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The Early Feeding Skills Assessment for Preterm Infants

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Abstract

Preterm infants develop the skills necessary to begin oral feeding as their health stabilizes and as they reach a postconceptional age that supports coordination of breathing and swallowing with oral-motor functioning. The time from initiation of oral feeding to full oral feedings (with adequate intake for growth and maintenance of physiologic stability) can vary from days to months for the preterm infant. The approach to feeding the infant during this transition period must be developmentally supportive and tailored to meet the needs of the individual. To accomplish this, caregivers—notably nurses and parents—need to communicate about the specific skills that the infant has gained, about skills that are emerging, and about skills that the infant has not yet developed. The Early Feeding Skills (EFS) Assessment is a checklist for assessing infant readiness for and tolerance of feeding and for profiling the infant's developmental stage regarding specific feeding skills: the abilities to remain engaged in feeding, organize oral-motor functioning, coordinate swallowing with breathing, and maintain physiologic stability. This article introduces the EFS.

Neonatal clinicians, clinicians who work with families during the early postdischarge period, and parents of preterm infants are in an important position to observe and support the development of an emergent motor skill: oral feeding. Oral feeding skills have commonly been conceptualized by health care providers as an infant's ability to organize and coordinate oral-motor functions to efficiently consume enough calories for growth. Early feeding skills are much more complex than this, however. They also involve the infant's ability to (1) engage and remain engaged in a physiologically and behaviorally challenging task, (2) organize oral-motor movements so as to have long-term functional benefits, (3) coordinate breathing with swallowing to avoid prolonged apnea or aspiration of fluids, and (4) regulate the depth and frequency of breathing to maintain physiologic stability.

Motor skill development corresponds to changes in an infant's brain, body, and experience.[1] According to research, two factors affect progression in ability to feed orally: the infant's state of health[2-6] and oral feeding experience.[7-11] According to other research, neuromaturation of the following contributes to an individual infant's skill in feeding: the ability to regulate oxygen,[11,12] development of alertness,[13-15] and development of sucking strength and organization of the sucking pattern.[16,17] External influences can also change the nature of the task. These include the size and speed of flow of the fluid bolus,[18-20] the impact of nasogastric tubes in place during feeding,[21] and the type of feeding support provided by the caregiver.[22-26]

During its emergent phase, motor skill expression varies considerably.[27] Early feeding skills can vary from feeding to feeding and even across a given feeding. Some infants adapt and improve in skill as the feeding progresses, the skills of some deteriorate as the feeding continues, and others maintain a more steady expression of skill throughout a feeding. In addition, changes in the plan of care during this learning period add to the inherent variability

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in an emergent skill. For example, infants are often weaned to open cribs, supplemental oxygen is decreased or eliminated, and medications such as xanthines or diuretics are discontinued or adjusted. As infants become better able to interact with their caregivers, they are held more and exposed to more intense environmental stimuli. All of these changes affect the infant's ability to organize the multiple components of feeding skill. Early oral feeding skills are thus best described as falling within a range. Diminished variability within skill components is an indication of development. As the infant acquires an oral feeding skill, coordination in applying it increases, feeding becomes more patterned, expression of the feeding skill is more consistent, and the infant adapts more smoothly to a change in task.[28]

This article describes the Early Feeding Skills (EFS) Assessment, a checklist designed to standardize the measurement of feeding skills of preterm infants and to facilitate the development of individualized interventions to support skill level.[29-31] Using a multidimensional systems framework, the EFS extends the growing body of research and scholarship on oral feeding skill development.32 Content validity of the EFS has been established with expert neonatal nurses and oral feeding researchers. Intra- and interrater reliability have been found to be stable and acceptable. Predictive, concurrent, and construct validity are currently being tested.

ORGANIZATION OF THE EARLY FEEDING SKILLS ASSESSMENT

The EFS is a 36-item observational measure of oral feeding skill that can be used from the time of initiation of oral feeding through maturation of oral feeding skill. The initial section, “Oral Feeding Readiness,” is designed to assess whether the infant has sufficient energy for feeding, is in an optimal state, and has adequate baseline oxygen saturation. The middle section, “Oral Feeding Skill,” has items to assess four skill domains critical to successful feeding. The final section, “Oral Feeding Recovery,” is used to evaluate the impact of the feeding on the infant's state of alertness, energy level, and physiologic system.

The aim of assessing an infant's feeding skills is to describe the highest skill level he is capable of demonstrating. The caregiver must provide optimal support during the assessment feeding. Table 1 provides guidelines for setting the stage for optimal feeding performance.

The EFS is scored based on observation of an entire feeding. Each item has two, three, or four scaled choices (yes-no; never-occasionally-often; all-most-some-none). The assessment profiles areas of competence and difficulty for the infant, with scores on each item indicating the degree to which he sustains the skill throughout the feeding. The EFS thus enables care providers to track skill development, plan intervention strategies, and evaluate intervention effectiveness.

In scoring the assessment, the individual feeding the infant has advantages over an observer. The feeder can feel the infant's body and its tone and organization, the strength of his latch on the nipple, and tongue movements, for example; can feel, hear, and observe the rise and fall of the infant's chest during breathing; and can hear and feel him swallowing. Scorers sitting next to a mother or another clinician feeding the infant have also completed the assessment successfully, however.

Several of the assessed items require physiologic monitors such as pulse oximetry to be in use. When infants no longer require monitoring during feeding, these individual items are disregarded.

Following are research evidence in support of each skill area and relevant definitions of terms or phrases. For examples of items within each section, see Table 2. Tips for making an accurate assessment are also given.

ORAL FEEDING READINESS

The infant demonstrates behavioral organization and energy for the work of feeding by attaining and maintaining an awake state, a flexed body posture with sufficient muscle tone, and interest in sucking. Physiologic stability, indexed by sufficient oxygen saturation of hemoglobin (pulse oximetry SaO_2), supports these behaviors.

Several studies have demonstrated that the infant's condition immediately prior to feeding affects feeding skill. The capacity to sustain a state of alertness for five minutes prior to feeding is associated with an ability to engage in a greater number of sucks and longer sucking bursts during the first five minutes of feeding.[14] Also, an infant who is able to achieve an alert or quiet awake state prior to feeding can take in a higher volume during the feeding.[33-35]

Even when an awake state sets the stage for optimal feeding, infant attention must be focused on the feeding. The infant indicates ability to sustain attention on the feeding through readiness to participate and through interest in sucking. Shaker theorizes that an infant who searches for the nipple (roots) at the onset of feeding indicates neurodevelopmental readiness for feeding. An infant who is ready to feed and interested will search for the nipple when it is presented, organize his tongue to receive it, and orient his body posture midline with arms coming forward to assist. Infants who are interested in but lack the energy to accomplish feeding have difficulty sustaining body orientation for the feeding.[29]

Starting the feeding with sufficient oxygen saturation, gauged by the infant's baseline SaO_2, is important to the success of the feeding. Baseline SaO_2 is the autonomic system's point of stability, or the oxygenation range maintained by the infant in a stable state and to which he returns after recovering from a stressor. Sufficient baseline SaO_2 stabilizes respiratory function.[36] It also reduces the risk of bradycardia and hypoxemia related to breathing irregularities common to preterm infants during bottle feeding.[11,12,37-42] To prevent and/or minimize desaturation during feeding, Shiao and colleagues suggest a minimum baseline oxygen saturation of 95 percent prior to oral feeding.[12]

To complete the first section of the EFS, the caregiver assesses the infant's readiness during preparation for feeding. The infant's abilities to maintain a flexed body posture and to seek the opportunity to suckle are assessed. Baseline SaO_2 is determined when the infant is in a quiet state, with no demands being made, and should be assessed throughout the preparation period. If all answers to the five oral readiness items are yes, indicating readiness, the caregiver feeds the infant orally. If not, the caregiver can provide preparatory interventions such as nonnutritive sucking.[33,43-47] After using these interventions, the feeder swaddles or reswaddles the infant to better support flexion and re-evaluates his readiness. If all items are then answered yes, the caregiver feeds the infant orally; otherwise, the infant is gavage fed.

ORAL FEEDING SKILL

The EFS is used to assess four domains of infant feeding skill, expressed in the following abilities: (1) to remain engaged in feeding, (2) to organize oral-motor functioning, (3) to coordinate swallowing and breathing, and (4) to maintain physiologic stability. Although these skill areas are assessed separately on the EFS, each necessarily influences the others.[30] An infant who becomes fatigued during feeding will score lower on ability to remain engaged, for example, and may also have less coordinated swallowing and breathing due to decreased arousal.

Ability to Remain Engaged in Feeding

Engagement skill represents the infant's ability to modulate external and internal demands well enough to remain ready for feeding. Infants adaptively engage or disengage in the environment to manage stimulation within a comfortable range and/or to signal to caregivers to adjust their behavior.[48] Infant feeding behaviors fall within a range of engagement and disengagement. An infant who is engaged in feeding brings energy to the task of feeding, demonstrates robustness, and actively participates in and attends to the feeding. If not engaged, an infant is being passively fed, appears fatigued or exhausted, or is actively withdrawing from the feeding.[26]

Engagement—important for learning a new skill—requires an awake state, sufficient energy, robustness, and focused attention.[49] During early oral feedings, preterm infants have difficulty remaining engaged.[26] As they develop, they are able to sustain an awake state during feeding and to complete feedings with sufficient energy for interaction.[15]

Low engagement, as seen with decreased arousal and/or fatigue, may affect the infant's ability to coordinate sucking, swallowing, and breathing; impair ability to avoid aspiration; and reduce motoric stability of the respiratory system.[50] Fatigued infants also become more vulnerable to physiologic distress because they are less able to cue their caregiver for assistance.[51]

Three items on the EFS are used to assess an infant's ability to remain engaged. The first two are used to assess ability to maintain an optimal feeding state. The caregiver observes the infant's state and the smoothness of changing states throughout the feeding. States that are optimal for feeding include alert and inactive or less alert but quiet and awake with eyes open or closed. Infants may close their eyes while feeding yet engage in and attend to the feeding. Less optimal feeding states include awake but passive, inactive with vigor lacking, irritability and/or restlessness, and rapidly shifting states.

The third item is used to assess the infant's ability to maintain energy for the feeding, as demonstrated by postural control. The preterm infant is likely to require caregiver support, particularly of the shoulders and trunk, to maintain a flexed posture throughout the feeding. If an infant cannot maintain energy for feeding, his muscle tone will decrease, indicated by loss of midline orientation of the arms and loss of elbow flexion.

Ability to Organize Oral-Motor Functioning

Oral-motor organization reflects the maturation and functioning of the oral-motor structures for feeding. An infant who has achieved sufficient oral-motor maturation for oral feeding will seek the nipple when his lips are stroked, position his tongue to accept the nipple into his mouth, and achieve a nutritive sucking rhythm.

Seven items on the EFS are used to assess the infant's ability to organize oral-motor functioning. The first few relate to the infant's readiness to feed prior to each nipple offering. The caregiver observes his ability to smoothly engage in feeding at the onset of each feeding episode. Does the infant respond promptly to stroking of the nipple at his lips, or does he become interested in feeding only after repeated stroking or other tactile stimulation, talking to, repositioning, or resting? An infant who is not ready at the onset typically does not open his mouth in response to stroking of his lips. The caregiver may observe inconsistent rooting, an ability to organize the lips and tongue only with repeated stroking of the lips, or movement of the lips or mouth but an inability to organize the lips and tongue to take in the nipple in response to rooting.

The tongue should descend following the rooting reflex. The infant may hold his tongue against the hard palate in an attempt to either stabilize the head and neck muscles[52] or compensate for excessive breathing effort.[30]

The infant's ability to initiate sucking in an organized and smooth rhythm immediately after accepting the nipple is also assesssed as part of oral-motor functioning. If an infant has difficulty coordinating breathing with sucking, the typical initial smooth sucking changes to disorganized sucking that lacks rhythm. This sucking pattern likely reflects a problem with breathing, not with ability to organize the oral-motor structures for sucking. An infant who is unable to organize sucking has disorganized sucking from the onset. He may chew on the nipple, have difficulty latching on to it, or have a nonnutritive sucking pattern with diminished suction.

In addition to ability to engage in rhythmic sucking at feeding—whether at the onset or during the feeding—ability to *maintain* a smooth, rhythmic sucking pattern throughout the feeding is also assessed. The pattern of sucking may vary from infant to infant and may change within the same feeding. Infants may suck in long bursts and breathe only during sucking pauses, they may suck with breaths interspersed, or they may suck only in short bursts with long breathing periods during pauses between bursts. These patterns of sucking and breathing are stages of oral-motor development.[16,53,54] Longer sucking bursts are generally expected as infants mature; however, preterm infants may engage in sucking bursts that exceed their ability to maintain physiologic stability. The assessor must note, therefore, not only the length of sucking bursts, but also whether that length matches the infant's ability to maintain physiologic stability and to self-regulate. The caregiver watches for behavioral stress signs and/or negative cardiorespiratory responses to the length of sucking bursts. Behavioral stress cues include chin tugging, nasal flaring, eyebrow lifting—all an infant's attempts to further expand the airway and increase oxygen uptake.[30] Negative cardiorespiratory responses include oxygen desaturation and/or bradycardia.

As preterm infants develop, sucking pressure increases, sucking bursts lengthen, and bursts become closer together.[14,15] The EFS therefore assesses not only the sucking pattern, but also the quality of the infant's sucking. A skilled infant can suck steadily with strength. If an infant cannot do this, the caregiver senses that she could withdraw the nipple easily or that the infant has only a loose hold on it.

Finally, the EFS includes items to assess an infant's ability to maintain steady control of the nipple with his tongue. An infant who is fatigued, who has difficulty maintaining a cupped tongue on the nipple, or who requires more postural support may demonstrate difficulties, with his tongue sliding off the nipple as he attempts to exert suction. The caregiver listens for the clicking sound created by the tongue sliding off the nipple. If tongue clicking is heard, the infant can be repositioned or the rooting reflex used to assess whether the clicking ceases.

Ability to Coordinate Swallowing and Breathing

Coordination of swallowing with sucking and breathing reflects the infant's skill at managing fluid while adequately protecting his airway. Infants learn to swallow efficiently as they mature. Coordinated swallowing includes matching sucking pressure and burst length with efficient swallowing and also completing swallowing before initiating the next breath.

Preterm infants integrate swallowing and breathing inefficiently.[55,56] They often respond to fluid in the oropharynx with prolonged apnea, an exaggerated protective response.[57,58] The size of the fluid bolus, the speed with which it travels through the oropharynx, the number of swallows needed to clear the bolus, and the postconceptional age of the infant all affect changes in the respiratory pattern to accommodate swallowing. Thoyre and Carlson noted in a study of very low birth weight infants who were nearing discharge that multiple swallowings, when they occurred, typically followed a long sucking burst. Multiple swallowings significantly contributed to the length of apnea infants had and often resulted in hypoxemia.[51]

Compared to mature feeders, preterm infants who are learning to feed orally are less able to match the duration and strength of their sucking with their ability to swallow efficiently.[19,38,59] Preterm infants often suck in excess of their capacity to swallow, which places a large bolus of fluid in the mouth, requiring several swallows to clear and obstructing the airway for a prolonged period.[55,56] Hanlon and colleagues found that apnea time during swallowing and the incidence of multiple swallows decreased as healthy preterm infants matured. Preterm infants continued to have longer swallowing apneic events at term than full-term infants do, however.[55]

Assessing the infant's ability to coordinate swallowing involves listening for the sound of swallowing in relation to breathing sounds and observing the infant's management of fluid. Quiet and effective swallowing protects the infant from near-choking or choking incidents and allows for sufficient breathing between swallows to maintain physiologic stability.

Six EFS items are used to assess the infant's ability to coordinate swallowing and manage the bolus of fluid. The caregiver observes for loss of fluid at the lips around the nipple. If the amount of fluid is more than the tongue can “hold,” the infant will loosen his tongue seal on the nipple and purposefully allow the fluid to spill out.[20] Fluid spillage, or “drooling,” may be a problem through the entire feeding or may occur intermittently. The timing and context of drooling provide important information about the infant's capacities and affect intervention strategies. For example, does drooling occur concurrent with signs of fatigue? Does it begin with lengthy sucking bursts? Is drooling an early sign of distress for the infant? Hill and Rath found that drooling was associated with younger postconceptional age, lower heart rate, and diminished oxygen saturation.[60]

During swallowing, fluid may flow into the nasopharyngeal area or pool in the hypopharynx, creating gurgling or congested sounds.[30] Changes in breathing sounds from baseline, along with their context, are noted. Has the infant's state of arousal diminished? Was he sucking at a rapid rate and receiving more fluid in his mouth? Did fluid sounds disappear with a change in position or with a break from sucking to clear his throat?

The EFS includes items to assess the infant's ability to swallow quietly and to time the swallow with the breathing cycle. During swallowing, the vocal cords should be closed. When the infant appropriately completes the swallow before reopening the airway, the swallow is quiet. When inhalation occurs just prior to completion of the swallow, however, the vocal cords reopen too soon. Air passing between partially closed vocal cords then creates a high-pitched, crowing, stridulous, or yelping sound. This signals potential safety issues with the swallow.[30] Signs of possible aspiration include coughing or choking sounds.

Gulping sounds (loud, hard swallows) occur when the infant sucks rapidly or swallows air with the fluid.[30] Air swallowing may precipitate a vagally mediated apnea.61

The EFS also provides an opportunity for the caregiver to assess the infant's capacity to swallow proficiently. The caregiver listens for multiple swallows and observes the ratio of sucks to swallows. Multiple swallows are often purposeful, typically an infant's attempt to complete the swallow and protect his airway from fluid. They are frequently associated with breath holding of more than three seconds. It is easy to miss hearing multiple swallows, but if the caregiver pays attention to apneic periods during feeding, swallowing patterns become more evident. An infant who needs to swallow multiple times to clear fluid is not regulating the amount of intake well; that is, the amount of fluid is not matching his swallowing capacity.[30] A bolus of fluid may be too large when the flow of fluid from the bottle nipple is too fast, when the infant's sucking pressure is too great, or when his sucking burst is too long.

Ability to Maintain Physiologic Stability

Physiologic organization and breathing modulation reflect the infant's capacity to maintain physiologic stability without excessive work of breathing. To score these items, the assessor gauges the infant's color, oxygen saturation, heart rate, respiratory rate, and effort of breathing throughout the feeding and compares them with the infant's baseline.

Adequate oxygenation enables infants to maintain behavioral organization.[26,62] It also provides energy for the physiologic work of effective and efficient feeding. Inadequate oxygenation is likely to contribute to the fatigue that preterm infants experience during feeding. This results in shorter feedings, less caloric intake, and prolonged transition to full oral feeding.

Infants who are regulated physiologically may adjust their breathing pattern during feeding—for example, they may intersperse bursts of rapid catch-up breathing with sucking bursts. Physiologically well-regulated infants do not increase the overall work of breathing, become less pink, or change baseline oxygenation or heart rates.

Eleven items on the EFS are used to assess an infant's ability to maintain physiologic stability throughout feeding. Assessment begins with observation of the infant's ability to make the transition from a nonfeeding to a feeding breathing pattern. Both full-term and preterm infants typically engage in the longest sucking bursts at the onset of feeding.24 During this “continuous” sucking period, more milk is consumed.[34] Minute ventilation is also lower (i.e., less air is moved per minute) due to lower respiratory frequency.[41,]63 Oxygenation is more likely to drop during the first minute than during any other time throughout feeding.11 The caregiver observes for a drop in oxygen saturation and for stress cues during the first 30 seconds after each nipple placement. Stress cues include pulling away from the nipple, swiping at the bottle or pushing it away, raising the eyebrows, and fluttering the eyes. Fatigued infants may lack the ability to signal distress.

For infants in general, continuous sucking is followed by an “intermittent” phase, in which sucking bursts shorten and the intervals between them lengthen, affording improved respiration. Preterm infants often have brief, shallow breaths during the intermittent phase, however, and recover only partially from the diminished ventilation that occurs during continuous sucking.[41] Sucking may therefore occur at the expense of respiration.[64] Balancing sucking burst length with an adequate number and optimal quality of breaths is a challenge for preterm infants.[65] When sucking bursts are prolonged, or when breathing periods between them are too short, preterm infants may become hypoxemic.[12,40,41,66,67] As the infant matures, coordination of sucking with an adequate number and optimal depth of breaths improves.

As feeding begins, the caregiver assesses the infant's ability to stop sucking, swallow, and intersperse sucks with an adequate number of breaths. The higher the baseline respiratory rate, the more breaths are required to maintain physiologic stability. The number of breaths considered sufficient therefore varies by infant. An adequate number of breaths maintains oxygen saturation near baseline. The caregiver listens for the number of breaths and observes the infant's oxygen saturation and color.

The infant's ability to intersperse an adequate depth of breath between sucking and swallowing bursts is also important. Shallow, brief breaths deplete the amount of air remaining in the lungs after expiration (functional residual capacity) and over time increase the infant's vulnerability to hypoxemia.[68] Mathew notes that recovery from disrupted breathing during feeding depends on duration of breathing periods and ability of the infant to increase ventilation during these breathing breaks. The infant must not only stop sucking at regular intervals for a breath, but also take breaths of adequate quality. Ideally, the infant uses a regular pattern of quiet breaths of adequate depth during sucking pauses.19

The caregiver also observes the infant for signs of increased breathing effort, as evidenced by compensatory behaviors intended to maintain oxygenation. An infant who is attempting to conserve oxygen will make purposeful, prolonged exhalations and grunting sounds. Breathing patterns may also change. Infants may engage in nasal flaring with nasal blanching to inhale deeper. Increased work of breathing during feeding may be best observed when an infant lifts up his chin. For this compensatory maneuver, he pulls back his head (as if someone were tugging on his chin) to biomechanically open the airway and increase inspiratory volume. The infant may also use accessory muscles during breathing (recruiting shoulder and upper rib cage muscles to lift and expand the rib cage) to enhance respiratory volume. Intercostal and substernal retractions are difficult to assess during feeding. Suprasternal retractions, however, are observable as midline tugging inward over the trachea.

The final item assessed using the EFS is the infant's ability to regulate breathing well enough to prevent signs of physiologic dysregulation. For example, does he stop to breathe *before* exhibiting behavioral stress cues? Does he maintain prefeeding color? Infants with feeding stress may become pale, exhibit circumoral or circumorbital cyanosis, or have more generalized cyanosis. Cyanosis is a late indicator of oxygen desaturation; assuming adequate hemoglobin, cyanosis is rarely observable until the oxygen saturation is <85 percent.[69] Sudden color changes may reflect near-choking episodes or obstruction of the airway.

Oxygen saturation and heart rate monitors, commonly used during the neonatal period and sometimes in the home postdischarge, provide additional information regarding adequacy of respiration throughout feeding. The caregiver observes oxygen saturation and heart rate throughout the feeding. A stressed infant may have desaturation episodes and/or a downward drift in oxygen saturation, a drop in heart rate to the point of bradycardia, or tachycardia. Typically during stressful episodes, breathing pauses precede oxygen desaturation, which precedes bradycardia.[11,12]

ORAL FEEDING RECOVERY

During the five minutes that follow feeding, the caregiver holds the infant quietly in an upright position while observing his behavioral and physiologic recovery from feeding. Items to be assessed include his state of alertness, energy level, and physiologic system. The infant is observed while he rests quietly. The observer notes the infant's physiologic stability [range of SaO_2, respiratory, heart rate] and behavioral indicators of energy and arousal (state, muscle tone).

FEEDING DESCRIPTORS

The EFS provides for description of the feeding context (e.g., type of nipple used, position chosen by the caregiver, postconceptional age of the infant on the day of the assessment, the infant's weight and baseline physiologic measures, and use of supplemental oxygen prefeeding) and of the feeding (e.g., length and the volume of intake). Descriptors placed at the top of the assessment form are conditions or features the caregiver would know or would note prior to feeding (e.g., postconceptional age of the infant, prescribed volume, and baseline physiologic measures). Descriptors at the end of the assessment form relate to conditions or features of the feeding known only afterwards (e.g., whether the infant's skills were maintained, improved, or declined across the feeding; the type of nipple used; and the amount of oxygen, if any, used).

Caregiver feeding strategies are also noted. Caregiver actions range from “no extra support measures required” to “passive attempts to alter the milk flow for the infant.” Developmentally supportive actions may include repositioning the infant, providing a rest period during the feeding, or stopping the feeding to realert the infant. Feeders have increased the preterm infant's volume of intake by stabilizing the jaw and providing cheek support.[22] Such interventions have

decreased the interval between sucking bursts.[60] These actions obligate the infant to respond by increasing suction pressure, however, resulting in a faster flow and larger bolus of fluid. Close assessment is needed to determine whether the infant is capable of handling this faster flow and larger bolus. Several actions, sometimes referred to as *prodding* (e.g., pulling the nipple in and out, twisting/turning the nipple, jiggling the nipple, rhythmically squeezing the cheeks, or moving the infant's jaw up and down), may be intended to support or encourage the infant's intake by causing passive expression of fluid from the nipple. These maneuvers make coordination of swallowing and breathing more difficult, however, and therefore do not help the infant to become a more successful feeder.[30]

The EFS Assessment ends with a section in which the caregiver notes concerns, makes plans for further assessment, and recommends interventions for the infant.

SUMMARY

The EFS provides a means of identifying, for individual preterm infants, areas of strength and areas in which support is required to accomplish safe and effective feeding. All too often during oral feeding, infants experience multiple episodes of oxygen desaturation, increased energy expended in response to stress, and fatigue. Possible negative sequelae of recurring stress are often unnoticed, disregarded, or minimized. Through developmental conceptualization of specific infant feeding skills, the EFS provides an infant-focused framework for planning individualized interventions.[29,30] In addition, the EFS provides a means for assessing infant readiness to engage in oral feeding and for evaluating infant response to a feeding, including any interventions employed.

Assessment and intervention are integrated functions. As infants are fed and their capacities assessed, caregiver behaviors and assessment foci must be adjusted for the individual infant. If he stops sucking spontaneously only on occasion, for example, the infant probably needs a brief imposed break from sucking to support regulation of breathing and to prevent fatigue and/or physiologic dysregulation. If the infant does not root when his lips are stroked, indicating lack of readiness to feed, the feeder explores reasons for this. If the infant has difficulty coordinating swallowing and breathing, the feeder is more alert to his capacity to manage the bolus of fluid given the frequency of sucks and the duration of sucking bursts. The feeder will want to help prevent abbreviated or missed breaths for the infant, to listen more closely for complete and safe swallowing, and to explore the need for a sidelying feeding position, low-flow nipples, pacing strategies, or more extensive swallowing evaluation by a pediatric therapist. Thorough and ongoing assessment is an essential component of feeding practice, particularly for infants early in their skill development.

Training in the underlying theoretical basis and practical use of the EFS will be accomplished through two-day workshops held nationally. This will include learning to use the tool, scoring sample infants, and applying the tool to clinical/bedside work. Contact the first author for specifics on training and obtaining the EFS.

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TABLE 1

Setting the Stage for Optimal Feeding Performance

Provide an appropriate setting for the observation

• Feed the infant in the quietest setting possible.

• Remove all distractions and aim for no interruptions.

• Expect to give your full attention to the infant throughout the feeding.

Select an optimal feeding:

• Ensure that the infant is hungry and in a quiet-awake state. Change the diaper, and bring the infant to an awake state before starting the feeding. Facilitate minimal expenditure of the infant's energy during the prefeeding period.

• If needed, offer nonnutritive sucking and/or visual, auditory, vestibular, and/or tactile stimulation to help the infant get organized and ready for feeding.

Assess the baseline condition of the infant

• During a calm, inactive period, when no demands are being placed on the infant and when he is not recovering from a recent change such as handling, assess the infant's baseline physiologic status:

- Baseline oxygen saturation
- Baseline respiratory rate and breathing effort
- Baseline heart rate
- Stability/variability of physiologic measures
- Prefeeding color
- Level of oxygen supplementation, if administered

Provide developmental feeding support

• Hold the infant either in your arms or semiupright in your lap with the upper body and head upright at a 45° angle to the buttocks; or feed with the infant side-lying, head higher than hips. If side-lying, have the infant face you to enable you to see stress signals.

• Facilitate neutral head-neck flexion (chin slightly tilted down, not with the head extended or with excessive flexion, which can compromise airway maintenance).

• Keep the infant's head midline (not to one side).

• Swaddle-support the infant with a blanket, elbows inside, to promote hands toward the midline/center of the body and to contain the infant. Avoid tightly swaddling the arms away from the face. Avoid losing sight of the infant's upper arms and hands, which provide important information regarding the infant's experience and energy level during feeding.

• Coregulate the feeding:

- Observe for stress signals and respond contingently in ways that promote self-regulation.
- Begin feeding by eliciting the rooting response (i.e., by stroking the infant's lips at the corners or center). This promotes the infant's active engagement in feeding, which reflects his readiness to begin feeding with adequate breathing and vigor. Lack of rooting may indicate stress and typically signals nonreadiness to initiate sucking. If the infant does not open his mouth in response to a nipple touching his lips, realert the infant, swaddle or reswaddle him to provide better support, and reassess his interest and capacity to engage in feeding. Place the nipple in the infant's mouth only in response to his cues of readiness (rooting, descending tongue).
- Do not urge the infant to feed. Respect his pauses in sucking, not only because they influence the infant's ability to self-regulate during feeding, but also because they influence swallowing coordination. The pause patterns that occur or do not occur reflect the infant's skill or lack of skill in coordinating sucking, swallowing, and breathing. Observe the infant's physiologic status during pauses to learn potential reason (s) for them. Do not attempt to prod the infant to continue sucking (through turning or twisting the bottle or by passively moving the infant's jaw). If the infant's breathing is calm and sleep or fatigue is suspected, do not encourage sucking, but rather provide a rest and realerting period.

TABLE 2

Examples of EFS Items within Each Section

Oral Feeding Readiness				
Able to hold body in a flexed position with arms/hands toward midline			Yes	No
Demonstrates energy for feeding—maintains muscle tone and body flexion through assessment period			Yes	No
Oral Feeding Skill				
Ability to Remain Engaged in Feeding				
Predominant muscle tone (energy infant demonstrates for feeding)	Maintains flexed body position with arms toward midline	Inconsistent tone, variable muscle tone	Some tone consistently felt, but somewhat hypotonic	Little or no tone felt; flaccid, limp most of the time
Ability to Organize Oral-Motor Functioning				
Opens mouth promptly when lips are stroked at feeding onsets	All	Most	Some	None
Once feeding is under way, maintains a smooth, rhythmic pattern of sucking				
Ability to Coordinate Swallowing and Breathing				
Able to engage in long sucking bursts (7–10 sucks) without behavioral stress signs or an adverse or negative cardiorespiratory response				
Ability to Maintain Physiologic Stability				
In the first 30 seconds after each feeding onset, oxygen saturation is stable, and behavioral stress cues absent				
Stops to breathe before behavioral stress cues appear				
Clear breath sounds—no grunting breath sounds (prolonging the exhale, partially closing glottis on exhale)				
Oral Feeding Recovery (During the First Five Minutes Postfeeding)				
Predominant state	Quiet Alert	Drowsy	Sleep	Fuss/Cry
Range of oxygen saturation (%):				