against his or her chest, because arm position can influence the rooting reflex. The infant should turn his or her head toward the stimulated side and try to suck. If there is no initial response, you may stroke the upper and lower lips to elicit the response. Stimulation of the upper lip may be followed by opening of the mouth and retroflexion of the head. After stimulation of the lower lip, the mouth may open and the jaw drop.

Scores:

1. No response.
2. Only a weak head turn toward the stimulated side.
3. **Full head turn toward stimulated side and grasp with lips.**
4. Very vigorous head turn toward stimulated side and grasp with lips.
5. Head turn away from stimulated side.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

22. Sucking

Place your glove-covered finger 3 or 4 cm into infant's mouth with the nail toward the tongue. You

should feel rhythmical sucking movements that include stripping action of the tongue forcing upward and back with suction (negative pressure). Sucking typically occurs as groups of 8 to 12 sucks per 10 seconds with pauses: the "burst-pause" pattern.

Scores:

1. No sucking response.
2. Weak or barely discernible suck.
3. **Moderate suction with grouping of sucks in burst-pause pattern.**
4. Exaggerated (hyperactive) suction but has a burst-pause pattern; infant may appear frantic.
5. Disorganized sucking pattern in which there are excessive bouts (15–30 per 10 seconds) and no burst-pause pattern.
6. Exaggerated and disorganized (a combination of 4 and 5 above).
7. Dysfunctional sucking in which the infant may bite or clench jaw, retract the tongue, or show tongue thrusting.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

23. Grasp of Hands

Place 1 finger (index finger or thumb) in the infant's hand and press the palmar surface without touching the back of the hand. The infant's fingers should flex and close around your finger. Do this for both hands but not at the same time, because pressing both palms at the same time can elicit the palmar mental reflex (infant's mouth opens).

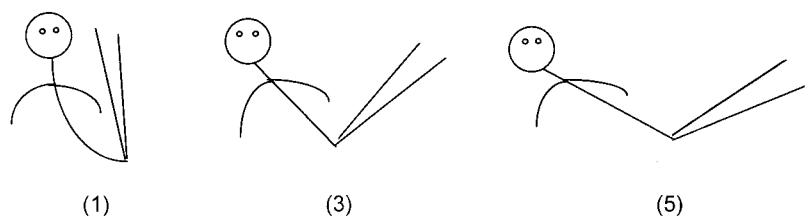
Scores:

1. No grasp response.
2. Short, weak flexion.
3. **Strong and sustained grasp for several seconds that then relaxes.**
4. Prolonged, excessive grasp; tips of infant's fingers turn white, may be long latency to relax or no relaxation at all.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

24. Truncal Tone

Place 1 hand under infant's buttocks and hold the back of the infant's head at the neck with the other hand. Lift the infant above the surface of the crib such that his or her buttocks do not touch the surface during the maneuver. Gently flex the infant's trunk by bringing his or her head forward. You should be able to bring the infant to a sitting position. Score

Fig 4. Infant positions during flexion for scoring truncal tone.



only the tone of the trunk, not the tonicity of the arms and legs (see Fig 4).

Scores:

1. Hypotonic response: little or no tone felt as infant is flexed.
2. Some tone felt as infant is flexed, with infant somewhat hypotonic.
3. **Good tone felt as infant is flexed: normal response.**
4. Some hypertonicity felt as infant is flexed.
5. Hypertonic response: may not be able to flex infant.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

25. Pull to Sit (States 4 and 5)

Place a thumb in both of the infant's palms and also hold the infants wrists/forearms with your fingers. With the arms extended, use the infant's automatic grasp to pull the infant to sit. As the infant is pulled to sit, the score is based on the extent to which: the shoulder-girdle muscles respond with increased tone; there is muscular resistance to stretching the neck and lower musculature; and the infant attempts to right his or her head into a position that is in midline of the trunk and parallel to the body. When in a seated position, the infant's attempts to right his or her head can be felt via the shoulder muscles as you maintain a grasp on the infant's arms.

Scoring is based on the extent to which the infant attempts to maintain his or her head upright and the length of time the infant is able to do it. Some infants can get their heads up only to have it pivot forward through the midline. This pivoting may be because of the infant being pulled forward, not because of the infants' effort. For other infants, the head is heavy and out of proportion to the rest of his or her body mass, so the head falls backward. You may talk to the infant during this maneuver to help keep the infant calm and encourage the infant to lift his or her head.

Some infants resist flexion and head righting by arching backward. If this occurs, the item must be scored 11. If the infant becomes completely hypertonic, assign a score of 10. The average infant makes 1 or 2 attempts to maintain the head in an upright position after seating and can participate as he or she is brought to sit. If the infant's head remains back after being pulled to sit, score no higher than a 2. If there is no head lag (or forward head drop) as the infant is pulled to sit, score 8 or 9.

In some infants, Pull to Sit can be administered only when you provide support to the upper trunk. If Pull to Sit can be elicited only with additional support from you, such as extending the arms to the side after being placed in seated position, assign a score of 2 regardless of the quality of the response that is elicited.

Scores:

1. Head lags/flops completely in Pull to Sit; no attempts to right it in sitting.

2. Futile attempts to right head, but shoulder tone increase is felt.
3. Slight increase in shoulder tone; seating brings head up once but not maintained; no further efforts; head may pivot briefly through midline.
4. Shoulder and arm tone increase; seating brings up head; not maintained at midline, but there are additional efforts to right it.
5. Head and shoulder tone increase as pulled to sit; brings head up once to midline by self as well and maintains it for at least 1 to 2 seconds.
6. Head brought up twice after seated, then can keep it in position ≥ 2 seconds.
7. Shoulder tone increases, but head not maintained until seated, then can keep it in position 10 seconds; when it falls, the infant repeatedly rights it.
8. Excellent shoulder tone; head up for 10 seconds after seated; no head lag as comes up.
9. Head up during lift and maintained for 1 minute after seated; shoulder tone and whole body tone increases as pulled to sit.
10. Hypertonic response; upper trunk and neck rigid; head comes up in vertical plane with back, or legs stiffen and infant pulls to standing position.
11. Infant resists flexion and head righting by arching backward and item cannot be administered.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

F. Upright Responses (States 3–5)

26. Placing

Hold the infant upright or slightly leaning forward with both hands under the arms and around the chest. Use your thumb(s) to limit or support movement of the infant's head. Do not hold the infant against your chest. Lift the infant so that the top of the infant's foot is stroked and gently pressed downward against a protruding corner or edge on the crib or a table top. The infant should lift his or her foot by flexing the knee and hip and then extend the leg as if taking a step. Repeat with the other foot.

Scores:

1. No response.
2. Minimal flexion and extension of foot.
3. **Foot is lifted and then extends to "place."**
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

27. Stepping

Hold the infant upright and slightly tilted forward, with both hands under the arms and around the chest. Let the soles of the feet touch the surface and move the infant forward as stepping occurs. Slight rotation of the infant's body may help elicit the response. Alternating stepping movements with both legs are scored.

Scores:

1. No stepping movements; infant is too weak to support his or her weight, and the legs collapse.

2. No stepping movements, although infant is able to support his or her weight.
3. Some indication of stepping: infant takes 1 or 2 steps.
4. **Clear stepping response, with legs alternating; infant takes ≥ 3 steps.**
5. Exaggerated (hyperactive) response: stepping is excessive, and infant may appear to run.
6. Legs stiffen, infant becomes hypertonic, knees may lock, toe standing may occur, and stepping may or may not be elicited.
7. Infant's feet cross in a scissoring pattern, and stepping cannot be elicited.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

28. Ventral Suspension

Suspend the infant in the air in a prone position by placing a hand under the infant's chest and abdomen. Keep the infant horizontal and make sure the limbs are hanging free. Observe the final position of the infant's head, limbs, and trunk. If a final position (consistent tone) is not observed, score 6 (see Fig 5).

Scores:

1. Infant is hypotonic; there is little tone as infant flaccidly hangs down.
2. Head hangs down, but there is some flexion of the extremities.
3. **Head lifting with some flexion of the limbs.**
4. Sustained head lifting and extension of the lower limbs.
5. Infant is hypertonic or stiff; remains in horizontal plane with extension of legs and arms; may show arching or opisthotonic response.
6. Consistent tone is not observed; infant shows variability in tone, changing from hypotonic to hypertonic and vice versa.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

29. Incurvation

Slowly tap/poke or scratch a line with your thumbnail a few centimeters from the vertebrae, downward from the shoulder to the buttocks. Repeat on the other side. The trunk should flex laterally in a concave curve on the stimulated side.

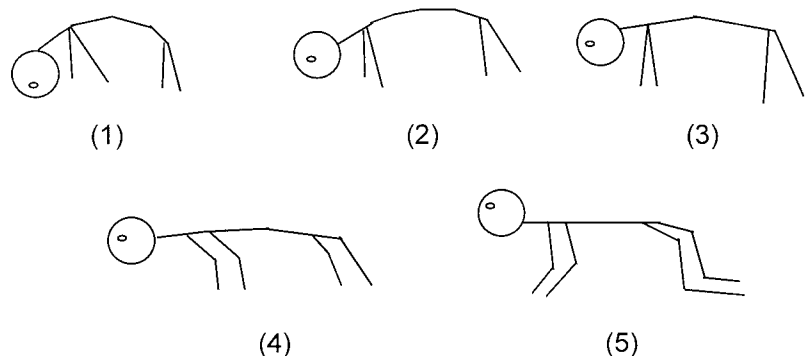


Fig 5. Infant positions for scoring ventral suspension.

Scores:

1. No response.
2. Weak, incurvation movement: may be short, slow, or delayed.
3. **Fully developed incurvation of the whole vertebral column.**
4. Exaggerated response, with excessive and abrupt incurvation even to a weak stimulus and little or no relaxation afterward.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

G. Infant Prone (States 3–5)

30. Crawling

Both Crawling and Head Raise in Prone (next item) are scored from the following maneuver. With infant prone, place head in midline (without supports) and arms near the head, palms down. Observe for 30 seconds. If the infant does not crawl spontaneously, stimulate the response by gently pressing your palms on the soles of the feet. Score the response, and then score whether stimulation of the feet was necessary to elicit the response.

Scores:

1. No crawling response.
2. Weak attempt to crawl.
3. **Coordinated crawling.**
4. Prolonged and exaggerated response: excessive movement with little or no inhibition; may also show arched back and hyperextended neck.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

31. Stimulation Needed

Scores:

1. No stimulation was applied.
2. Stimulation was applied.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

32. Head Raise in Prone

Scores:

1. No response.

2. Neck muscles briefly contract, but head is not lifted from surface.
3. Brief head lift once or twice.
4. **Lifting sustained for a few seconds.**
5. Lifts head several centimeters for at least 10 seconds.
6. Prolonged and exaggerated response including hyperextended neck.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

H. Pick up Infant (States 4 and 5)

Cuddliness

This item is a summary measure of the infant's response to being held in alert states. There are several components that are scored in response to the infant being held in a cuddled position both horizontally against your chest and vertically on your shoulder. The infant's resistance to cuddling should be assessed as well as the ability to relax or mold, nestle, and cling to you. Give the infant a chance to initiate cuddling (~10 seconds). Facilitate cuddling only if there is no active participation on the part of the infant or if the infant is unable to relax or mold. If the infant initiates cuddling, score 5 and above. Cuddliness should not be administered with the infant swaddled. Also, refrain from talking to the infant during the administration of this maneuver. Assign separate scores for Cuddle in Arm (horizontal) and Cuddle on Shoulder (vertical).

33. *Cuddle in Arm*

Scores:

1. Resists being held, continuously pushing away, thrashing, stiffening or arching.
2. Resists being held most but not all of the time.
3. Doesn't resist, but doesn't participate either; infant lies passively in arms (like a sack of meal).
4. Eventually molds into arms but after a lot of nestling and cuddling by examiner.
5. Molds and relaxes on own but with some delay.
6. Molds and relaxes on own without delay.
7. Molds, relaxes, and initially nestles head in crook of the examiner's elbow.
8. In addition to molding and relaxing, the infant nestles and turns head, fits feet into cavity of examiners other arm; all of the infant's body participates.
9. All of the above, and the infant grasps and clings to the examiner.
97. Item discontinued because infant changes to state 1, 2, or 3 or reaches state 6.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

34. *Cuddle on Shoulder*

Scores:

1. Resists being held, continuously pushing away, thrashing, stiffening, or arching.

2. Resists being held most but not all of the time.
3. Doesn't resist, but doesn't participate either; lies passively against shoulder (like a sack of meal).
4. Eventually molds into shoulder but after a lot of nestling and cuddling by examiner.
5. Molds and relaxes on own but with some delay.
6. Molds and relaxes without delay.
7. Molds and relaxes; head nestles into crook of the examiner's neck.
8. In addition to molding and relaxing, the infant nestles and turns toward the examiner's neck and leans forward on his or her shoulder; all of the body participates and always molds initially.
9. All of the above, and the infant grasps and clings to the examiner.
97. Item discontinued because infant changes to state 1, 2, or 3 or reaches state 6.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

I. Infant Supine on Examiner's Lap (States 4 and 5)

The Orientation package examines the infant's ability to orient to animate and inanimate visual and auditory stimuli. The order of administration of the Orientation items is not predetermined. The auditory inanimate (ie, rattle) and animate visual and auditory (ie, face and voice) stimuli are generally thought to be the most arousing and attention-getting, and the visual alone (ie, face or ball) and animate auditory (ie, voice) the least arousing and attention-getting. For more-fragile infants who may be hypersensitive, starting the orientation sequence with less-intense stimuli may be preferable. Other infants may need more-intense stimuli to maintain a state 4 or 5.

Administer the Orientation items while sitting on a chair with the infant resting on your lap. You should have the infant at a slight upward angle. (It may help to place your feet on a footrest.) When administering the Orientation items, it is recommended to try each Orientation item at least once before going on to the next one. However, do not spend too much time administering individual items (ie, ~15 seconds with each stimulus [eg, a duration of ~15 seconds for the rattle on 1 side of the head]).

Give the infant the opportunity to maintain a state 4 or 5 on his or her own. The preferred focus is on the infant's ability to maintain a state 4 or 5 and show orientation abilities within a self-maintained state rather than on how well an infant can orient when you manipulate his or her state (eg, when swaddling). It is generally believed that infants will show better orienting abilities when swaddled, but the infant's capacity to deal with environmental demands are better reflected in the ability to 1) maintain a state 4 or 5 and 2) orient while in a self-maintained state. Nonetheless, you can use techniques such as swaddling if the infant cannot maintain a state 4 or 5.

There are several techniques you can use to elicit a state 4 or 5 from a lower state. These techniques include gently rocking the infant up and down and presenting auditory stimulation (rattle/voice). If the infant cannot maintain a state 4 or 5 or the infant's

activity interferes with his or her performance, hold the infant's arms and/or legs to restrain interfering movement, swaddle, and give the infant a pacifier to suckle. If used, score these items in the summary items as techniques used to maintain alertness (item 46, Orientation Handling Procedures). Additionally, if the rattle is used to rouse the infant during orientation, the rattle should be counted as a technique used to maintain alertness.

Some infants, such as small prematures, may have more difficulty with stress and temperature regulation. In these cases, it may be necessary to wrap or swaddle for the infant's safety. You should attempt to administer these items without swaddling, but if the infant appears stressed, it is appropriate to swaddle.

35. Orientation: Inanimate Visual

This is a measure of the infant's ability to fixate on and follow the red ball. Jiggle the ball and change its distance from the infant slightly to find the infant's focal range, generally 10 to 12 inches from the eyes. Then slowly move the ball horizontally from 1 side to the other. If the infant's head becomes "stuck" on 1 side, gently position it back to the midline and repeat visual stimulation with the ball to the other side. If the eyes and head follow to at least 1 side, move the ball vertically and in an arc to see whether the infant will continue to follow.

Avoid talking to the infant or letting the infant be distracted by your face during this maneuver.

The score is based on the infant's ability to alert (decrease in random activity, focusing on the object when it is in his or her line of vision, slow regular respiration, and following in smooth arcs when it moves), brighten (change in facial expression, widening of eyes and brighter look, and irregular respiration, with an associated decrease in random activity), and fixate on the stimulus, following it horizontally or vertically, and coordinate head and eye movements. If the infant's eyes and head follow the stimulus concurrently, score 6 to 9. Chin movement can be used as the criterion for assessing a 30° and 60° vertical following.

Scores:

1. Does not focus on or follow stimulus.
2. Stills with stimulus and brightens.
3. Stills; focuses on stimulus when presented; little spontaneous interest; brief following.
4. Stills; focuses on stimulus; follows for 30° arc; jerky movements.
5. Focuses and follows with eyes horizontally for at least a 30° arc; smooth movement; loses stimulus but finds it again.
6. Follows for two 30° arcs with eyes and head; eye movements are smooth.
7. Follows with eyes and head at least 60° horizontally, maybe vertically; partly continuous movement; loses stimulus occasionally; head turns to follow.
8. Follows with eyes and head 60° horizontally and 30° vertically.

9. Focuses on stimulus and follows with smooth, continuous head movement horizontally and vertically and follows in a circular path for a 180° arc.
98. Item not administered because the infant is not in a sustained state 4 or 5.
99. Item not administered due to examiner error.

36. Orientation: Inanimate Auditory

This is a measure of the infant's response to the rattle stimulus. Shake the rattle twice (a 2-count), 6 to 12 inches from the infant's ear and out of sight. Repeat the procedure so there are 2 "trials" on each side. Gently position the infant's head back in midline after each presentation. The response may include brightening of the face and eyes, turning, and searching and looking toward the stimulus. The sound may be varied in intensity and rhythm to determine the level of stimulation appropriate for the infant.

If the infant turns his or her eyes and head toward the stimulus, score 6 to 9. A search is defined as looking for the stimulus. If the infant responds with a head turn but the eyes are closed, the maximum score is 6.

Scores:

1. No reaction.
2. Respiratory change or blink only.
3. General quieting as well as blinking and respiratory changes.
4. Stills and brightens but no attempt to locate source.
5. Shifting of eyes to sound; stills and brightens.
6. Alerting and shifting of eyes; head turns to source.
7. Alerting; head turns to stimulus; finds or looks at stimulus once or twice.
8. Alerting prolonged; head and eyes turn to stimulus repeatedly (3 of 4 times).
9. Turning and alerting to stimulus; finds or looks at the stimulus on both sides 4 out of 4 times.
98. Item not administered because the infant is not in a sustained state 4 or 5.
99. Item not administered due to examiner error.

37. Orientation: Inanimate Visual and Auditory

Gently shake the red rattle 10 to 12 inches from the infant's eyes. Slowly move the rattle horizontally from 1 side to the other in front of the infant's face. If the infant's head becomes "stuck" on 1 side, gently position it back to the midline and repeat the stimulation with the rattle to the other side. If the eyes and head follow to at least 1 side, move the rattle vertically and in an arc to see whether the infant will continue to follow.

Avoid talking to the infant or letting the infant be distracted by your face during this maneuver.

The score is based on the infant's ability to alert (decrease in random activity, focusing on the object when it is in his or her line of vision, slow regular respiration, and following in smooth arcs when it moves), brighten (change in facial expression,

widening of eyes and brighter look, and irregular respiration, with an associated decrease in random activity), and fixate on the stimulus, following it horizontally or vertically, and coordinate head and eye movements.

Scores:

1. Does not focus on or follow stimulus.
2. Stills with stimulus and brightens.
3. Stills; focuses on stimulus when presented; little spontaneous interest; brief following.
4. Stills; focuses on stimulus; follows for 30° arc; jerky movements.
5. Focuses and follows with eyes horizontally for at least a 30° arc; smooth movement; loses stimulus but finds it again.
6. Follows for two 30° arcs with eyes and head; eye movements are smooth.
7. Follows with eyes and head at least 60° horizontally, may be briefly vertically; partly continuous movement; loses stimulus occasionally; head turns to follow.
8. Follows with eyes and head at least 60° horizontally and 30° vertically.
9. Focuses on stimulus and follows with smooth, continuous head movement horizontally and vertically and follows in a circular path for a 180° arc.
98. Item not administered because the infant is not in a sustained state 4 or 5.
99. Item not administered due to examiner error.

38. Orientation: Animate Visual

The next 3 items score the infant's response to your social cues: voice and/or face. This item measures the infant's response to your face. Place your face 12 to 18 inches in front of the infant's face. Then, slowly move from 1 side to the other. If the infant's head becomes "stuck" on 1 side, gently position it back to the midline and repeat visual stimulation to the other side. If the eyes and head follow to at least 1 side, move your face vertically and in an arc to see whether the infant will continue to follow. Do not talk to the infant during this item.

Scores:

1. Does not focus on or follow stimulus.
2. Stills with stimulus and brightens.
3. Stills; focuses on stimulus when presented; little spontaneous interest; brief following.
4. Stills; focuses on stimulus; follows for one 30° arc; jerky movements.
5. Focuses and follows with eyes horizontally for at least a 30° arc; smooth movement; loses stimulus but finds it again.
6. Follows for two 30° arcs with eyes and head; eye movements are smooth.
7. Follows with eyes and head at least 60° horizontally, may be briefly vertically; partly continuous movement; loses stimulus occasionally; head turns to follow.
8. Follows with eyes and head at least 60° horizontally and 30° vertically.

9. Focuses on stimulus and follows with smooth, continuous head movement horizontally and vertically and follows in a circular path for a 180° arc.
98. Item not administered because the infant is not in a sustained state 4 or 5.
99. Item not administered due to examiner error.

39. Orientation: Animate Auditory

This is a measure of the infant's response to your voice. Speak softly into 1 of the infant's ears with your face out of the infant's line of vision, ~6 to 12 inches away. Present the stimulus twice on each side. Gently position the infant's head back in midline and repeat the stimulation with the voice to the other side. The sound of the voice may be varied in intensity and rhythm. A soft, slightly higher-pitched voice can be the most-potent stimulus.

A response may include brightening of the face and eyes, turning, and searching and looking toward the stimulus. If the infant turns his or her eyes and head toward the stimulus, score 6 to 9. A search is defined as looking for the stimulus.

Scores:

1. No reaction.
2. Respiratory change or blink only.
3. General quieting as well as blinking and respiratory changes.
4. Stills; brightens; no attempt to locate source.
5. Shifting of eyes to sound; stills and brightens.
6. Alerting and shifting of eyes; head turns to source.
7. Alerting; head turns to stimulus and finds or looks at stimulus once or twice.
8. Alerting prolonged; head and eyes turn to and find stimulus repeatedly (3 out of 4 times).
9. Alerting prolonged; head and eyes turn to and find stimulus 4 out of 4 times.
98. Item not administered because the infant is not in a sustained state 4 or 5.
99. Item not administered due to examiner error.

40. Orientation: Animate Visual and Auditory

This is a measure of the infant's response to your face and voice. Speak in a soft, slightly higher-pitched voice, with your face 12 to 18 inches in front of the infant's face. Then, slowly move from 1 side to the other. If the infant's head gets "stuck," gently position it back in midline and repeat the stimulation. If the eyes and head follow to at least 1 side, move the face vertically and in an arc to see whether the infant will continue to follow.

Scores:

1. Does not focus on or follow stimulus.
2. Stills with stimulus and brightens.
3. Stills; focuses on stimulus when presented; little spontaneous interest; brief following.
4. Stills; focuses on stimulus; follows for one or two 30° arcs; jerky movements.
5. Focuses and follows with eyes horizontally for at least a 30° arc; smooth movement; loses stimulus but finds it again.

6. Follows for two 30° arcs with eyes and head; eye movements are smooth.
7. Follows with eyes and head at least 60° horizontally, may be briefly vertically; partly continuous movement; loses stimulus occasionally; head turns to follow.
8. Follows with eyes and head 60° horizontally and 30° vertically.
9. Focuses on stimulus and follows with smooth, continuous head movement horizontally and vertically and follows in a circular path for a 180° arc.
98. Item not administered because the infant is not in a sustained state 4 or 5.
99. Item not administered due to examiner error.

J. Infant Spin (States 3–5)

41. Tonic Deviation of Head and Eyes

Use this maneuver to score both Tonic Deviation of Head and Eyes and Nystagmus (item 42). Hold the infant upright facing you, with your hands under the infant's arms, your thumbs across the chest, and fingers around the infant's back. The infant's head can be supported at the base with your fingers. Spin in a full or three-quarter circle and observe the infant's eye movements. Stop and look for nystagmus (saccadic "beats" of the eyes). Spin in the other direction and repeat. The infant's eyes should move in the direction of the spin. It is normal not to observe Nystagmus in the newborn; therefore, an optimal score is not provided.

Scores:

1. No response of eyes in the direction of the spin.
2. Weak, barely discernible response; small excursions of the eyes.
3. Eyes are closed but head turns in the direction of the spin.
4. **Clear response of head/eyes turning in the direction of the spin.**
5. Response is exaggerated and excessive; head may "whip" in the direction of the spin and may not return to midline when the spin is completed.
6. Eyes and/or head turn in opposite direction (ie, away from spin).
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

42. Nystagmus

Scores:

1. No nystagmus.
2. Weak response: 1 or 2 beats.
3. Clear nystagmus: repetitive beats (3 or 4).
4. Persistent sustained nystagmus.
98. Item not administered because infant is not in an appropriate state or infant's eyes are closed.
99. Item not administered due to examiner error.

K. Infant Supine in Crib (States 3–5)

43. Defensive Movements

With the infant's head in midline, hold a small cloth in place over the infant's eyes and nose, not occluding but putting light pressure on the nostrils. The cloth should be kept in place for up to 1 minute. Do not discontinue the item if infant reaches a state 6. If the infant makes directed swipes at the cloth, let go of it to see whether the infant will remove it.

The score is based on the infant's highest level of performance. It is not a cumulative score (eg, score 8 does not require that the infant showed all of the behaviors in scores 1–7).

Scores:

1. No response.
2. Changes to states 1 or 2.
3. General quieting.
4. Nonspecific activity increase with long latency.
5. Nonspecific activity increase with short latency.
6. Rooting and lateral head turning.
7. Neck stretching.
8. One or more nondirected swipe of arms in the upper quadrant of the body.
9. One or more directed swipe of arms toward the cloth.
10. Successful removal of cloth with swipes.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

44. ATNR

Turn the infant's face slowly to 1 side and hold briefly in that position with the jaw over the shoulder. Wait for the infant to make a relaxed postural adjustment and to settle. Repeat on the other side. Keep 1 hand on the infant's chest to prevent the trunk from rotating. Avoid touching the infant's cheek, because that may elicit the rooting reflex. Look for extension of the arm and leg on the "face" side (ie, the side to which the face has been turned) and flexion of the arm at the elbow on the opposite side. The ATNR may be absent or present in the newborn; therefore, an optimal response is not provided.

Scores:

1. No response.
2. Weak or incomplete response: there is some change in the position of arms or legs, but it is transient.
3. Well-marked response.
4. Well-marked response that is prolonged and exaggerated; infant is unable to release response.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

45. Moro Reflex

This reflex can be elicited in any state; however, there is some evidence¹⁷ that state 3 is optimal for obtaining the complete response, as initially described by Moro.¹⁸ Hold the infant supine in your

hands with 1 hand under the head and the other hand supporting the back and buttocks. The infant should be in a symmetrical position with head in midline and arms in front of or beside the chest. When the infant's neck muscles are relaxed, drop the head a few centimeters with a sudden and rapid movement. The body should not be tilted. More than 1 trial may be necessary to elicit the full response. In the complete response there is abduction (away from the axis of the body) of the upper limbs at the shoulders, extension of the forearms at the elbows, and extension of the fingers. This is followed by adduction (toward the axis of the body) of the arms at the shoulders and flexion of the forearms at the elbows. The Moro response is evoked by stimulation of vestibular receptors and is often asymmetrical, with a bias toward a more-complete response on the right side¹⁷ This distinguishes it from the startle reflex, which is typically symmetrical and can be elicited by tactile, thermal, auditory, or vestibular stimuli individually or in combination.¹⁹

Scores:

1. No response.
2. Weak response with minimal abduction of shoulders and some elbow extension followed by narrow adduction at shoulders and just discernible flexion at the elbow.
3. Adequate abduction of shoulders and extension of the elbow but minimal or no adduction.
4. **Adequate abduction at the shoulder with extension of the elbow followed by full adduction flexion at the elbow.**
5. Exaggerated, hyperactive response with excessive abduction and full extension of the elbow followed by adduction at the shoulder across the midline.
98. Item not administered because the infant is not in an appropriate state.
99. Item not administered due to examiner error.

L. Summary Items

The following are summary items or items not presented in sequence.

46. Orientation: Handling Procedures

Was infant in state 4 or 5? [yes] [no]
If yes, record whether you used any facilitation during orientation. Mark "yes" to all the handling procedures that apply. Mark "no" if not used.

Scores:

- 46a. Repeated time out.
- 46b. Hand-holding/ventral pressure.
- 46c. Auditory stimulation (voice or rattle).
- 46d. Jiggling/vertical rocking.
- 46e. Covering/wrapping.
- 46f. Swaddling.
- 46g. Rocking/walking.
- 46h. Sucking/pacifier.
- 46i. Other.

47. Alertness (States 4 and 5)

This is a summary score of the infant's alertness and responsiveness to stimuli in states 4 and 5. Alerting is defined as brightening of the eyes and softening of facial expression and can occur at any time during the examination. Orientation describes the infant's responsiveness to a stimulus (eg, turning toward the rattle). The score indicates the extent to which the infant alerts, the duration of the focused alertness (as compared with a "blank-stare" alertness), and the latency of the infant's responsiveness.

Scores:

1. Never alert and rarely or never responsive to direct stimulation.
2. Brief alerting; responsiveness is brief and always delayed; alerting and orientation are very brief and general, not specific to stimulus.
3. Quality of alerting is variable; responsiveness is brief and often delayed.
4. Quality of alerting is variable; responsiveness is brief but not delayed.
5. Alerting is less variable; responsiveness is of moderate duration but may be delayed.
6. Alerting is less variable; responsiveness is moderately sustained, not delayed and not variable.
7. Alerting is sustained; responsiveness is neither delayed nor variable.
8. Sustained periods of alertness throughout the examination; alerting and orientation are frequent; stimulation brings infant to alert state and quiets infant.
9. Always alert for most of examination; intensely and predictably alert.
98. Item not scored because the infant is never in appropriate state.

48. General Tone: Predominant Tone (States 4 and 5)

This item scores the motor tone of the infant in states 4 and 5. Because it is a summary assessment, it should include the overall tone as the infant responds to being handled. Tone means the resistance of parts of the body to passive movement. Typically, the neonate holds the limbs in flexion, in both prone and supine, and there is mild to moderate resistance to passive extension. However, the infant with typical tone is able to actively flex and extend the limbs. Gravity imposes a passive force on the child's body. Thus, the "floppy infant" will lie in prone or supine with the extremities predominantly in contact with the supporting surface. The infant's trunk will drape over your hand like a rag doll in both dorsal and ventral suspension. When tone is increased, the infant holds the limbs tightly in flexion or extends the limbs stiffly, strongly resisting your attempts to reposition them.

Tone is scored by a summary assessment of the motor responses observed when the infant is at rest and is confirmed by handling and testing the infant's motor resistance when handled. Tone is assessed in such maneuvers as spontaneous activity, pull to sit, prone placement, ventral suspension, placing, stepping, and the cuddling items

Scores:

1. Flaccid, limp like a rag doll; no resistance when limbs are moved; may have complete head lag in pull to sit.
2. Flaccid, limp most of the time, but responds with some tone <25% of the time.
3. Flaccid, limp most of the time, but responds with some tone at least 25% of the time.
4. Some tone half the time; responds with average tone less than half the time.
5. Tone average when handled; lies with relaxed tone at rest.
6. Responsive with good tone as infant is handled ~75% of the time; may be on the hypertonic side up to 25% of the time; variable tone in resting.
7. Is on the hypertonic side ~50% of the time.
8. When handled, infant is responsive with hypertonicity ~75% of the time.
9. Hypertonic at rest (in flexion) and hypertonic all the time.
10. Tone not consistent either because infant alternates between hypertonicity and hypotonicity or because of an imbalance of hyper/hypotonicity between upper and lower extremities or between trunk and extremities.
98. Item not scored because the infant is never in appropriate state.

49. *Motor Maturity (States 4 and 5)*

This item is a summary measure of the quality or form of spontaneous and elicited arm movements, assessed throughout the examination in states 4 and 5. It assesses smoothness versus jerkiness, reflecting the balance between flexors and extensors, and unrestricted versus restricted arcs. The premature infant has unlimited freedom of movement (floppy), but movements are jerky and cog-like, overshooting the marks. The very mature infant has freedom of movement in all directions associated with a smooth, balanced, and modulated performance (not floppy). The average newborn is somewhat limited in arcs of movement, especially those above the head.

To score this item, consider whether the infant's movements are smooth or jerky or whether there is overshooting. Jerky movements must be differentiated from excursions and involve the whole extremity, whereas tremors are high-frequency, low-excursion movements and may involve only part of the extremity. Overshooting must also be differentiated from smooth, unrestricted movements. Overshooting is characterized by abruptness and lack of modulation (ie, a large "ballistic" movement of a limb) and is often seen in the premature infant.

The size of the arcs of smooth movements must also be considered. They are evaluated from the beginning to the end of the movement. For example, large arcs are movements that move through $\geq 90^\circ$ arcs (eg, a smooth movement starting from the hand resting on the chest to the arm extended out to the side or a smooth movement of the arm from laying extended and parallel to the infant's body to the arm extended out perpendicular to the body). Arcs of 45° appear restricted (eg, a movement from the hand

resting on the abdomen to the arm resting on the chest).

Scores:

1. Cogwheel-like jerkiness; overshooting of legs and arms in all directions.
2. Jerky movements predominate with mild overshooting.
3. Jerky movements with little or no overshooting. There may be some smooth movements.
4. Jerky movements half the time; smooth movements half the time; arcs up to 45° .
5. Smooth movements predominate; arcs predominantly 60° half the time; may be some jerkiness.
6. Smooth movements; arcs predominantly 60° .
7. Smooth movements and arcs of 90° less than half of the time.
8. Smooth movements and unrestricted arms laterally to 90° most of the time.
9. Smoothness; unrestricted arcs of $>90^\circ$ all of the time.
98. Item not scored because the infant is never in appropriate state.

50. *Consolability With Intervention (States 6 to 4-1)*

This item is measured after the infant has been crying actively (state 6) for 15 seconds and measures the number of maneuvers you use to bring the infant from state 6 to states 4, 3, 2, or 1. Some infants will quiet only when they are dressed and left alone. Others will console only when they are held and actively rocked. A steady hand on a crying infant's belly will act as a soothing stimulus. Others need 1 or both arms to be held in addition to the hand on the belly. Holding the arm or arms interferes with disturbing startle activity that may be triggered as the infant cries or fusses. A few infants may quiet to your voice or face. Consoling is demonstrated when the infant quiets for at least 15 seconds.

To administer this item, start with the infant in state 6. Wait 15 seconds to give the infant an opportunity to self-quiet from state 6 to state 4 or lower. If the infant does not move into 1 of these states, proceed with the consoling maneuvers. Begin with face alone and then proceed through the rest of the maneuvers in the order described below (items 10-2). The administration of the maneuvers is cumulative (eg, picking up and holding the infant includes restraining arm movements and using your face and voice). If possible, administer this item twice during the examination in different packages. Score the infant's best performance (ie, the least number of maneuvers required to console the infant) of the 2 administrations. If consolability has been administered in a package or has already been administered twice, you can use any maneuver or set of maneuvers to console the infant during subsequent episodes of state 6. If the infant never reaches state 6, score 98.

Scores:

1. Not consolable.
2. Pacifier or finger to suck in addition to wrapping, holding, and rocking.

3. Wrapping, holding in arms or on shoulder, and rocking.
4. Holding and rocking.
5. Picking up and holding on shoulder.
6. Picking up and holding in arms.
7. Hand on belly and restraining 1 or both arms.
8. Hand steadily on belly.
9. Examiner's voice and face alone.
10. Examiner's face alone.
98. Item not administered because the infant is never in appropriate state.
99. Item not administered due to examiner error.

51. *Peak of Excitement (All States)*

This item measures state-related level of arousal over the course of the whole examination. Observe the infant's peaks of excitement and note how the infant returns to a lower state. The kind of intense reactions that some infants demonstrate when they reach their peak of excitement makes them unavailable to the outside world and is scored high on this scale. Others can hardly be jogged to respond at all, and their peak of excitement is very low. An average response would fall in the moderate, midpoint range, in which the infant could be brought to respond to stimuli despite a high degree of upset or excitement, but then returns to more moderate states. The infant should reach the highest state for at least 15 seconds.

Scores:

1. Low level of arousal to all stimuli; never above state 2; does not awaken fully.
2. Some arousal to stimulation and reaches state 3.
3. Infant reaches state 4 only briefly but is predominantly in state 3 or lower.
4. Infant is predominantly in state 4 or lower but may reach state 5.
5. Infant reaches state 6 after stimulation once or twice but predominantly is in state 5 or lower.
6. Infant reaches state 6 after stimulation more than twice but returns to a lower state spontaneously at least 2 times.
7. Infant reaches state 6 in response to stimuli more than twice but, with consoling, is easily brought back to a lower state.
8. Infant screams (state 6) in response to stimulation more than twice, although some quieting can occur with consoling, with difficulty; usually needs finger or pacifier to console.
9. Infant achieves insulated crying state in which the infant is unavailable and unresponsive; unable to be quieted or soothed.

52. *Rapidity of Build-up (All States With State 6 for at Least 15 Seconds)*

This item is a measure of when during the examination the infant first reaches state 6. The order of the examination as listed below cannot always be maintained, because it depends on the infant's state pattern. If the order of administration of the packages differs from the preferred order, assign the score according to whether the infant reached state 6 in the first third, middle third, or last third of the

examination. However, if the Habituation package was not administered because the infant was not asleep, use the full range of scores (except score 11). If the infant first cries for 15 seconds at a point that is not designated below, score the item that is nearest to this point and according to the sequence of the examination.

Scores:

1. Infant never upset.
2. At end of examination with infant supine in crib. For alternative orders, infant reaches state 6 in the last third of the examination.
3. During Infant Spin.
4. During Orientation items when infant is supine on examiner's lap.
5. During Infant Prone package. For alternative orders, infant reaches state 6 in the middle third of the examination.
6. During Upright Responses package.
7. During Upper Extremities and Face package.
8. During the Lower Extremity Reflexes package. For alternative orders, infant reaches state 6 in the first third of the examination.
9. During Response Decrement to Tactile Stimulation of the Foot.
10. During Unwrap and Supine package.
11. During Habituation package (only if first package in examination).
12. Never was quiet enough to score this item.

53. *Irritability (All States)*

This item measures the number of times the infant gets upset as well as the kind of stimuli that make the infant irritable. To score this item, count the number of stimulus packages or specific items listed below to which the infant responds with audible fussing or crying for no less than 3 seconds (but not as long as 15 seconds, which would be scored as a state change). If >2 of the packages or items listed below are not administered because the infant was in a state 6, score 9. At least half of the items within a package must be administered to evaluate irritability during the package. Do not count missing Habituation and Response Decrement to Tactile Stimulation of the Foot unless they were skipped because of crying.

- Habituation
- Unwrap and Supine
- Response Decrement to Tactile Stimulation of the Foot
- Lower Extremity Reflexes
- Upper Extremities and Face
- Upright Responses
- Infant Prone
- Cuddling
- Infant Supine on Examiner's Lap (Orientation)
- Infant Spin
- Infant Supine in Crib

Scores:

1. No irritable fussing to any of the above.
2. Irritable fussing during 1 of the packages or items.

3. Irritable fussing during 2 of the packages or items.
4. Irritable fussing during 3 of the packages or items.
5. Irritable fussing during 4 of the packages or items.
6. Irritable fussing during 5 of the packages or items.
7. Irritable fussing during 6 of the packages or items.
8. Irritable fussing during 7 of the packages or items.
9. Irritable fussing during 8 of the packages or items or >2 of the packages or items not administered because the infant was in a state 6.
98. Infant never achieved an awake state.

Activity (States 3–5)

This item is a summary of the activity seen throughout the examination when the infant is in states 3, 4, and 5. Two kinds of activity are scored separately in items 54 and 55, respectively: Spontaneous activity measures the infant's level of activity when you are not administering a maneuver and is seen over the course of the examination, and elicited activity is when the infant is responding to the administration of an item.

An additional dimension reflected in the scoring is the inaccessibility of the infant's activity. This refers to when your maneuvers do not interfere or affect the infant's ongoing activity.

The amount of activity is graded as: much = $\geq 75\%$ of the time; moderate = 50% of the time; slight = 25% of the time. After stimulation that triggers activity, the amount of activity that persists can be assessed: "much" is activity that builds up quickly and perpetuates itself for a period of time (eg, ~ 15 seconds or more); "moderate" is activity that has little or no delay and lasts for ~ 5 to 10 seconds; "little" is activity that may be delayed and quickly subsides (~ 5 seconds or less). Continuous activity is a high level of activity (much) that cannot be consoled or interfered with during handling or other maneuvers.

54. Spontaneous Activity

Scores:

1. None.
2. Slight.
3. Moderate.
4. Much.
5. Continuous but consolable movement.
6. Continuous, inconsolable movement.
98. Item not scored because the infant is never in appropriate state.

55. Elicited Activity

Scores:

1. None.
2. Slight.
3. Moderate.

4. Much.
5. Continuous but consolable movement.
6. Continuous, inconsolable movement.
98. Item not scored because the infant is never in appropriate state.

56. Tremulousness (All States)

This item measures the number of times tremors (quivering) of the infant's limbs and chin are seen and in which state the tremors are seen. Tremulousness may indicate CNS irritation or depression and also may be a sign of immaturity or may occur for metabolic reasons. If it is severe, the infant should be considered as suspect. Milder forms of tremulousness are demonstrated at the end of a startle and as an infant comes from sleeping to awake states. Some tremor of the extremities can be expected in the infant's first week. Because the infant normally becomes dehydrated in the second and third day, metabolic imbalances cause some tremulousness. In light sleep, or as the infant startles in deep sleep, tremors of the extremities may be noted. Tremors of the chin should not be scored if seen in state 6. As the infant becomes alert and active, the tremulousness should subside. Aversive stimuli may set off a startle that is followed by a return of tremulousness. Mildly aversive stimuli should not cause observable tremors. Jerkiness and startles should be differentiated from tremors.

The scoring of tremulousness is a cumulative score (ie, a score of 6 means 1 or 2 tremors were seen in state 4 and also may have been seen in states 5 and 6 or sleep).

Scores:

1. No tremors or tremulousness noted.
2. Tremors only during sleep.
3. Tremors only after the Moro response or startles.
4. Tremulousness seen 1 or 2 times in states 5 or 6.
5. Tremulousness seen ≥ 3 times in states 5 or 6.
6. Tremulousness seen 1 or 2 times in state 4.
7. Tremulousness seen 3 times in state 4 and < 3 in other states.
8. Tremulousness seen > 3 times in state 4 and may be seen > 3 times in each of several other states.
9. Tremulousness seen consistently and repeatedly in all states.

57. Amount of Startle During Examination (States 3–6)

Both spontaneous startles and those that have been elicited in the course of administering an item are scored. Some infants never startle during an examination except when a Moro response is elicited. Some infants react to any disturbing stimulus with a startle and have startles for no observable reason; hence, they must be considered "spontaneous" or due to internal stimuli. A startle is scored when there is total body movement and should be distinguished from the movements that involve only part of the body. The Moro response is used as an example of this kind of total-body movement. Anything less than whole-body startle should not be scored. Discount startles elicited by your clumsy movement, and do not include startles observed during Habituation items.

Scores:

1. No startles noted.
2. Startle as a response to the examiner's attempt to set off a Moro reflex only.
3. One startle, excluding Moro reflex.
4. Two startles, excluding Moro reflex.
5. Three startles, excluding Moro reflex.
6. Four startles, excluding Moro reflex.
7. Five to six startles, excluding Moro reflex.
8. Seven to nine startles, excluding Moro reflex.
9. Ten or more startles, excluding Moro reflex.
98. Item not scored because the infant is never in appropriate state.

58. *Lability of Skin Color as Infant Moves From States 1 to 6*

This item measures the changes of color and vascularity that take place during the examination (eg, the acrocyanosis or peripheral mild cyanosis when the extremity is left uncovered or the change from pink to pale or cyanotic when the infant is undressed). Mottling and a web-like appearance may occur in an effort to maintain body heat. A normal newborn is likely to demonstrate mild color changes several times in an examination during which he or she has been undressed, disturbed, and upset. The length of time after undressing before the infant begins to change color is a good way to judge color change. Additionally, the amount of the area of the body that changes should be scored, as should the degree of the change and the time until recovery of the original color. When the color is abnormal and there is no observable change in color during the examination, it may be the result of a depressed or overstressed autonomic and vascular system, as seen among lethargic, pale, or cyanotic infants. Marked changes that vary from minute to minute will be seen in premature infants or infants who have not yet adjusted to extrauterine temperature changes.

- Acrocyanosis: record when there is more than mild, localized cyanosis of the extremities and around the mouth, especially when the infant is not in enough stress to account for such mild changes.
- Paling: dusky color, lack of color, or grayish color. This should be checked when unusual or excessive.
- Reddening: record when there is more than mild or localized reddening in the extremities or on the body or when the infant is not under enough stress to account for the change. This can be the result of unusual vascular changes, dehydration, or skin irritation.
- Other skin abnormalities: record any other abnormalities such as hypo- or hyperpigmentation or hemangiomas, because they might reflect metabolic or hematologic variations, which could influence the behavioral outcome of the examination.

With nonwhite infants with deep pigmentation of the skin, it may be more difficult to score lability of skin color. In these infants, changes in skin color may be more subtle and are often visible around the eyes, lips, hands, and feet.

Scores:

1. Skin color does not change during the examination.
2. Skin color changes minimally during the examination.
3. Skin color changes to slightly more blue around mouth or extremities during the examination, improving somewhat during the examination.
4. Slight change in skin color to acrocyanosis in extremities as well as chest or abdomen but more rapid recovery. There may be mild cyanosis around mouth or extremities after stress during examination.
5. Changes in skin color on parts of the body only. There may be a mild color change of chest and abdomen; mottling may appear on face, chest, or limbs; original color returns quickly.
6. Complete change in skin color to red over whole body, but color returns with soothing or covering.
7. Skin color changes to very red when uncovered or crying but recovers slowly if covered or soothed.
8. Skin color changes rapidly to very red early in the examination; recovery is slow.
9. Marked, rapid changes in skin color to very red; good color does not return during rest of examination.
10. Infant becomes pale and dusky during examination, but skin color improves with handling.
11. Infant becomes pale and dusky during examination; color does not improve with handling.

59. *Lability of States (All States)*

This item measures the infant's state performance over the examination period. Every definite state change over a recognizable period of at least 15 seconds is counted. Count 1 more state change after the Moro reflex if the infant is crying. It is recommended that you score this item as soon as possible after the administration of the examination. This may be done by mentally reconstructing the order of the examination and documenting each state that the infant maintained for 15 seconds. Counting should include changes upward and downward over the examination period. Scores of 1 to 3 on this item are aimed at the infant whose states are not very labile. Scores 4 to 6 reflect moderate lability, and 7 and higher are reserved for the infant who is very labile.

The scores correspond to the frequency of changes.

Scores:

1. There were 0 to 2 changes over the course of the examination.
2. There were 3 to 5 changes over the course of the examination.
3. There were 6 to 8 changes over the course of the examination.
4. There were 9 to 10 changes over the course of the examination.
5. There were 11 to 13 changes over the course of the examination.

6. There were 14 to 15 changes over the course of the examination.
7. There were 16 to 18 changes over the course of the examination.
8. There were 19 to 22 changes over the course of the examination.
9. There were ≥ 23 changes over the course of the examination.

60. *Self-Quieting Activity (States 6 and 5 to 4-1)*

This is a measure of the activity that the infant initiates in a crying or fussy state as an observable effort to quiet itself. The success of the activity is measured by an observable state change to state 4 or below and persisting for at least 5 seconds.

Most infants cry or fuss vigorously at some time during the examination (state 5 or 6). For those who never cry or fuss, a score of 98 should be given. The activities that can be counted are: 1) hand-to-mouth efforts; 2) sucking on fist or tongue; and 3) focusing on a visual or auditory stimulus from the environment.

Scores of ≥ 6 on this item are reserved for infants who have consoled themselves to a lower state ≥ 1 times.

Scores:

1. Makes no attempt to quiet self; intervention always necessary.
2. A brief attempt to quiet self (<5 seconds) but with no success.
3. Several attempts to quiet self but with no success.
4. One brief success in quieting self for period of ≥ 5 seconds.
5. Several brief successes (5 seconds) in quieting self.
6. An attempt to quiet self that results in a sustained, successful quieting with the infant returning to state 4 or lower (for at least 15 seconds).
7. One sustained (15 seconds) and several brief (5 seconds) successes in quieting self.
8. At least 2 successful (15 seconds) successes in quieting self.
9. Consistently quiets self for sustained periods; never needs consoling.
98. Item not scored because the infant is never in appropriate state.

61. *Hand-to-Mouth Facility (All States)*

This item is measured in all states. A hand-to-mouth reflex is inborn and seems to be a response to stroking the cheek or the palm of the infant's hand. It can be triggered in the infant by mucus and gagging or by discomfort as one places the infant in prone. It is seen spontaneously as the infant attempts to control or comfort him/herself when upset. This item is a measure of the infant's ability to bring hand to mouth as well as success in insertion. Some infants bring their hands to their mouths repeatedly, insert a part of the fist or fingers, and suck actively on the inserted part.

To score this item, the infant must actively achieve

hand to mouth. If the hand is placed next to the mouth accidentally as you place the infant in prone or up on the shoulder, a hand-to-mouth success should not be counted. However, if the infant touches the mouth on his or her own or actively inserts the fingers in these positions, it may be counted toward the scoring of this item.

Scores:

1. No attempt to bring hands to mouth.
2. Brief swipes at mouth area, but no real contact.
3. Hand brought to mouth and contact, but no insertion; once only.
4. Hand brought next to mouth area twice; no insertion.
5. Hand brought next to mouth area at least 3 times, but no real insertion; abortive attempts to suck on fist.
6. One insertion that is brief but unable to be maintained.
7. Several actual insertions that are brief but not maintained; abortive sucking attempts, >3 times next to mouth.
8. Several brief insertions in rapid succession in an attempt to prolong sucking at this time.
9. Fist and/or fingers actually inserted and sucking on them for 15 seconds or more.
10. Frantic, exaggerated attempts to get hand in mouth.

62. *First Predominant State*

Apart from Habituation, record which state the infant was in during most of the examination.

63. *Second Predominant State*

Apart from Habituation, record which state the infant was in second-most often during the examination.

64. *Postexamination-State Observation*

After the examination is over, place the infant in the crib and begin the 2-minute postexamination period. Record the last state the infant achieved for at least 15 seconds at the end of the period as the Postexamination-State Observation. If crying, restrict the arm and leg movements but do not swaddle, use a pacifier, or hold the infant. If the infant cannot achieve less than state 6, score the Postexamination-State Observation as 6, and terminate the observation period after 30 seconds. If the infant begins in states 1 to 5 and then changes into a state 6, allow 30 seconds for the infant to self-comfort. If not, end the observation period and score the Postexamination-State Observation as 6. If the examination is ended before all items are completed, record the Postexamination-State Observation and end time. If only Habituation items are administered after the Postexamination-State Observation, the end state is recorded. In both cases, score 6 (interrupted order) on item 65 (Order of Administration).

Scores:

1. State 1

2. State 2
3. State 3
4. State 4
5. State 5
6. State 6

65. Order of Administration

The sequence of items (1–45) reflects the preferred order of administration. An alternative order based on the infant's cues is to begin the Orientation items (Infant Supine on Examiner's Lap) after Pull to Sit rather than after Cuddle on Shoulder. A third alternative order maintains the internal structure of the packages but not their order; that is, all items within a package are administered together, but the packages are not administered in either the preferred or the alternative orders. A fourth alternative is to administer items without maintaining the order of either the packages or the items within packages. A fifth alternative order is to administer the Unwrap and Supine package after the Preexamination Observation because the infant is not sleeping. Habituation may be administered later if the infant sleeps. Finally, an interrupted order can occur if the infant's state requires that the examination be stopped and another procedure or a nap period given before resuming the NNNS. This is not a short break but a real interruption in the flow of the examination. Record the best description of the order of administration for the examination. If >1 descriptor applies, record the highest score.

Scores:

1. Preferred order.
2. Alternative order: Orientation items after Pull to Sit.
3. Third order: packages maintained but out of order.
4. Fourth order: items administered independent of packages.
5. Fifth order: Habituation items not administered at all.
6. Interrupted order: other procedures or nap time interrupt the examination.

PART II: STRESS/ABSTINENCE SCALE

The Stress/Abstinence Scale is divided into 7 categories; physiologic, autonomic, CNS, skeletal, visual, gastrointestinal, and state. Score each item as "yes" if present or "no" if absent using the definitions provided. Some items are inherently tied to state (eg, items 28–32 relate to orientation). Score as "no" if the infant never attained the appropriate state. State is irrelevant in many items. The sum of positive signs within each category can be used to provide a score representing the amount of stress/abstinence related to that category (ie, separate scores for physiologic stress, autonomic stress, etc). The total number of signs checked (summed over all 7 categories) provides a single summary score of the amount of stress/abstinence observed.

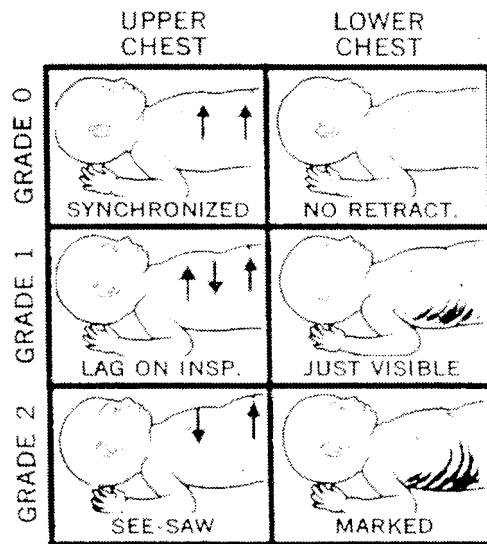


Fig 6. Respiratory patterns for scoring labored breathing.

M. Physiologic

66. Labored Breathing

Score yes if the infant seems to have difficulty maintaining normal, regular respiration that may include drawing in of the intercostal tissues during respiration (retracting), lag on inspiration, or "see-saw" breathing (see Fig 6).

67. Nasal Flaring

Score yes if repeated dilation of the nares is observed (usually seen in relation to respiratory problems).

N. Autonomic

68. Sweating

Spontaneous sweating is associated with abstinence and otherwise not common in the newborn. Score yes if sweating is spontaneous and is not due to excessive clothing or high room temperature.

69. Spit-up

Score yes if at least 1 episode of regurgitation is observed even if vomitus is contained in the mouth.

70. Hiccoughing

Score yes if there are at least 3 hiccoughs during the session.

71. Sneezing

Score yes if there are at least 3 sneezes during the session.

72. Nasal Stuffiness

Score yes if the infant sounds congested; mucous may be visible.

73. Yawning

Score yes if there are at least 3 yawns during the session.

O. CNS

74. *Abnormal Sucking*

Score yes if weak, hyperactive, or disorganized sucking is seen during the sucking response or observed elsewhere during the examination. Tongue thrusting is also included.

75. *Choreiform Movements*

Score yes if irregular jerking and writhing movements, often in tongue, face, neck, and shoulder are observed.

76. *Athetoid Postures and Movements*

Some of the fingers are fully flexed while others are simultaneously extended, simultaneous flexion of the elbow and rotation of the upper limb, or extension at the elbow with rotation of the wrist. Athetoid movements are slow, writhing changes from 1 athetoid posture to another. Score if athetoid postures only or if both athetoid postures and movements are observed.

77. *Tremors*

Tremors are rapid, rhythmic oscillation movements with a segmented quality.

Scores:

77a. Score yes if low frequency (<6 times per second)/high amplitude (≥ 3 cm) tremors are observed.

77b. Score yes if high frequency (≥ 6 times per second)/low amplitude (<3 cm) tremors are observed.

78. *Cogwheel Movements*

Score yes if slower, cog-like, jerky movements are observed.

79. *Startles*

Score yes if ≥ 1 total-body responses (such as the Moro response) are observed. Do not include startles elicited by you or startles that occur during sleep states.

80. *Hypertonia*

Hypertonia is defined as excessive or above-normal muscle tone or tension; score yes if the infant's musculature becomes "stiff" or rigid, and the infant shows marked resistance to passive movements.

81. *Back Arching*

Score yes if the infant stiffens and arches his or her back. This can occur when the infant is being stimulated or handled, or it may occur spontaneously.

82. *Fisting*

Score yes if the infant has tightly clenched fists for long periods of time. The infant appears tense and may appear panicked.

83. *Cortical Thumb*

Score yes if the thumb is folded inside the palm of the hand in an obligatory manner/for long periods of time.

84. *Myoclonic Jerks*

Myoclonic jerks are defined as involuntary muscular contractions that usually involve a single group of muscles. These are exceedingly abrupt, shocklike contractions, irregular in rhythm and amplitude, and usually asynchronous or asymmetrical in distribution. Score yes if myoclonic jerks are observed.

85. *Generalized Seizures*

In the newborn, generalized seizures are most commonly seen as fragmentary or multifocal clonic attacks consisting of asymmetric clonic jerking or shifting clonic movements that migrate from limb to limb in a disorderly manner. Strictly focal seizures involving 1 or both limbs on 1 side of the body are also common. Unusual limb movements may accompany a seizure. These movements are pendular and rhythmic and, when found in the upper limbs, they often resemble "swimming" or "rowing." In the lower limbs, they resemble "pedaling" or "bicycling." Pallor and hypotonia may also be seen. Tonic-clonic seizures that are seen in older infants are rare in newborns. Score yes if generalized seizures are observed.

86. *Abnormal Posture*

Includes opisthotonus (ie, exaggerated, total-body extension with pronounced arching of the trunk), tonic extension, obligatory or exaggerated ATNR, or abnormal posture associated with hypotonia (flaccidity). Score yes if, any time during the examination, the infant assumes an abnormal posture.

P. Skin

87. *Pallor*

Score yes if the infant becomes pale, gray, or dusky during the examination.

88. *Mottling*

Score yes if the infant shows mottling during the examination.

89. *Paroxysmal Cyanosis*

Score yes if deep redness or purple precedes or occurs during a vigorous cry or vigorous handling of the infant (eg, ATNR); may be seen as a leaden bluish or black-and-blue discoloration. The color darkens suddenly and profoundly.

90. *Overall Cyanosis*

Score yes if the infant shows bluish-purple discoloration of the skin over the whole body that is a gradual onset and not related to vigorous handling or crying.

91. *Circumoral Cyanosis*

Score yes if localized cyanosis around the mouth and upper lip is observed.

92. *Periocular Cyanosis*

Score yes if localized cyanosis around the eye sockets is observed.

Q. Visual

93. *Gaze Aversion During Orientation*

Score yes if the infant turns his or her eyes and/or head away from auditory and/or visual stimulus. This is not a lack of responsivity; it is an active response in which the infant is aware of the stimulus and actively rejects it. The infant remains in a state 4 or 5.

94. *Pull Down During Orientation*

Score yes if the infant responds to auditory and/or visual stimulation by returning to a lower state (1, 2, or 3). The state change may not be sustained (>15 seconds), and the infant may return to state 4 or 5 when the stimulus is removed. However, the infant responds to the stimulus by returning to a lower state.

95. *Fuss/Cry During Orientation*

Score yes if the infant fusses or cries in direct response to the presentation of the stimuli used during orientation. The item presumes that the infant was in a state 4 or 5 when the maneuver(s) was started and that the orientation stimulus elicited the cry.

96. *Obligatory Following During Orientation*

Score yes if the infant reacts to a stimulus during orientation with an exaggerated, pronounced response. The head jerks rapidly to 1 side, the head movement is not smooth, and the infant may overshoot the target. The reaction is a hypersensitive or hyperreactive response in which the infant turns "too quickly."

97. *End-Point Nystagmus During Orientation*

Score yes if nystagmus occurs as the infant fixates on a visual stimulus during orientation.

98. *Sustained Spontaneous Nystagmus*

Score yes if nystagmus occurs spontaneously, such as after a slight movement of the head, and is sustained (>4 beats).

99. *Visual Locking*

This can occur anytime during the examination and is seen as a blank stare often at an object. The infant has difficulty or is unable to break visual contact. Score yes if visual locking is observed.

100. *Hyperalertness*

Score yes if exaggerated, overly intense alertness is observed. Eyes appear unusually large and may appear to bulge, and the infant may have a stressed or panicked expression.

101. *Setting-Sun Sign*

Score yes if the eyes point downward, pupils are partially covered by the lower eyelids, sclera are

visible above the pupils, and it is sustained (which may be a sign of intra/endocranial pressure).

102. *Roving Eye Movements*

Score yes if the infant exhibits poor control of eyes. Eyes may appear uncoordinated, with unconjugated eye movements, and they may appear to "float" around in the eye sockets.

103. *Strabismus*

Score yes if one or both eyes are not centered and deviated to the left or the right due to imbalance of the extraocular muscles (the visual axes do not meet at the desired objective point). The infant may appear "cross-eyed."

104. *Tight Blinking*

Score yes if the infant avoids auditory and/or visual stimulation by closing his or her eyes in a reflexive-like manner and the infant opens his or her eyes when the stimulus is removed (the response is not a state change but rather an attempt to block the stimulation by closing the eyes).

105. *Other Abnormal Eye Signs*

Score yes if any unusual eye signs not listed above are observed (eg, overshooting without obligatory following).

R. Gastrointestinal

106. *Gagging/Choking*

Score yes if any transient interruption of the airway occurs, causing the infant to choke or gag.

107. *Loose or Watery Stools*

If not apparent during the examination, check the diaper after the examination is completed. Score yes if loose or watery stools are observed.

108. *Excessive Gas and/or Bowel Sounds*

Score yes if these sounds occur continuously throughout the examination or in episodes.

S. State

109. *High-Pitched Cry*

Score yes if the infant's cry was high pitched at any time during the examination when the infant was in a sustained state 6. Do not include brief "squeals" that the infant may emit during a fuss.

110. *Monotone-Pitch Cry*

Score yes if the infant's cry has a flat, arrhythmic, unmodulated quality. As above, this type of cry is scored only during a sustained state 6.

111. *Weak Cry*

This cry is a low-amplitude, "soft" cry that can happen either during a sustained state 6 or during fussy bouts. When it occurs during fussy bouts, you often have the impression that the infant is "trying" to cry hard but can't, as if there is not enough respiratory effort. Score yes if a weak cry is observed.

112. No Cry

Score yes if the infant never reaches state 6 (for 15 seconds) during the examination.

113. Extreme Irritability

Score yes if the infant fusses or cries throughout the examination and the fuss/crying seems to be insulated in the sense that it seems to control the infant and determines the flow of the examination. This is the infant who is "at the mercy" of his or her fussiness; crying is persistent and excessive, and the infant cries to minimal as well as vigorous handling and maybe even without stimulation.

114. Abrupt State Changes

Score yes if transitions from 1 state to the next are very sudden and there is no gradual, smooth change from 1 state to the next. The abrupt state changes may be from lower states to higher states or vice versa and may include skipping states, most often attentional states (eg, state 3 to 6).

115. Inability To Achieve State 4

Score yes if the infant is not able to achieve a sustained state 4 (15 seconds) despite attempts by you. Orientation may have been attempted, but the infant was not available enough to provide responses that could be scored.

ACKNOWLEDGMENTS

This work was supported by National Institute of Child Health and Human Development contract N01-HD-2-3159.

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The Neonatal Intensive Care Unit Network Neurobehavioral Scale Procedures
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Pediatrics 2004;113:641-667
DOI: 10.1542/peds.113.3.S1.641

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