Neonatal
Eating
Outcome Assessment

Neonatal Eating Outcome (NEO) Assessment Manual

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Part I.

Introduction to the NEO Assessment

Purpose:

To assess age-appropriate oral motor and feeding skills in preterm infants prior to and at term equivalent age. This assessment attempts to gauge normal versus abnormal progression of feeding across differing postmenstrual ages (PMA), when lack of feeding success can be either a flag for abnormality or part of the normal process of maturation. While this tool may assist in identifying feeding abnormalities, it does not establish treatment priorities. It can be used with breast or bottle fed infants. Scoring of the NEO is based on the infant's PMA at the time of assessment.

Ages:

The full assessment is appropriate for infants who have initiated oral feeding (approximately 30-32 weeks PMA) through approximately 4-6 weeks post-term. An abbreviated form can be used for infants after 30 weeks PMA who are not yet orally feeding.

Assessment Procedures:

Feeding performance can change with different modes of feeding, with different positioning and with different interventions. Use the most common mode of feeding, along with typical interventions used for the specific infant being assessed, for the first feeding assessment using this tool. Thereafter, the effect of different interventions can be determined through reassessment.

Score only Section I (Pre-Feeding Behaviors) if the infant is not yet orally feeding.

When oral feeding is attempted, complete Sections I, II, III, and IV for the full assessment.

For infants not yet orally feeding, provide non-nutritive sucking using a gloved finger or pacifier for 1-3 minutes. For infants who are orally feeding, make observations prior to bottle nipple insertion or latch to the breast followed by observing an oral feeding for a maximum of 20 minutes.

The score that is **bolded** in each item represents the optimal response for an infant at or beyond term equivalent age. The score that is in *italics* in each item represents a response that is always abnormal, irrespective of PMA. Not all items have an italicized option. If an infant demonstrates behaviors that are described in two responses, choose the one that is most representative of the infant's abilities at time of assessment. When two score responses equally represent the infant's behavioral response, score the least optimal score.

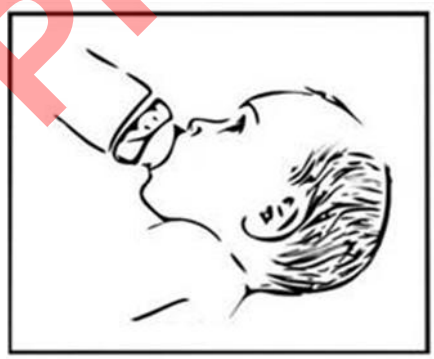
The test is composed of 4 different sections:

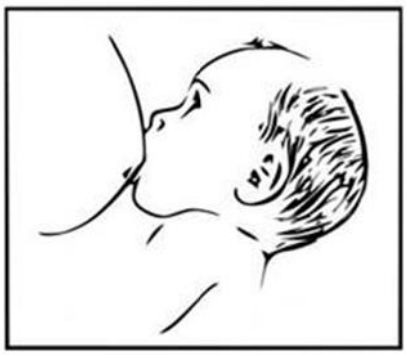
Section I: Pre-Feeding Behaviors (7 items)
For infants not yet orally feeding, provide the infant with 1-3 minutes of non-nutritive sucking using a gloved finger or pacifier, then score Section I. For breastfed infants, non-nutritive sucking can be assessed with a gloved finger, pacifier, or at the breast (as in when the mother has expressed milk prior to a sucking attempt). For infants not being orally fed, score *only* Section I, using the abbreviated form scoring criteria.
For infants who are orally fed, observe the time prior to bottle nipple insertion or latch to the breast and score Section I, giving the infant a score of 'D' or 'normal' for item I-7 (Non-Nutritive Sucking) if a sucking pattern is initiated. If a sucking pattern is not initiated, oral feeding should be stopped and Pre-Feeding Behaviors should be the only items on the assessment scored.

Item I-3 (Respiratory Support) is used to determine readiness for oral feeding, but it is not a scored item.

Items marked with an asterisk (*) are highlighted in green on the score sheet. These items relate to feeding readiness. If an infant receives a score of 'A' on any of these items, oral feeding is not appropriate, and the abbreviated scoring of the NEO should be used. If items in green are scored a 'B' or 'C', cautious assessment of feeding with a neonatal therapist or nurse trained in cue based feeding may occur. Feeding readiness may be developmentally regulated in the preterm infant prior to term. In infants who continue to demonstrate low arousal and inadequate root and grasp at term and beyond, their responses may be related to alterations in development rather than the need for maturation, and careful assessment by a neonatal therapist is warranted.

Section II: Oral Feeding (9 items)
For infants being orally fed, feed the infant according to standard procedure. Ensure that a side view of the lips, jaw, and nipple/breast can be viewed, as shown in picture below. Score Section II based on observations in the first 10 minutes of the oral feeding. Adaptations made by the feeder (such as providing external pacing) should be considered as necessary, if provided, and should be reflected in the scoring.





Items marked with two asterisks (**) are highlighted in red on the score sheet. These items are related to safety issues during feeding. If a score of 'A' is achieved, feeding should be stopped and either 1) time for maturation be allowed to occur, or 2) if an infant is term age, a formal swallowing evaluation should be considered.

The scoring of infant performance changes as PMA advances. Due to this, the changing skills of the preterm infant across time may not be fully appreciated on this assessment, due to the changing scoring based on level of immaturity. For clinicians interested in observing the maturation of feeding skills across time with the consistent measure of feeding using a static comparison, the scoring criteria for a full term infant can be used across time. By using the full term criteria, the examiner can compare how far the infant is from 'mature' by comparing the infant's score to the 'term' score for that item.

If a certain skill was not able to be observed, due to lack of elicitation during the assessment, write in NT (not tested) and give that item a score of 5. If the infant is on an 'ad lib on demand' feeding schedule and does not appear to have appropriate arousal or latch/grasp onto the nipple, it is suggested to return for the next time the infant is fed to complete the assessment.

Section III: Observations at the End of Feed (3 items)
After the feeding is stopped, completed, or 20 minutes of time has elapsed since the nipple was first placed in the infant's mouth, score Section III.

The item marked with three asterisks (***) is highlighted in yellow on the score sheet. This item relates to success with oral feeding. A score of 'F' indicates success with the prescribed volume. Any other score may indicate the need for supplemental feeding.

Section IV: Items Not Scored (13 items)
Section IV provides more information about the nature of the feeding environment to better define performance in relation to nipple type, position, feeder experience, etc.

If the goal of using this assessment is to evaluate the effectiveness of adapted feeding methods or interventions, re-assess an entire feeding on a different day using the apparatus, methods, and positioning that have been recommended. Section IV should document what was used during the assessment and the resultant performance. Recommendations for subsequent feedings can be made at the bottom of the score sheet.

Score Sheet Color Coding Reference to Determine Oral Feeding Readiness, Safety and Success:

Section	Item(s)	Construct	Score	Response
One: Pre-Feeding	I-1 – I-5 Page 8-14	Feeding Readiness	Score of 'A'	Oral feeding is not appropriate, use abbreviated scoring
One: Pre-Feeding	I-1 – I-5 Page 8-14	Feeding Readiness	Score of 'B' or 'C'	Cautious assessment with a professional trained in cue based feeding is necessary
Two: Oral Feeding	II-8 – II-9 Page 27-29	Safety	Score of 'A'	Oral feeding should be stopped
Four: Breastfeeding Non-Scored	IV-18 Page 41	Breastfeeding Complications	Any boxes checked in this section	Breastfeeding is medically contraindicated, and the decision to proceed with breastfeeding should be carefully considered in conjunction with a physician
Three: End of Feed Observations	III-3 Page 33-34	Success with Oral Feeding	Score of 'A', 'B, 'C', 'D', or 'E'	Need for supplemental feeding should be evaluated
Four: Breastfeeding Non-Scored	IV-15 Page 40	Mother's Milk Supply	Check of anything other than '89-100% of volume needed each day for infant'	Need for supplemental feeding should be considered

Prescribed Feeding Volume:

In the NICU, the delivery of fluids, nutrition, and calories are important for growth and development. Several items on the NEO are in relation to how much volume the infant consumed in relation to the prescribed volume within a 20-minute period. The prescribed volume of intake is most often established by the neonatologist or dietician in the neonatal intensive care unit.

Appropriate volume is often determined by calculating the nutritional and fluid needs of the infant, but calculation of appropriate volume is balanced by the increasing maturity of the gastrointestinal system across PMA in the preterm infant and in conjunction with other co-morbid factors. Nutritional needs, coupled with the routine assessment of gastrointestinal tolerance, are used to determine a daily prescribed volume for each infant. *Typically, the goal volume of formula or breastmilk is calculated at 100-120 calories per kilogram per day.* However, the number of calories in breast milk varies, but is considered on average to be consistent with regular formulas, which are 19-20 calories per ounce. Breastmilk can be modified to be higher in caloric density or it can be fortified for preterm infants. Preterm formulas typically are 22-24 calories per ounce. For infants with established gastrointestinal tolerance, the total needed volume (based

on caloric density of the milk as well as current infant weight) is then divided by the number of feedings per day (typically 8) for a prescribed volume per feeding. The prescribed volume is typically defined by the neonatologist and/or dietician.

If an infant is being fed within a couple of days of birth at term equivalent age, very small amounts of intake may be appropriate. Consider small amounts of intake to be adequate (a full feeding), even if the infant only eats for a few minutes, unless otherwise specified by a pediatrician. After the third day of life, at term age or beyond, the amount of a feeding must be considered in the context of what has been consumed over the past 24-hour period. A poor feeding of a small amount over a short period of time should be re-assessed at the next attempted feeding.

General Scoring:

- Scoring of the NEO assessment is based on the infant's PMA at the time of assessment. PMA is calculated by adding the number of completed weeks of gestation at birth to the number of completed weeks elapsed since birth.
- In this assessment, some items are intended to evaluate pre-feeding behavior, while others assess feeding behaviors and responses to feeding. If the infant is not orally feeding, score only the Pre-Feeding Behavior items during Non-Nutritive Sucking (Section I) and use the abbreviated form scoring criteria. If oral feeding is attempted, use the full form (Section I, II, and III) for scoring after observing non-nutritive sucking and oral feeding for 20 minutes. Complete Section IV to document environmental, positioning, and adaptive strategies used during the assessment process.
- Each item is worth 1, 3, or 5 points (unless specified that the item is not scored). A score of 1 on each item reflects a feeding challenge for that PMA, a score of 3 reflects a questionable performance, and a score of 5 reflects a normal performance. A questionable performance indicates that the skill may be emerging, may be impacted by concurrent medical complications, or could indicate abnormal performance. Circle the letter designation for the closest description of how the infant performed on a given item. Sometimes infants demonstrate behaviors across more than one scoring criteria. When this happens, score the one that more closely represents the infant's performance, paying closer attention to the first criteria listed under that item. If scoring clearly falls in between two scores, score the least optimal response of the two. Use the infant's PMA at time of assessment to determine the assessed value of each item (1, 3, or 5 points).
- All point-valued items are added for a total raw score. Raw scores can be categorized as normal, questionable, or abnormal based on established ranges. Such ranges are based on expert opinion and are currently being tested in a cohort of 50 preterm infants for validity. The range of scores and appropriate

classifications are available on the bottom of the score sheet and on page 37 of this manual under 'Scoring Criteria'.

- Some items (in section IV) are designed to provide information about the feeder, the feeder's experience with feeding infants, the infant's experience with feeding, the position during feeding, external supports during feeding, and other factors within the feeding. These items are NOT scored. Items numbered IV-15 through IV-22 are non-scored items for breastfeeding only. Items IV-15 are highlighted in yellow, indicating that checking any box other than "89-100% of infant's volume each day" may signify the need for supplemental feeding. Item IV-15 is highlighted in red, indicating a safety issue. Checking any box on item IV-18 indicates that breastfeeding is contraindicated, and continuing with breastfeeding should be carefully considered in conjunction with a physician.

Example Item Scoring:
Item: Arousal/State Organization (I-1)
Item most closely matching performance: B. Short periods of arousal with stimulation

On the scoring sheet under Arousal/State Organization (I-1), item "B" for an infant who is 37 weeks PMA is worth 1 point. If the infant were 34-35 weeks PMA, "B" would be worth 3 points, and if the infant were 33 weeks PMA, "B" would be worth 5 points.

Training:

Therapists seeking to use the NEO should undergo training to ensure accuracy in scoring. Training typically involves approximately two hours of learning involving a PowerPoint and observations of feeding videos. Trainees then rate 5 feeding sessions and score feeding performance using the NEO. Trainees are considered reliable if they have 80% accuracy of scores (this means that trainees have agreement in a minimum of 15 of the 19 scored items).

States of Consciousness for Scoring Purposes:

There are 6 states of consciousness through which an infant cycles several times throughout the day. Two are sleep states, and the other four are waking states. As an infant's nervous system becomes more developed, the infant will begin to settle into a pattern of waking and sleeping with increased periods of arousal to engage in eating.

State 1	Deep Sleep	Infant lies quietly without movement or responses to general noise in the environment.
State 2	Light Sleep	Infant is asleep with eyes closed but demonstrates some movement; eye movements beneath closed eyes are visible; noise may startle the infant and cause the infant to wake.
State 3	Drowsiness	Infant may be waking or falling asleep; heavy eyes are present and fussiness may be observed. Movement is often subdued and eyes most often are closed or glazed. Drowsiness is differentiated from light sleep by the amount of activity, as active rooting and sucking responses and body movements are typically observed in a drowsy state but not in light sleep.
State 4	Quiet Alert	Infant is awake and alert with open eyes and clear visual focus, however, there is little movement of the body; infant appears attentive.
State 5	Active Alert	Infant is awake with eyes open and is alert, and demonstrates active movements of extremities, body, or neck.
State 6	Crying	Infant may be flailing extremities and demonstrating disorganized movements; audible, sustained cry is heard.

Adapted from (Brazelton and Nugent, 1995)

Part II.

Detailed Scoring Criteria for the NEO Assessment

I. PRE-FEEDING BEHAVIORS

If the infant is not yet orally feeding, score after observing 1-3 minutes of non-nutritive sucking on a pacifier or gloved finger. If the infant is orally feeding, this section is scored during the time prior to and at bottle nipple insertion or latch to the breast for oral feeding (and score item I-7 [Non-Nutritive Sucking] as "normal" if a sucking pattern is achieved). If a sucking pattern is not initiated, oral feeding should be stopped and Pre-Feeding Behaviors the only ones scored.

- **I-1. Arousal /State Organization*** - This item is intended to assess the level of ease of arousing the infant for the feeding, and should be assessed within 15 minutes of the scheduled feeding/care time. Observe the initial state, and if no spontaneous waking is evident, re-assess following a diaper change, gently changing the infant's position, and/or assessing vital signs.

A.	Unable to rouse to state 3, even with stimulation	Feeder is unable to rouse the infant long enough to initiate feeding. Infant maintains a state 2 or lower, even with attempted stimulation.
B.	Short periods of arousal with stimulation	Infant predominantly remains in state 2 or lower with brief periods being at or above state 3. Infant rouses to state 3 or above, but arousal is limited to less than 1-2 minutes. Brief arousal may occur with stimulation (diaper change, rocking, bouncing, auditory stimulation), however infant falls asleep when stimulus is removed.
C.	Prolonged arousal sustained after stimulation	Infant achieves state 3 or higher following stimulation and maintains it for greater than two minutes. Infant may be wakened with diaper change or stimulation, but did not arouse on his/her own. If infant has been wakened due to routine activities, score 'C'.
D.	**Wakes spontaneously**	**Infant wakes independently in anticipation of feed or to signal hunger. Infant achieves ≥ state 3 and sustains it.**

I-4. Rooting and Grasp* - This item is intended to assess how an infant demonstrates the rooting reflex and grasp in preparation for feeding. It is also an assessment of perioral/facial sensitivity. Rooting demonstrates the infant's awareness and response to tactile cues and/or his or her ability to seek food. The rooting and grasp response should be assessed prior to oral feeding by gently stroking each side of the mouth with a finger, pacifier, or breast and observing the infant's response. If a response cannot be seen on the sides of the mouth, stroke the upper and lower lip surfaces. The rooting response is observed when the infant turns the head toward the stimulated side or orients the head to the stimulus with an open mouth and grasps with mouth. A grasp is when the infant contacts the bottom of the nipple with the top of the tongue and closes the mouth around the bottle nipple. For breastfeeding, this item assesses whether the infant responds to the cue of the nipple and gets the mouth somewhere on the breast. It is ideal that the infant is sufficiently roused (in a state 3 or higher) with the head in midline for an optimal response.

A.	No response	The infant does not demonstrate sensory or motor awareness of the pacifier, gloved finger, or nipple. The infant is unable to suck due to inadequate grasp. The infant does not respond to the cue of the pacifier, finger, nipple, or breast and does not turn head toward stimulus when trying to elicit the rooting response, and does not open/close his/her mouth for the placement. Even with passive placement of a pacifier, gloved finger, or nipple the infant does not appear to respond to the stimulus by closing the mouth around it.
B.	Weak or unilateral root and grasp	Despite attempts to provide extra stimulation (as described in item 'C'), the infant does not respond and requires the feeder to passively place the nipple, pacifier or finger in the infant's mouth due to lack of adequate mouth opening. Upon passive placement, the infant's mouth may close around the finger, pacifier, or nipple, but grasp of the stimulus is weak. The infant may demonstrate diminished rooting response to either or both sides. This may include a delayed response (turning toward the stimulus after a few seconds or multiple stimuli) or only a partial head turn toward the stimulus. Score 'B' if the infant does not demonstrate appropriate arousal and/or responsiveness to the nipple, resulting in the examiner not attempting to place the nipple in the mouth. For breastfeeding, the infant may have a diminished rooting response or demonstrate licking in response to the breast but does not demonstrate an adequate response or mouth opening to get the mouth on the breast. The mother may attempt to passively place the breast into the infant's mouth.
C.	Root and grasp with stimulation	The infant may appear interested in the stimulus and respond to the stroking stimulus for rooting and may turn or orient the head partially or fully toward the stimulus, but the infant does not open the mouth adequately in response to the stimulus in order to grasp the finger, pacifier or nipple. The infant's mouth does not immediately open for the feeding with tactile stimulation around the face. Infant may require additional stimulation (>3 attempts), such as increased tactile stimulation of the perioral surface or jaw, touching the lips or other stimulation provided by the feeder in addition to eliciting the rooting response. The infant responds to this stimulation and closes around the finger, pacifier, or nipple once in the mouth. For breastfeeding, score 'C' if the infant appropriately responds to and places the mouth on the breast after >3 attempts, demonstrating a need for the extra stimulation. The stimulation may include: increased tactile stimulation of the perioral surface or jaw with a finger or the breast; touching the lips or other stimulation provided by the feeder in addition to eliciting the rooting response, squeezing the breast or increasing tactile stimulation through use of a breast shield.
D.	**Spontaneous root and grasp**	**Infant responds to a stroking stimulus, turns or orients the head toward the stimulus, opens the mouth in preparation for sucking, and closes the mouth around the finger, pacifier, or nipple. The infant must meet *all* of these criteria to receive a score of 'D' for this item. Score 'D' if the tactile input for rooting and grasp are provided between 0-3 times.** **For breastfeeding, score 'D' if infant roots and places mouth around breast within 3 trials of elicitation.**
E.	*Brisk, frantic response or avoidance*	*Infant's response is excessive or avoidant. The infant may frantically turn toward the stimulus, may demonstrate jerky or uncoordinated movements toward the nipple, and may appear over-stimulated by the rooting stimulus (response may appear frantic or obligatory). The infant may abruptly open the mouth, find the finger, pacifier or nipple and close around it in a hyper-responsive fashion that appears to indicate significant hunger or haste. The infant also may abruptly open the mouth and search frantically with a disorganized response that does not result in an appropriate grasp OR the infant may demonstrate jaw clenching or lip pursing and demonstrate avoidance (i.e. turning the head away from the stimulus). If infant demonstrates jaw clenching or lip pursing without avoidant behaviors, score 'A' or 'B'.* *For breastfeeding, score 'E' if infant demonstrates activity that is too high to enable root and close around the nipple or if infant demonstrates an avoidant response. Score 'E' when infant's activity level is too high and infant's hands consistently get in the way of latching onto the breast due to rigorous rooting and hands to mouth responses.*

II. ORAL FEEDING

Score this section based on the first 10 minutes of oral feeding. Score each item based on the criteria that best represents the infant's performance. If the infant's performance appears to fall between two criteria, score the item based on the least optimal response.

For infants who are assessed during breastfeeding, in order to assess the infant's ability to demonstrate adequate oral feeding skills, it is important for the mother to have adequate milk supply (750-1000 ml per day), for the mother's breasts to be full at the time of feeding, and for 2 or more hours to have elapsed since the last feeding or milk expression. Alterations to milk supply can be made as an intervention, but this assessment should then be used to assess the infant's performance with adaptations, rather than as a tool to identify alterations in feeding performance.

II-1. Suck-Swallow-Breathe Coordination - This item assesses the infant's ability to coordinate sucking, swallowing, and breathing for successful oral feeding, with particular focus on the first two minutes of oral feeding when the infant adjusts to the flow of milk and then achieves a pattern of suck-swallow-breathe. The rate of suck-swallow-breathe should be different between non-nutritive sucking (NNS) and nutritive sucking (NS). There is minimal to almost no fluid to swallow during NNS (sucking a pacifier, on a gloved finger, or the infant sucking on his/her own fingers) when compared to NS (oral feeding). The rate of NS is generally slower than the rate of NNS.

The rate of suck-swallow-breathe is generally considered a 1:1:1 ratio in the mature infant. In preterm infants, the ratio can be up to 4:1:1. The infant must be able to intersperse breaths within the suck/swallow sequence. These breaths must be both well timed with sucking and swallowing and sufficiently large to provide appropriate ventilation for the baby while eating. If the baby is not able to sequence breathing independently, interventions may be provided by the feeder to maintain physiologic stability.

One intervention is external pacing whereby the flow is stopped by the feeder to allow the infant to take breaths. External pacing can be done by tipping the fluid out of the nipple or removing the nipple from the infant's mouth. Another intervention is placing the baby in sidelying during bottle-feeding, which improves respiratory support and changes the liquid flow trajectory which may slow the flow. These interventions may be needed only at some times during the feeding, most often at the beginning of the feeding. Sidelying is considered an intervention for bottle-feeding, but not for breastfeeding, as it is the most common breastfeeding position.

This item assesses the infant's ability to independently sequence breaths within the sucking burst to enable a rhythmic pattern of suck-swallow-breathe synchrony and adequate ventilation. For bottle-feeding, this item can be observed and scored immediately after sucking commences and beyond. In the breastfeeding baby, there is a period of minimal milk flow prior to the onset of the milk ejection reflex, also known as 'let-down'. Therefore, this item cannot be observed and scored until active let-down has occurred and beyond.

A.	Unable to coordinate sucking swallowing and breathing; immediate sequelae	Upon initiating feeding, the infant is unable to sequence breaths within the suck/swallow pattern and immediately experiences physiological sequelae/decompensation, such as oxygen desaturation or heart rate drop. The infant does not respond to interventions, or consequences occur quickly before intervention can occur. Additional feeding attempts result in the continuous inability to coordinate suck-swallow-breathe, even with external supports. Also score this item if the infant is not able to exhibit sufficient bursts or movements to establish a pattern and continue feeding.
B.	No independent suck/swallow/breathe coordination; able to coordinate only when provided with interventions	Infant is unable to independently intersperse breaths within the suck/swallow sequence and experiences sequelae, such as physiologic (oxygen desaturation or heart rate drop) or motor (arching, facial grimace, increase in tone) consequences. However, infant is able to feed with intervention techniques such as: external pacing; tactile cues; positioning in sidelying and/or changing to a slow flow nipple. Without these techniques, the infant would breath-hold or underventilate during feeding. Techniques may need to be used throughout the feeding, but continue after the initial adjustment to oral feeding. The infant is dependent on the feeder's interventions to coordinate the suck-swallow-breathe sequence. For breastfed infants, the infant may demonstrate stress signs such as physiologic (oxygen desaturation or heart rate drop) or motor (arching, facial grimace, increase in tone). However, the infant is able to feed with intervention techniques, such as expressing milk prior to feeding or removing the infant from the breast regularly to enable a pause in sucking and swallowing to breathe. The success of feeding relies on continuous caregiver intervention, therefore, the length of breastfeeding may be shortened due to inability to have a continuous breastfeeding process.
C.	Able to feed with intermittent interventions; independent swallow/breathe sequencing	After an initial adjustment to feeding (after the first couple of minutes), the infant is able to independently intersperse appropriate breaths in the suck/swallow sequence to remain physiologically stable with minimal to no stress cues. However, there is evidence of challenges with suck-swallow-breath, largely at the beginning of feeding. Interventions may be needed at only a few times during the feeding with the infant taking over independent swallow/breathe control at other times. In breastfed infants, the feeder may need to remove the infant during milk ejection but then the infant can successfully pace thereafter. Interventions to slow the flow down or aid the infant in handling the flow of milk is only observed a few times during the feeding, usually near the beginning during let-down.
D.	**Independently demonstrates appropriate suck/swallow/breathe sequence**	**Infant is able to independently intersperse breaths within the sucking/swallow sequence for the entire feeding. Breaths are adequate for ventilation. Score this item if the infant displays multiple sucks per burst in a rhythmic, predictable suck-swallow-breathe ratio ranging from 1-4:1:1. Score 'D' even if the infant uses a slow flow nipple to achieve coordination of the suck-swallow-breathe sequence.** **In the breastfed infant, there is a change in the rate of sucking with an adjustment to swallow during milk ejection or let-down. The suck-swallow-breathe pattern is rhythmically organized and results in physiological stability.**

II-3. Suction - This item assesses the infant's ability to form a vacuum and enable movement of liquid from the bottle or breast. This is achieved through coordination of a proper anterior seal, oral stability and appropriate tongue and jaw movement to create suction pressure. For breastfeeding, assess suction after let-down.

A.	No suction	Infant appears to be unable to generate suction pressure to create liquid flow, despite being in the appropriate state. Infant may use solely a compressive force on the nipple. The nipple easily slides out of the infant's mouth due to inability to form a vacuum. The infant is unable to maintain a grasp on the nipple.
B.	Minimal suction	Infant demonstrates minimal suction pressure, which may cause minimal liquid to be expressed into the mouth. Some suction is achieved that may or may not result in the feeding being completed. A decrease in suction is observed, and the nipple can be pulled out of the mouth with little effort. It may appear that the infant is doing non-nutritive sucking during oral feeding. During breastfeeding, the infant may initially grasp and shape the breast but cannot maintain the nipple in the mouth. This may be observed as a release of the nipple during a sucking pause. Very little movement of the breast inward toward the mouth may be observed.
C.	**Normal**	**Infant achieves a good suction pressure and grasp on the nipple without excess effort and with appropriate energy expenditure to express liquid into the mouth. Suction provides a steady flow of milk from the bottle. Pulling the nipple out of the mouth results in a break in suction and then the nipple can be removed with minimal effort.** **For breastfeeding, the infant is able to pull the nipple into the mouth, shape it into a teat and maintain suction while sucking. During sucking pauses, the infant maintains adequate suction to retain the breast in the appropriate position in the mouth. Small movements of the breast in toward the mouth and relaxing can be observed.**
D.	Excessive suction	Infant demonstrates strong suction that may cause the nipple to collapse due to the suction (note that some bottles are vented so the nipple will not collapse with excess suction). Excessively fast flow of fluid through the nipple may also occur. Increases in oral tone may accompany strong suction. Strong movements and visible motion of the cheeks being sucked in may be observed. Removing the nipple from the infant's mouth requires some effort. For breastfeeding, the infant maintains strong suction at the breast and a seal that is difficult to break. Maternal discomfort may be noted. The breast is round, but not flattened, when removed from the mouth.

II-4. Oral Tone - This item is designed to capture the infant's oral tone, including the tongue, cheeks and lips. Appropriate maintenance of the oral-musculature tone enables efficient milk expression and movement of the milk into the pharynx for swallowing.

A.	Flaccid	Infant's mouth is largely flaccid throughout the feed, and the infant cannot maintain sufficient tone to efficiently express and control the milk within the mouth. This may be observed through flaccid cheeks, flattened tongue, or inability to control the flow of milk to the back of the mouth for adequate swallow.
B.	Decreased tone	Infant's oral tone allows for limited success with feeding. Tone is decreased in the tongue, cheeks, and lips, but the infant is able to demonstrate some success with milk expression and management. There may be some poor liquid expression or intermittent breaking of seal. Tone is decreased to the point that it requires increased energy expenditure to engage in feeding and fatigue is rapid, which may or may not lead to poor completion of the feeding. This item is differentiated from 'A' in that the infant may be able to express some milk, yet inefficiently.
C.	**Adequate for feeding**	**Infant maintains sufficient oral tone throughout the feed to facilitate efficient feeding. The infant is able to express milk from the breast or bottle without excessive effort and is able to control the passage of milk to the back of the mouth for efficient swallowing.**
D.	*Increased oral tone, clenched jaw, and/or pursed lips*	*Infant demonstrates increases in tone in the jaw, tongue, and/or lips during feeding. The infant may be observed as making tight, restricted movements that may impact the efficiency of the feeding and require increased or decreased effort to efficiently express liquid. Clenching of the jaw may be observed. For infants with increased tone in the lips, it may appear that they fail to form a good seal around the nipple. The lips may appear pursed around the nipple. Increased tone interferes with the efficiency or mechanics of feeding. Increased tone could result in significant increases in intraoral suction resulting in rapid milk expression, which may or may not be handled effectively. Alternatively, tone may be increased to the extent that the infant clamps down on the bottle nipple and collapses it, which could prevent milk from passing through the bottle nipple. Initial pre-feeding observations of a clenched jaw or pursed lips could give clues to increases in tone, but the observation of tone for scoring of this item should be made during the first 10 minutes of oral feeding.* *In the breastfed infant, increased compression of the breast nipple is observed and may result in pain and discomfort for the mother resulting in limited stimulation and milk ejection.* *The infant may express minimal liquid due to excess tone preventing milk from passing through the ducts into the mouth.*

III. OBSERVATIONS AT THE END OF FEEDING

- **Score these items after feeding has been stopped by the caregiver or the infant or after 20 minutes of oral feeding.**

III-1. Feeding Completion - This item is intended to evaluate why the feeding is discontinued and/or to define behaviors that are present after a 20-minute attempt at oral feeding. Feeding discontinuation may be due to physiologic sequelae (airway compromise, excessive apneas, and bradycardias), inability to maintain arousal, inability to organize behavior, discomfort, or just that the infant completed the feeding.

Refer to section on prescribed volume in this manual on page 3.

A.	Stops due to physiologic instability	Infant experiences physiologic instability or problems sufficient to require stopping the feeding prior to full intake. This may include excessive apneas and bradycardias, increased work of breathing, or desaturation events.
B.	Stops due to fatigue (unable to continue) or feeder stopped the feeding	The feeding is stopped prior to full intake due to the infant's fatigue or inability to maintain an alert state. The infant may fall asleep during feeding and does not rouse with external cues provided by the feeder. *OR* The feeder may make the decision to stop/end the feeding. *If infant re-arouses with stimulation and completes the feeding, score 'D', as long as it is within 20 minutes of feeding initiation.
C.	*Discomfort*	*Infant displays excessive discomfort that the feeder is unable to alleviate, so the feeding is stopped. The infant is too uncomfortable (exhibits too many stress signs, such as back arching, squeezing eyes closed, strong withdrawal from nipple, abrupt color changes) to continue with the feeding. This can also include gastrointestinal signs such as straining, grunting, color changes, or squirming. If infant is unable to continue after a pause to burp, score this item 'C'.*
D.	**Completed feeding**	**Infant may need to pause to burp but continues the feeding to completion. Infant appears comfortable after feeding.** **Score 'D' if the infant is a full term infant in the first couple of days of life and has a small intake over only a couple of minutes, and the pediatrician has not specified a minimum volume of intake.**
E.	Completed feeding but demonstrates discomfort after feeding	Completed feeding, but following the feeding infant displays significant, non-state related, signs of stress (such as color change, arching, grunting).

Part III.

Scoring the NEO Assessment and Score Sheet

SCORING CRITERIA

Scoring:

After all of the characteristics have been matched to their appropriate point value based on the infant's PMA at assessment, place each point value in the score sheet for the corresponding item. The sum of all scores will derive a total. Points will fall into one of three categories as listed below:

Normal (expected performance for PMA)
Questionable (emerging or could signal challenge)
Feeding Challenge (immature for PMA or abnormal feeding)

Abbreviated Form:
If only Section I was scored, there is a range of scores from 6-30. Use the following criteria to score:

6-20: Feeding Challenge
21-26: Questionable
27-30: Normal

Full Form:
If Sections I, II, and III were scored, there is a range of scores from 18-90. Use the following criteria to score:

18-57: Feeding Challenge
58-76: Questionable
77-90: Normal

NEO Score Sheet: I. Pre-Feeding Behaviors

Version 5.5

Study ID/Infant's Name: Evaluation Date:

DOB: Day of Life: Breast or Bottle Feed:

EGA at Birth: Current PMA: Rater Name:

Section I: Pre-Feeding Behaviors	Item	Choices	Postmenstrual Age (weeks) 30	31	32	33	34	35	36	37	38
	I-1. Arousal/State Organization*	A. Unable to rouse to state 3, even with stimulation B. Short periods of arousal with stimulation C. Prolonged arousal sustained after stimulation **D. Wakes spontaneously**	A=3 B, C, D=5			A=1 B,C,D=5	A=1 B=3 C, D=5		A, B=1 C, D=5		
	I-2. Physiological Stability*	A. Poor physiological stability B. Intermittent periods of physiological stability with energy depletion C. Intermittent periods of physiological stability without energy depletion **D. Physiological stability**	A=3 B, C, D=5		A=1 B=3 C, D=5		A, B=1 C, D=5		A, B=1 C=3 D=5		
	I-3. Respiratory Support*	A. Ventilated B. Non-invasive respiratory support C. Minimal respiratory support **D. Room air**	Not Scored								
	I-4. Rooting and Grasp*	A. No response B. Weak or unilateral root and grasp C. Root and grasp with stimulation **D. Spontaneous root and grasp** *E. Brisk, frantic response or avoidance*	E=1 A=3 B, C, D=5				E=1 A, B=3 C, D=5		A, E=1 B=3 C, D=5		
	I-5. Initiation of Sucking*	A. None B. Requires moderate stimulation C. Requires minimal stimulation **D. Normal** *E. Active avoidance*	E=1 A=3 B, C, D=5		A, E=1 B=3 C, D=5		A,E=1 B=3 C, D=5				
	I-6. Tongue	A. Flaccid or non-responsive B. Flat with some tongue cupping C. Elevated and retracted **D. Tongue cupping with central groove** *E. Deviated to side, tongue thrusting, or tongue bunching*	E=1 A, B, C=3 D=5		A, E=1 B, C=3 D=5	A, B, E=1 C=3 D=5	A, B, E=1 C=3, D=5				
	I-7. Non-Nutritive Sucking	A. Absent B. Arrhythmic C. Intermittent burst-pause pattern **D. Normal burst-pause pattern** E. Prolonged burst-pause pattern	E=1 A, B, C, D=5			E=1 A=3 B,C, D=5	E=1 A,B=3 C,D=5	A,E=1 B=3 C,D=5	A,E=1 B,C=3 D=5	A,B,E=1 C=3 D=5	
											TOTAL (Section

Abbreviated Form:

If only Section I was scored, there is a range of scores from 6-30. Use the following criteria to score:

6-20 Feeding Challenge
21-26 Questionable
27-30 Normal

NEO Score Sheet: II. Oral Feeding & III. Observations at the End of Feed

Section II and III: Oral Feeding and Observations at the End of Feed	Item	Choices	Postmenstrual Age (weeks) 30	31	32	33	34	35	36	37	38	39	40+	Score
	II-1. Suck-Swallow-Breathe Coordination	A. Unable to coordinate sucking swallowing and breathing; Immediate sequelae B. No independent suck/swallow/breath sequencing; able to coordinate only when provided interventions C. Able to feed with intermittent interventions; independent swallow/breath sequence **D. Independently demonstrates appropriate suck/swallow/breathe sequence**	A, B, C, D=5			A=3 B,C,D=5	A, B=3 C, D=5		A=1 B=3 C, D=5	A=1 B,C=3 D=5		A, B=1 C=3 D=5		
	II-2. Sucking Burst Length	A. No sucking burst B. Minimal sucks per burst **C. Appropriate sucks per burst** D. Long pattern of sucks per burst	D=1 A, B, C=5			A, B=3 C, D=5				A, B= 1 C, D=5				
	II-3. Suction	A. No suction B. Minimal suction **C. Normal** D. Excessive suction	D=1 A, B, C=5			D=1 A, B=3 C=5	A, D=1 C=5		B=3	A, B=1 D=3 C=5				
	II-4. Oral Tone	A. Flaccid B. Decreased tone **C. Adequate for feeding** *D. Increased oral tone, clenched jaw, and/or pursed lips*	D=1 A=3 B, C=5		A, D=1 B, C=5			A, D=1 B=3 C=5				A, B, D=1 C=5		
	II-5. Quality of Sucking Movements	A. Abnormal sucking pattern B. Moderate discoordination C. Mild or intermittent discoordination **D. Mature sucking pattern**	A=1 B, C, D=5				A=1 B=3 C, D=5			A,B=1 C=3 D=5				
	II-6. Behavioral Response to Feeding	*A. Active avoidance or significant feeding stress responses* B. Limited positive engagement and comfort during feeding C. Minimal to moderate positive engagement and comfort with feeding **D. No discomfort**	A=1 B, C, D=5				A=1 B=3 C, D=5			A, B=1 C=3 D=5				
	II-7. Fluid Loss	A. Severe fluid loss B. Moderate fluid loss C. Minimal fluid loss **D. No fluid loss**	A, B, C, D=5					A=1 B=3 C, D=5			A, B=1 C, D=5			
	II-8. Swallow**	A. High risk (clear, clinical indications of aspiration) B. Moderate aspiration risk C. Mild aspiration risk **D. Normal swallow**	A=3 B, C, D=5								A, B=1 C=3 D=5		A, B, C=1 D=5	
	II-9. Respiratory Control During Feeding**	A. Respiratory compromise with markedly increased work of breathing B. Moderately increased work of breathing C. Mildly increased work of breathing **D. Appropriate respiratory control during feeding**	A=3 B, C, D=5			A, B=1 C, D=5			A, B=1 C=3 D=5				A, B, C=1 D=5	
	III-1. Feeding Completion	A. Stops due to physiological instability B. Stops due to fatigue (unable to continue) or feeder stopped the feeding *C. Discomfort* **D. Completed feeding** E. Completed feeding, but demonstrates discomfort after feeding	C=1 A, B, D, E=5					C, E=1 A, B, D=5		A, B=3 C, E=1 D=5			A, B, C, E=1 D=5	
	III-2. State Maintenance Check if stimulation was provided_____	A. Reaches state 3 or 4 only briefly B. Maintains state 3 or 4 for 4-7 minutes C. Maintains state 3 or 4 for 8-10 minutes **D. Maintains state 3 or 4 >10 minutes** *E. Maintains high level of arousal (state 5 or 6) that interferes with feeding*	E=1 A, B, C, D=5				E=1 A=3 B, C, D=5		A, E=1 B=3 C, D=5	A, B, E=1 C=3 D=5			A, B, C, E=1 D=5	
	III-3. Volume Consumed***	A. No milk consumption B. Minimal milk consumption C. Some milk consumption D. Half of feeding consumed E. 75% of feeding consumed **F. Full feeding**	A,B,C,D,E,F=5				A=3 B,C,D,E, F=5	A,B=3 C,D,E, F=5	A=1 B=3 C,D, E,F=5	A=1 B,C,D=3 E,F=5	A=1 B,C, D=3 E, F=5		A, B, C, D=1 E=3 F=5	
							TOTAL: (From Section 1)					TOTAL: (Sections 2 & 3)		

Full Form:

If Sections I, II, and III were scored, there is a range of scores from 18-90. Use the following criteria to score:

18-57 Feeding Challenge
58-76 Questionable
77-90 Normal

TOTAL SCORE: (Sections 1, 2, & 3)

Recommendations for Subsequent Feedings:

Apparatus	☐ Slow Flow ☐ Regular Flow ☐ Fast Flow ☐ Breast ☐ Breast with breast shield ☐ Breast with Supplemental Nursing System ☐ Special Specific nipple type (specify)_____
Methods	☐ Swaddling ☐ Decre ☐ Other:
Positioning	☐ Side-lying ☐ Uprigl
Breastfeeding interventions	☐ Increase milk supply
Additional Comments	

NEO Score Sheet: IV. Non-Scored Items *(FOR BREASTFEEDING ONLY)*

Section IV-Items Not Scored-BREASTFEEDING ONLY

IV-15. Mother's Milk Supply* **	☐ Minimal to none ☐ Some ☐ Diminished ☐ Adequate ☐ Over abundance # ml supply each day_____ ☐ Unknown Number of days since birth of infant_____ ☐ Small amounts of colostrum or within first few days after birth and milk has not come in ☐ Mix ☐ Mostly milk with some colostrum ☐ Mature milk ☐ Indicate if the Supplemental Nursing System is Used
IV-16. Pumping Schedule	☐ NA-mother not expressing milk ☐ Mother pumps intermittently in order to offer a b ☐ Mother with a i ☐ Mother not pump times per day ☐ ☐ Mother Average length of tir Approximate time fr Amount expressed at Type of pump used_
IV-17. Maternal Comfort Level	☐ No discomfort or p ☐ Pain of 7-10 with breastfeeding ☐ Pain of 3 or less O ☐ Only at beginning ☐ Between feeding
IV-18. Breastfeeding Contraindications**	☐ HIV ☐ Taking a tuberculosis ☐ prescribed cancer ☐ Untreat
IV-19. Mother's Flow Rate	☐ Within first f I

IV-20. Breast(s)	☐ Infant fed on only one breast: side _____ ☐ Infant fed on both breasts ☐ Right first ☐ Left first If fed on both breasts, time on first_____ time on second_____ ☐ Switched breasts a second time
IV-21.	☐ None

NEO Score Sheet: IV. Non-Scored Items

Section IV-Items Not Scored

IV-1. Feeder:	☐ Nurse ☐ Mother ☐ Father ☐ Therapist ☐ Other:
IV-2. Feeder Experience:	☐ First Time ☐ 2-4 Feeds ☐ 5-10 Feeds ☐ 10+ Feeds/expert ☐ unknown ☐ Previous breastfeeding experience for _____ weeks Previous challenges with breastfeeding, if any _____
IV-3. Infant Feeding Experience:	☐ First Time ☐ Some due to feeding problems or immaturity ☐ Some due to recent initiation of oral feeding ☐ Minimal recent experience ☐ Moderate ☐ Significant ☐ Unknown ☐ Infant is full term and has been feeding since birth: DOL_____
IV-4. Infant's Current Feeding Regimen: (check all that apply)	☐ Nuzzles at breast only ☐ Oral feeding attempts <4 times per week ☐ Only therapy feeding infant ☐ Oral feeding attempt once per day ☐ Oral feeding attempts 2-3 times per day ☐ Breastfeeding attempts with subsequent tube feeding of: _____ ☐ Oral feeding attempts 4-6 times per day ☐ Attempts at full oral feeding with less than 50% of volume consumed and remainder of volume tube fed ☐ Attempts at full oral feeding with 50-90% of volume consumed and remainder of volume tube fed ☐ Takes full oral feeds on a feeding schedule ☐ Ad Lib with a maximum time elapsed between feedings ☐ Ad lib on demand
IV-5. Nipple Type:	☐ Slow Flow ☐ Regular Flow ☐ Fast Flow ☐ Breast ☐ Breast with nipple shield ☐ Special Nipple used:_____
IV-6. Milk Type:	☐ Formula ☐ Breast Milk ☐ Mix of formula and breast milk ☐ Thickened Type of formula, if applicable:_____
IV-7. Interruptions:	#_____ Cause (change in position, change nipple, suspected aspiration):

IV-8. External Supports:	☐ None ☐ Tipping milk out of nipple ☐ Pulling nipple out of mouth intermittently ☐ Swaddling or other containment ☐ Unswaddling ☐ Decreased auditory stimuli ☐ Auditory support ☐ Decreased visual stimuli ☐ Tactile stimulation, state where_____ ☐ Turning bottle ☐ Tapping bottle ☐ Jaw support ☐ Chin support ☐ Cheek support ☐ Squeezing breast ☐ Holding/supporting breast ☐ Massage breast ☐ Form nipple ☐ Other_____
IV-9. Position During Feed:	☐ Side-lying ☐ Semi-side-lying ☐ Upright ☐ Enface ☐ Football hold ☐ Cradled ☐ Cross-Cradled ☐ Laid back nursing ☐ Mother nursing infant while she is side-lying Indicate supports used (nursing pillow, pillows under arm or under baby)_____ Comments:
IV-10. Heart Rate:	☐ No significant alterations in HR Number of times with HR >200: #_____ Longest time to recover _____ ☐ During active sucking and swallowing ☐ During a pause in sucking and swallowing ☐ After feeding is completed Number of times with HR <100: #_____ Longest time to recover _____ ☐ During active sucking and swallowing ☐ During a pause in sucking and swallowing ☐ After the feeding is completed
IV-11. Respiratory Rate:	☐ No significant alterations in RR RR at start of feed _____ RR at end of feed _____ Number of minutes with RR >60:_____ Longest time to recover _____ ☐ During active sucking and swallowing ☐ During a pause in sucking and swallowing ☐ After the feeding is completed ☐ Breath holding for 1-5 seconds: #_____ ☐ Breath holding for 6-10 seconds: #_____ ☐ Breath holding 10-20 seconds: #_____ ☐ Breath holding >20 seconds: #_____
IV-12. Oxygen Saturation:	☐ No significant alterations in O2 sats Number of times with O2 sats <90%: #_____ Longest time to recover: _____ ☐ During active sucking and swallowing ☐ During a pause in sucking and swallowing ☐ After the feeding is completed ☐ Check here if additional oxygen support was given during or immediately after the feeding ☐ Check here if infant with stable O2 sats but demonstrates respiratory alterations 2-3 minutes after the feeding ends
IV-13. Time:	Time infant engaged in non-nutritive sucking: _____ Time it took for infant to grasp nipple and initiate sucking after first presentation_____ Time infant engaged in oral feeding: _____ Number of burps: #_____Approximate time spent burping:_____ ☐ Difficulty burping

IV.14-Infant Anatomic and Functional Variations	☐ None ☐ Cleft lip ☐ Cleft palate ☐ Cleft lip and palate ☐ Micrognathia ☐ Tongue tied-no surgical intervention ☐ Tongue tied with surgical intervention ☐ Lip tie with surgical intervention ☐ Lip tie without surgical intervention ☐ Recessed jaw ☐ Macroglossia ☐ Neonatal Abstinence Syndrome ☐ Down's Syndrome ☐ Pierre Robin Sequence ☐ Cardiac anomaly Describe_____