

PEDIATRIC NEWBORN MEDICINE CLINICAL PRACTICE GUIDELINES

Feeding in the Weeks Leading Up to Discharge



Implementation Date:



Clinical Practice Guideline:
Feeding in the Weeks Leading up to Discharge

Points of emphasis:

This CPG is intended to guide oral (*per os*, PO) feeding practices in the weeks leading up to NICU discharge. Its creation was guided by the principles of evidence-based practice, individualized (cue-based) care, multi-disciplinary collaboration, and family-centered developmental practice.

This guideline was developed to assist in improving consistency of feeding practices amongst staff working with infants who are preparing for discharge to home, with the goal that this will improve patient outcomes, parent confidence and competence in feeding their infant/s, and family satisfaction with their NICU care.

This document is consistent with principles set out in the *10 Steps to Successful Breastfeeding* (Baby Friendly Hospital Initiative, WHO and UNICEF) and the *SOFFI model* (Support Of Feeding in Fragile Infants).

The working group consisted of representation from Nursing, Lactation Consultancy, Feeding Therapy (Speech-Language Pathology), Nutrition/ Dietetics, Respiratory Therapy, and Newborn Medicine.

In recognition of the primary care role of nursing staff in providing the daily cares of patients, this document was circulated within the NICU Nursing Practice Council for feedback and endorsement prior to circulation within the wider NICU.

Questions?

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Key terms:

- Term age: 37/40 weeks GA
- Due date: 40/40 weeks GA
- PO: *Per os* (by mouth)
- PG: *Per gavage* (by feeding tube)
- NPO/ All PG: Nothing by mouth (all feeds via feeding tube)
- Dysphagia: swallowing incoordination and/or dysfunction
- Aspiration: liquid passing below the vocal folds into the lower airway
- Silent aspiration: aspiration with no overt clinical signs, or effort to clear, such as coughing
- Adverse events: potentially life-threatening events, such as SpO₂ desaturation, apnea, and bradycardia



Clinical Guideline Name	Feeding in the Weeks Leading up to Discharge
Effective Date	
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Approved By	Pediatric Newborn Medicine Clinical Practice Council _ CWN PPG BWH SPP Steering Nurse Executive Board/CNO
Keywords	Feeding, bottle feeding, breastfeeding, preterm

All CPGs will rely on the [NICU Nursing Standards of Care](#). All relevant nursing PPGs are listed below.

NICU G.1 Gastrostomy Care and Feeding

<https://hospitalpolicies.ellucid.com/documents/view/3205/15783/>

WNH A.1 Alternate Feeding Methods for Infants

<https://hospitalpolicies.ellucid.com/documents/view/3234/15996/>

WNH B.9 Infant Feeding (lists the 10 Baby Friendly Initiative steps and details)

<https://hospitalpolicies.ellucid.com/documents/view/9605/12790/>



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**SUMMARY: EVIDENCE-BASED BOTTLE FEEDING STRATEGY (Copy included as APPENDIX A)**

Note: If mother intends to breastfeed, breastfeeding should be established first, with guidance from a lactation consultant.

LOW-RISK INFANTS	HIGH-RISK INFANTS (see list on next page)
<p><i>Start with:</i></p> <ul style="list-style-type: none"> • Slow flow (if born >34 weeks GA) • Very slow flow (if born 30-34 weeks GA) • Standard cradle hold 	<p><i>Start with full therapeutic compensations:</i></p> <ol style="list-style-type: none"> 1. Ultra slow flow (i.e. Ultra Preemie) 2. Side-lying position with horizontal milk flow 3. External pacing <p><i>If needed, following team discussion, consider:</i></p> <ul style="list-style-type: none"> • Thickened feeds
<p><i>As needed</i> (i.e. if the infant displays any decline in physiological stability or engagement during PO feeds) implement the following compensations, in the following order, until a suitable option is found:</p> <ol style="list-style-type: none"> 1. Slower flowing (therapeutic) bottle nipple <ul style="list-style-type: none"> • Very slow flow (i.e. Preemie) • Ultra slow flow (i.e. Ultra Preemie) 2. Horizontal milk flow <ul style="list-style-type: none"> • Side-lying position OR • Supported upright position • Avoid holding the infant in a reclined/ supine position 3. External pacing 	<p><i>As able</i> (i.e. provided infant is showing no decline in physiological stability or engagement during PO feeds), consider trialing removing therapeutic compensations (one at a time):</p> <ul style="list-style-type: none"> • Remove external pacing • Transition to supported upright, then standard cradle hold • Gradually increase nipple flow rate <ul style="list-style-type: none"> • Very slow flow (i.e. Preemie), then • Slow flow (e.g. Level 1) <p><i>Note: All high-risk infants and any low-risk infants requiring therapeutic bottle nipples or thickened feeds should be seen by feeding therapy to determine support needs</i></p>

BOTTLE NIPPLES (in decreasing order of flow):

- Slow flow (e.g. green ring disposable nipple, nipples marked Level 1, slow, or newborn)
- Very slow flow (i.e. Dr Brown's Preemie nipple)
- Ultra slow flow (i.e. Dr Brown's ULTRA Preemie nipple)

FEEDING POSITIONS:

In general, aim for **horizontal milk flow** (i.e. bottle horizontal, parallel to floor) to allow the infant to control the milk flow (liquids flow faster if the bottle is held vertically, and slower if held horizontally). This is easiest achieved in either:

- **Side-lying position** (like when being nursed at the breast, with the infant on their side, with their ear, shoulder, and hip facing up towards the ceiling).
- **Supported upright position** (infant's head above their chest and hips, with the infant's neck supported, such as by the inside of feeder's elbow).
- Avoid feeding infants in a fully **reclined/ supine position**.

EXTERNAL PACING:

The feeder helps the infant to take pauses to catch their breath during feeding.

- This is performed by tipping the bottle down to slow milk flow and drain the nipple of milk and/or removing the bottle from the infant's mouth to impose a break in sucking.

**HIGH-RISK INFANTS (i.e. infants at increased risk of aspiration/ adverse events during PO feeding)**

- Born <30 weeks GA
- Bronchopulmonary dysplasia (BPD)
- Congenital heart disease (CHD) with altered respiratory parameters
- Airway malformation (e.g. laryngomalacia, laryngeal cleft, vocal fold paralysis)
- Neurological injury or altered neurological state: (e.g. IVH grade 3 or 4, moderate-severe HIE, seizures; those on anti-epileptic drugs or sedatives)
- Certain genetic syndromes associated with high aspiration risk (e.g. Down syndrome, Prader Willi syndrome)
- Any infant who shows any adverse clinical events during PO feeding (e.g. SpO₂ desaturation, apnea, bradycardia, wet vocalizations, cough, 'choke').
- Note: Infants who are on positive pressure support (CPAP/ HFNC), or who are tachypneic (RR>70BPM) should *not* be fed PO at that time

Stages of infant feeding maturation

Mature	Integrated suck-swallow-breath pattern (1:1:1)
Intermediate	Bursts of multiple suck-swallows followed by a self-imposed break to catch breath (infant displays <i>self-pacing</i>)
Beginner	Bursts of multiple suck-swallows without a break to catch breath; the feeder needs to assist the infant to take breaks to catch their breath or adverse event (SpO ₂ desaturation, apnea, bradycardia event, or aspiration) may occur (infant requires <i>external pacing</i>)

Boston Infant Feeding Scale

Overall PO feeding status:	
1	Competent feeder
2	Functional feeder <i>with therapeutic compensations</i> (any or all of the following): <ul style="list-style-type: none"> • Slower flowing bottle nipple (i.e. very slow flow, ultra slow flow) • Altered positioning (e.g. side-lying position with horizontal milk flow) • External pacing (i.e. tipping the bottle down and/or removing from the infant's mouth to slow milk flow and impose break in sucking for them to catch breath)
3	Struggling/ beginner feeder despite compensations
4	Not ready for PO feeds
Current route for feeds:	
A	PO
B	PO with close monitoring
C	PO with PG top-up as required
D	All PG with conservative PO trials
E	All PG (nothing by mouth)

PO – *by mouth*PG – *by gavage*



1. PROMOTING BREASTFEEDING

The Brigham & Women's Hospital (BWH) supports and promotes breastfeeding as the ideal way to feed babies. BWH endorses the **Baby Friendly Hospital Initiative (BFHI)**

<https://hospitalpolicies.ellucid.com/documents/view/9605/12790/>. As part of this process, our practices are guided by the WHO and UNICEF document "**10 Steps to Successful Breastfeeding**" (<http://www.tensteps.org/>) (1) (see TABLE 1).

It is widely acknowledged that breastfeeding success in the NICU environment may be affected by factors such as infant prematurity and illness, maternal illness, and by separation of mother and infant. As a result, a modified version of the 10 Steps for the NICU environment has been proposed by an international expert group (2) (see TABLE 2). All staff working in the NICU should be familiar with these guidelines. In particular, any staff involved in supporting infant feeding (nursing, medical, and allied health professionals) should make themselves aware of each mother's intention to breastfeed and preferences regarding any bottle feeding and formula feeding.

TABLE 1: 10 steps to successful breastfeeding (for healthy full-term infants) (1)

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Train all health care staff in the skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding.
4. Help mothers initiate breastfeeding within one hour of birth.
5. Show mothers how to breastfeed and how to maintain lactation, even if they are separated from their infants.
6. Give infants no food or drink other than breast-milk, unless medically indicated.
7. Practice rooming in - allow mothers and infants to remain together 24 hours a day.
8. Encourage breastfeeding on demand.
9. Give no pacifiers or artificial nipples to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or birth center.

TABLE 2: Modified 10 steps to successful breastfeeding for the NICU (2)

Guiding principles:
<ul style="list-style-type: none"> • The staff attitude toward the mother must focus on the individual mother and her situation. • The faculty must provide family-centered care, supported by the environment. • The health care system must ensure continuity of care, that is, continuity of pre-, peri-, and postnatal care and, post-discharge care.
1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Educate and train all staff in the specific knowledge and skills necessary to implement this policy.
3. Inform all hospitalized pregnant women at risk for preterm delivery or birth of a sick infant about the management of lactation and breastfeeding and benefits of breastfeeding.
4. Encourage early, continuous, and prolonged mother-infant skin-to-skin contact (kangaroo mother care) without unjustified restrictions. Place babies in skin-to-skin contact with their mothers immediately following birth for at least an hour. Encourage mothers to recognize when their babies are ready to breastfeed and offer help if needed.
5. Show mothers how to initiate and maintain lactation and establish early breastfeeding with infant stability the only criterion.



6. Give newborn infants no food or drink other than breast milk, unless medically indicated.
7. Enable mothers and infants to remain together 24hrs a day.
8. Encourage demand feeding or, when needed, semi-demand feeding.
9. Use alternatives to bottle feeding at least until breastfeeding is well established, and use pacifiers and nipple shields only for justifiable reasons.
10. Prepare parents for continued breastfeeding and ensure access to support services/ groups after hospital discharge.

In general, infant feeding plans should be guided by the following principles (2):

1. Provide sufficient fluid and nutrition to meet the infant's requirements for health, growth, and development.
2. Protect the mother's milk supply (teach methods for expressing and storing milk, if breastfeeding at the breast is not possible at that time).
3. Work to address any obstacles to breastfeeding and/or breast milk feeding.
4. Where possible, provide support to have the infant feed at their mother's breast.
5. Where breastfeeding isn't possible, support the infant to receive breast milk where possible (own mother's milk is the first preference; with parent consent, donor milk is the next preference; formula is the last preference).

However, while breastfeeding is generally the best method for infants to feed, *all* mothers and infants should be supported by NICU staff in establishing successful feeding, regardless of their choice or ability to breastfeed.

See APPENDIX B: Breastfeeding Decision Tree for high-risk infants

Nutritive sucking:

Wherever possible, offer breastfeeding as the first PO feed.

Non-nutritive sucking (NNS):

NNS while on tube feeds has been shown to have benefits for the infant, such as improved transition from tube to PO feeds and better PO feeding performance (3). NNS on a fully pumped breast may be an option for some infants while they are on tube feeds. Mothers intending to use this technique should be taught to recognize:

- Signs of fully pumped breast (e.g. unable to pump any additional milk, soft breast).
- Signs of an additional let down (as sucking stimulation often triggers more milk production).
- Infant indicators that they are not managing milk flow (e.g. change in physiological status, coughing, or stress cues).

However, if an infant is NPO/ all PG due to aspiration risk +/- documented aspiration, they should not be offered the breast, as there is always a potential for milk transfer.

For all infants whose mothers intend to breastfeed, a referral to a lactation consultant (LC) should ideally be made within 24hrs of birth. Education provided by the LC includes:

- Education for pumping strategies to initiate and maintain milk supply.
- Education to help facilitate appropriate positioning and effective latch.



- Use of breastfeeding equipment: Breast pumps, nipple shields, supplemental nursing systems (line feeders), and safe use of oral syringe to deliver small volumes of breast milk when nursing at the breast isn't possible.

Other education that is provided by the LC, in association with other members of staff includes:

- Education regarding kangaroo care (skin-to-skin contact) (*Note: RNs often assist in providing this information and training*).
- Education for assessing infant feeding readiness cues (*RNs and feeding therapists often assist in providing this information and training also*).
- Discussion regarding offering 'empty' breast for NNS practice during gavage feeding (*this decision should involve medical and feeding therapy staff, in addition to LC and RN staff, if concerns regarding aspiration or adverse events during feeds exist*).
- Discussion of potential need for supplementation, with test weights and feeding assessment (*this decision should involve medical and nutrition/ dietetic staff, in addition to LC and RN staff, if concerns regarding growth exist*).
- Discussion regarding number of breastfeeds per day versus bottles in infants who need to be supplemented (*this decision should involve medical and nutrition/ dietetic staff, in addition to LC and RN staff, if concerns regarding growth exist*).

2. SPECIAL CONSIDERATIONS: CLEFT LIP / PALATE

- Many infants with cleft lip/ palate may be able to successfully breastfeed. Guidance from LC and feeding therapy staff will be provided.
- Infants with cleft lip/ palate can usually bottle feed successfully with the assistance of a specialty bottle with a one-way valve. Guidance from feeding therapy staff will be provided.
 - During typical infant feeding, milk extraction is achieved through *compression* (positive pressure) and *suction* (negative pressure). To generate suction/ negative pressure, there needs to be a closed system with adequate seal. Cleft prevents a closed oral system (air can leak through the cleft) and, hence, infants with cleft palate rely on *compression* alone (versus suction) for milk transfer.
 - **One-way valves** allow milk into the bottle nipple but prevent milk from moving backwards into the bottle. In this way, infants get more milk each time they compress the nipple. The two most widely-used, commercially available feeders with one-way valves are the *Haberman Special Needs Feeder* and the *Dr Brown's Specialty Feeding System*.
 - Currently, the *Dr Brown's Specialty Feeding System* is used preferentially in our NICU, as well as at multiple children's hospitals throughout the country, as it is easier to use, cheaper, and easier to access. This system allows an infant to express a bolus without requiring manual expression/assisted delivery from the feeder.

3. GENERAL BOTTLE FEEDING APPROACH IN LOW-RISK INFANTS

A useful approach to feeding preterm infants at low-risk of feeding difficulties is based on the SOFFI algorithm (4, 5) (see TABLE 4).

For the general preterm population, staff may consider offering first bottle feed with:

- a *slow flow bottle nipple* (e.g. disposable 'slow flow' nipples, Level 1) if born >34 weeks GA
- a *very slow flow bottle nipple* (i.e. Dr Brown's Preemie) if born 30-34 weeks GA



and holding the infant in a *standard feeding position* (i.e. traditional cradle hold).

Then, if needed (i.e. if the infant shows any decline in physiological stability or engagement, or liquid loss), staff should implement the following **therapeutic feeding compensations**, ideally in the following order, until a suitable option is found:

- **Slower flowing bottle nipple** (i.e. very slow flow or ultra slow flow)
- **Horizontal milk flow** (i.e. bottle horizontal, parallel to floor). This is easiest achieved in either:
 - **Side-lying position** (similar position to when an infant is being breastfed in a cross-cradle hold, with the infant on their side, with their ear, shoulder, and hip in line and facing up towards the ceiling)
 - **Supported upright position** (sitting position, with the infant's neck supported, such as by the inside of feeder's elbow)
 - Avoid holding the infant in a reclined/supine position
- **External pacing** (i.e. tipping the bottle down to slow milk flow and/or removing the bottle from the infant's mouth to impose a break in sucking)
- (For further information, see SECTIONS 5-8 below)

NOTE: The rationale for the order of changes is based on *gradually increasing demands on the parent/feeder*. Changing the bottle nipple puts the least amount of burden on the parent/feeder, whereas implementing horizontal milk flow (and associated positioning changes) and external pacing require more active effort, skill, and critical thinking from the parent/feeder, and there is a greater potential for variation between feeders.

4. FEEDING INFANTS AT HIGH-RISK OF ADVERSE EVENTS AND/OR ASPIRATION DURING FEEDS

Some preterm infants (such as those listed in TABLE 3) are at increased risk of **adverse events** (SpO₂ desaturation, apnea, bradycardia) and/or **aspiration** during PO feeds. In young infants, aspiration often presents as '**silent aspiration**' (i.e. aspiration with no overt clinical signs, or effort to clear, such as coughing). Often suspicion of swallowing incoordination/ dysfunction is raised via subtle clinical *signs* (e.g. changes in state or WOB during PO feeds) or *symptoms* (i.e. otherwise unexplained worsening of respiratory condition, failure to wean from supplemental O₂, failure to progress with PO feeds).

TABLE 3: Infants at high-risk of swallowing difficulties and impaired airway protection during PO feeds (6, 7)

- | |
|---|
| <ul style="list-style-type: none"> • Born <30 weeks GA • Bronchopulmonary dysplasia (BPD) • Congenital heart disease (CHD) with altered respiratory parameters • Airway malformation (e.g. laryngomalacia, laryngeal cleft, vocal fold paralysis) • Neurological injury or altered neurological state: (e.g. IVH grade 3 or 4, moderate-severe HIE, seizures; those on anti-epileptic drugs or sedatives) • Certain genetic syndromes associated with high aspiration risk (e.g. Down syndrome, Prader Willi syndrome) • Any infant who shows any adverse clinical events during PO feeding (e.g. SpO₂ desaturation, apnea, bradycardia, wet vocalizations, cough, 'choke'). |
|---|



- Note: Infants who are on positive pressure support (CPAP/ HFNC), or who are tachypneic (RR>70BPM) should *not* be fed PO at that time

For these infants, given the high-risk of **aspiration** (which can contribute to, or prolong recovery from, lung disease, as well as prolonging transition to full PO feeds and length of stay) and/or **adverse events** during PO feeds (which can impact neurological development and are potentially life-threatening) a *conservative approach* to the introduction of PO feeding is encouraged (TABLE 4). This involves:

- Commencement of any PO feeding with **full therapeutic compensations**:
 - **ultra slow milk flow** (fully/ partially emptied breast or slower therapeutic bottle nipple)
 - **side-lying position and horizontal milk flow**
 - **external pacing as required**
 - (see further information in SECTIONS 5-8 below)
- *Breastfeeding only, if possible:*
 - Flow of milk from the breast is more responsive to the infant's sucking than milk flow from the bottle, which generally occurs passively whether the infant is actively sucking or not.
 - In addition, breastfeeding is infant-driven, unlike bottle feeding, which can be feeder-driven if the infant is 'encouraged' to feed by holding the bottle nipple in the infant's mouth, twisting or jiggling the bottle nipple to stimulate sucking, or holding the infant's mouth closed around the nipple in the form of chin and cheek support.

There should be a *low threshold for discontinuation of PO feeds* in this population if any concerns regarding airway protection arise (e.g. change in physiological stability and vital signs, gulp, cough, 'choke', increased work of breathing).

If PO feeds are slow to progress, respiratory support needs increase, or if the patient is unable to wean from respiratory support, a swallowing imaging study (e.g. **modified barium swallow study, MBS** or **fiberoptic endoscopic evaluation of feeding, FEES**) may be warranted to objectively evaluate swallow function and determine aspiration risk (see SECTION 16). Some patients who are unable to feed safely with one feed plan, may be able to feed safely with other plans (i.e. change of feeding equipment, feeding position, external pacing, +/- thickened feeds).

While, in general, staff should encourage and support **cue-based feeding**, if there is a concern regarding **silent aspiration** during feeding, it is recommended to use a very conservative approach. In these cases, staff should work to provide developmental and bonding opportunities through other means (e.g. non-nutritive sucking, swaddling and holding during tube feeds). In addition to safety issues, staff should actively work to avoid adverse patient experiences likely to cause long-term feed aversion.

**Table 4: EVIDENCE-BASED BOTTLE FEEDING STRATEGY (4, 5).**

LOW-RISK INFANTS	HIGH-RISK INFANTS (see list on next page)
<p><i>Start with:</i></p> <ul style="list-style-type: none"> • Slow flow (if born >34 weeks GA) • Very slow flow (if born 30-34 weeks GA) • Standard cradle hold <p><i>As needed</i> (i.e. if the infant displays any decline in physiological stability or engagement during PO feeds) implement the following compensations, in the following order, until a suitable option is found:</p> <ul style="list-style-type: none"> • Slower flowing (therapeutic) bottle nipple <ul style="list-style-type: none"> • Very slow flow (i.e. Preemie) • Ultra slow flow (i.e. Ultra Preemie) • Horizontal milk flow <ul style="list-style-type: none"> • Side-lying position OR • Supported upright position • Avoid holding the infant in a reclined/supine position • External pacing 	<p><i>Start with full therapeutic compensations:</i></p> <ul style="list-style-type: none"> • Ultra slow flow (i.e. Ultra Preemie) • Side-lying position with horizontal milk flow • External pacing <p><i>If needed, following team discussion, consider:</i></p> <ul style="list-style-type: none"> • Thickened feeds <p><i>As able</i> (i.e. provided infant is showing no decline in physiological stability or engagement during PO feeds), consider trialing removing therapeutic compensations (one at a time):</p> <ul style="list-style-type: none"> • Remove external pacing • Transition to supported upright, then standard cradle hold • Gradually increase nipple flow rate <ul style="list-style-type: none"> • Very slow flow (i.e. Preemie), then • Slow flow (e.g. Level 1) <p><i>Note: All high-risk infants and any low-risk infants requiring therapeutic bottle nipples or thickened feeds should be seen by feeding therapy to determine support needs</i></p>

*See SECTION 9 below re: extra considerations before implementing thickened feeds

Feeding an infant on CPAP/ HFNC:

Given the potential for adverse respiratory events related to the underlying respiratory disease, as well as from the effect of positive pressure flow delivered through the pharynx and larynx (8), staff should adhere to the following guidelines:

- Infants will not be fed PO while on CPAP or HFNC.
- When infants are weaned off CPAP/ HFNC into LFNC/ RA, they should demonstrate stable vital signs on this reduced level of respiratory support for \geq 6 hours prior to any initiation of PO feeding.

Note:

- PO feeding includes *any fluids given by mouth that are swallowed* (e.g. medication, breast milk, formula, sucrose solutions) given via any device.
- Oral cares (\leq 1mL liquid used to moisten and clean mouth) and gels applied to the oral mucosa may be used with caution, as needed. Any liquids delivered to infant's mouth should be broken down into 0.1- 0.2mL boluses to replicate the size of a typical infant swallow.
- Note:
 - Healthy full-term infants swallow an average of 0.2mL per swallow (9).
 - Preterm infants swallow an average of 0.1 – 0.15mL per swallow (9).
 - In a fast infant feed, it takes at least 10 seconds to swallow 1mL (90mL in 15mins = 1mL per 10sec, where most infants would do 5-10 sucks).



Feeding infants who demonstrate increased work of breathing and/or tachypnea (regardless of degree of respiratory support):

Given the potential for adverse events related to the underlying respiratory disease, as well as from the effect of mis-timing of swallows during inspiration, staff should adhere to the following guidelines:

- Infants who display increased **work of breathing** (e.g. nostril flaring, head bobbing, tracheal tug subcostal retractions) and/or who are tachypneic (RR > 70BPM) should not be fed PO at that time due to increased risk of aspiration.

Infants with severe neurological impairment or altered neurological state:

- Infants who display altered neurological state (whether due to effects of medication, or otherwise) should not be fed PO at that time due to increased risk of aspiration.
- Infants with severe IVH (grade 3 or 4) or moderate-severe HIE should be considered at risk of swallowing incoordination/ dysfunction, and any PO intake should proceed with caution and close monitoring.

Infants with congenital heart disease (CHD) with altered respiratory parameters:

- Infants with the conditions listed below should be considered at increased risk of aspiration and/or adverse events during feeding, and should be fed per the high-risk protocol (i.e. starting with full therapeutic feeding compensations):
 - Infants with Single Ventricle defects (e.g. Hypoplastic Left Heart Syndrome, Double Outlet Right Ventricle, Ebstein's Anomaly, Pulmonary Atresia)
 - Infants with Tetrology of Fallot, Total Anomalous Pulmonary Venous Return, Transposition of the Great Arteries, Tricuspid Atresia, and Truncus Arteriosus
 - Infants with supplemental O₂ requirement that Cardiology and/or NICU deems inconsistent with degree of cardiac defect

Infants with significant micrognathia/retrognathia +/- glossoptosis:

- Whether they occur in isolation or as part of a genetic syndrome (e.g. Pierre Robin sequence), significant micrognathia/ retrognathia +/- glossoptosis can impact an infant's ability to maintain a patent airway.
- This can impact the infant's ability to safely coordinate a suck-swallow-breath pattern for feeding.
- These infants may have special positioning requirements to feed safely (e.g. prone or side-lying to help bring tongue forward and open airway).
- These infants should be considered at increased risk of aspiration and/or adverse events during feeding. Any PO intake should proceed with caution and close monitoring.

Any staff involved in feeding high-risk patients should be alert for *signs and symptoms suggestive of swallowing incoordination/ dysfunction*. See TABLE 5.

TABLE 5: Signs and symptoms suggestive of possible swallowing incoordination/ dysfunction (10, 11)

- | |
|--|
| <ul style="list-style-type: none"> ○ Adverse events (SpO₂ desaturation, apnea, bradycardia) during PO feeds ○ Gulp, cough, 'choke', color change during PO feeds ○ Anterior milk spillage during PO feeds ○ Increased work of breathing during or after PO feeds ○ Increased congestion or fremitus during or after PO feeds |
|--|



- Unexplained respiratory infection
- Unexplained O₂ requirement/ inability to wean from O₂ support
- Delayed PO feeding milestones (e.g. starting PO feeds, attaining full PO feeds)
- Requiring compensations during PO feeds (e.g. modified feeding equipment, modified positioning, or external pacing)

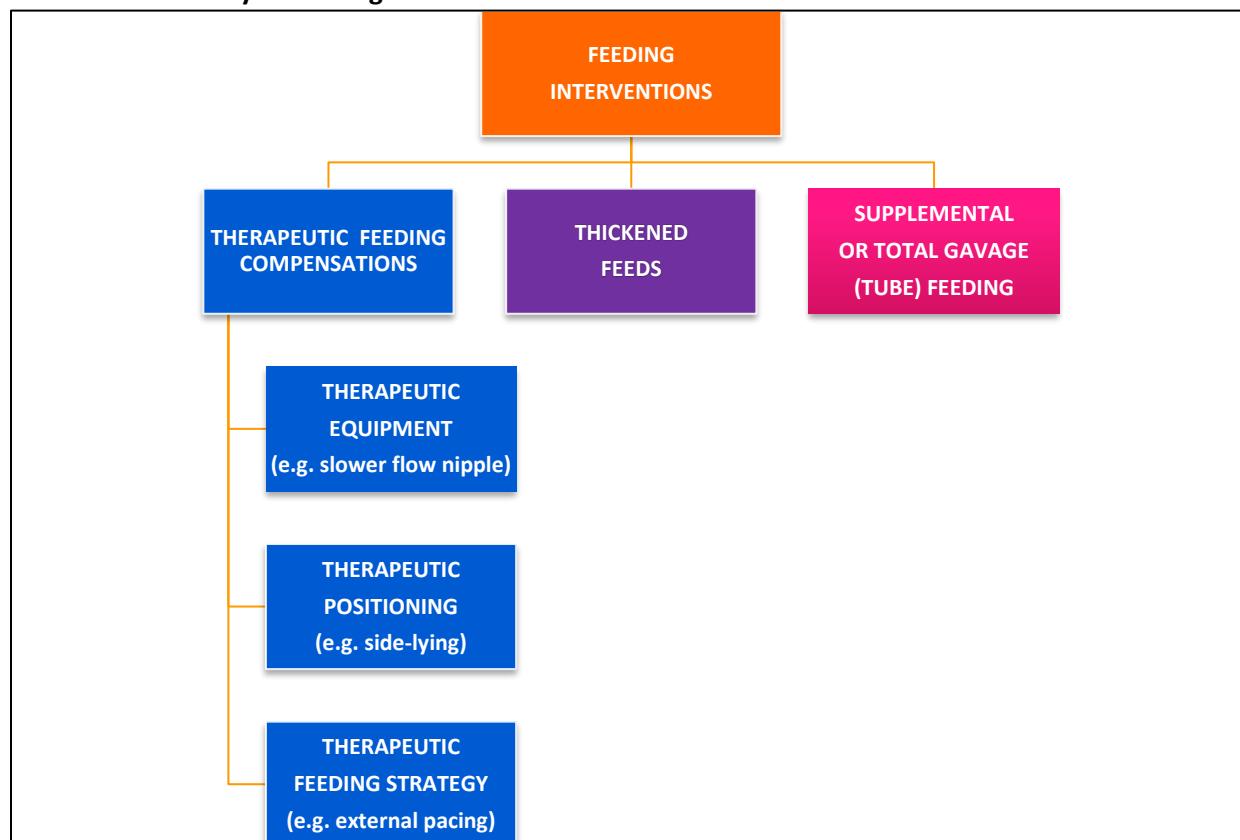
5. THERAPEUTIC FEEDING COMPENSATIONS

For infants with swallowing incoordination/ dysfunction, there are 3 main lines of feeding interventions:

- *Alter how the feed is delivered*, via **therapeutic compensations** (e.g. therapeutic equipment, therapeutic positioning, therapeutic strategies)
- *Alter the feed itself* (i.e. thickened feeds)
- *By-pass the oral-pharyngeal mechanism*, and deliver the feed directly to the gut (i.e. gavage tube feeding)

(See FIGURE 1)

FIGURE 1: Summary of feeding interventions



For all therapeutic feeding compensations:

- If a staff member (RN or feeding therapist) assesses that therapeutic compensation is useful for an infant, this should be documented in the infant's medical record.



- Other staff members should continue use of therapeutic compensation unless they assess that this is no longer useful. If so, the reason for this change should be documented in the infant's medical record.
- Staff should *avoid making frequent changes* to feeding plans, as inconsistencies in feeding practices may contribute to infant feeding difficulties.
- *Parent training* will be required when using any therapeutic compensations, as these are special strategies that are often not intuitive to parents or other care-givers who may be feeding the infant. Feeding therapists and RNs may be involved in performing parent training.

6. THERAPEUTIC FEEDING EQUIPMENT

Slower flow bottle nipples (e.g. very slow flow and ultra slow flow nipples):

- Slower flowing bottle nipples may be used to assist the infant to regulate milk flow and assist with suck-swallow-breath coordination.
- In addition, given that milk flow from the breast is generally not as fast as many bottle nipples, the use of slower flowing bottle nipples when bottle feeding may assist with transition to breastfeeding.
- Summary of information from a recent study by Pados et al (12):
 - **Disposable bottle nipples labeled 'slow flow'**
 - On average, these nipples are equivalent to standard commercial slow flow/ Level 1 bottle nipples
 - There is often variable flow rate between nipples (poor quality control)
 - These nipples are made to be single use (i.e. it is generally not safe to re-use them)
 - These nipples are not readily available to families after discharge from the hospital
 - **Commercial bottle nipples labeled 'preemie' or 'ultra preemie':**
 - These nipples are considered VERY slow flow or ULTRA slow flow
 - They have a more consistent flow rate than disposable nipples (due to stricter quality control in the manufacturing process)
 - These nipples are made to be re-usable (i.e. they can be kept, cleaned, and re-used).

(See TABLE 6)

TABLE 6: Bottle flow rates (in increasing order)

FLOW RATE	NAMES	EXAMPLES
Ultra slow flow	Ultra preemie nipple	Dr Brown's ULTRA Preemie nipple
Very slow flow	Preemie nipple	Dr Brown's Preemie nipple
Slow flow	Newborn nipple	Dr Brown's Newborn nipple
	Level 1 bottle nipple	Green ring disposable nipple; nipples marked slow flow/ Level 1
Fast flow	Level 2-3 nipples	White and clear ring disposable nipples; nipples marked medium/ standard flow/ 3-6mths

Rationale and considerations when recommending a bottle nipple with a slower flow rate:

Suck- swallow- breath coordination:

- Difficulty with suck-swallow-breath coordination often presents as:
 - Physiological changes (e.g. SpO₂ desaturations, apnea, bradycardia)
 - Work of breathing during feeds
 - Frequent self-imposed rest breaks



- Requiring external pacing to impose breaks to catch breath
- A change to weaker or slower sucking patterns (i.e. baby who can suck well on a pacifier, but doesn't suck well on a bottle)
- Anterior milk spillage
- If slower flow rate is effective, there should be less of these events.

Time to finish feedings:

- Typical infant feedings last 20-25 minutes (13).
- Slower flow rate may have the potential to extend feeding times. However, in clinical practice, slower flow often does not push infant feed times outside normal limits, as the slower flow generally improves suck-swallow-breath coordination, so the infant spends less time pulling away from the nipple and/or taking breaks to catch breath.
- It should be noted that infants do not need to complete feedings in 10-15 minutes. This is not physiologic and may possibly contribute to increased reflux and/or a preference for bottle feeding over breastfeeding.

Faster-flowing bottle nipples:

- Many NICUs stock fast flowing bottle nipples, with the thought that faster milk flow may make sucking easier.
- However, in infants with poor suck-swallow-breath coordination, it is known that faster milk flow generally does not help and can make swallowing coordination harder. Concerns include airway compromise (e.g. aspiration, SpO₂ desaturation, increased work of breathing), reduced patient enjoyment of feeding (reduced engagement with feeder and potential development of aversion to feeds), and possible flow confusion if moving between breastfeeds and bottle feeds.
- Infants who may benefit from a somewhat faster flow include those with *oral-phase feeding difficulties* (versus pharyngeal phase), such as infants with cleft lip/ palate. In these cases, an assessment must be made to determine the flow rate which is fast enough to assist with effective milk transfer, without being so fast as to interfere with swallowing safety.

7. THERAPEUTIC FEEDING POSITIONING

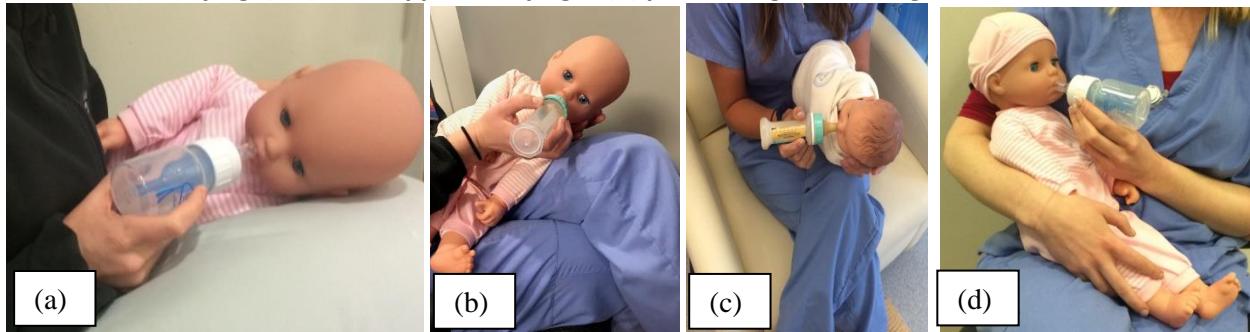
Given that fluids flow more slowly when a bottle is held horizontally versus vertically, the use of **horizontal milk flow** may be used to assist the infant to regulate milk flow (reducing bolus size) and assist with suck-swallow-breath coordination (14-16).

- It is easiest to achieve horizontal milk flow if the infant is positioned in a **side-lying position** or in a **supported upright position** for PO feeds (see FIGURE 2). *Avoid feeding infants in a reclined/supine position.*
- Given that most infants are held in a side-lying position when breastfeeding, the use of a side-lying position when bottle feeding may assist with transition to breastfeeding.
- The transition to standard cradle hold (semi-reclined) position can be made when tolerated by the infant.

Note: Regardless of the position that the infant is held in (e.g. cradle hold, side-lying, supported upright), preterm infants generally benefit from *additional postural support* during PO feeds, given that many have immature/ altered tone. Supportive positioning can assist in facilitating a *flexed position*, which is most conducive to effective sucking.

- For breastfed infants, support is provided by the mother's torso and arms. It is suggested that the infant is unwrapped to allow skin to skin contact and assist the infant to latch effectively without extending their neck or stretching their mother's nipple.
- For bottle fed infants, some level of support is provided by the feeder's torso and arms. However, given that the presence of the bottle obstructs the closeness of the infant and feeder, many preterm infants benefit from being *swaddled* during bottle feeds. This can make handling easier for the feeder and less stressful for the infant.
-

FIGURE 2: Side-lying (a-c) and supported upright (d) positioning for feeding



8. THERAPEUTIC FEEDING STRATEGIES

External pacing (FIGURE 3) is a strategy that may be used if an infant is having difficulty self-coordinating sucking, swallowing, and breathing (16, 17).

- External pacing involves either/ both:
 - *Tipping the bottle down*, to reduce the amount of milk in the nipple and slow milk flow
 - *Removing the nipple from the infant's mouth*, to impose a break in sucking to allow the infant to catch their breath.
- External pacing may be performed on a schedule (e.g. every 3 sucks) or on demand (i.e. cue-based).

FIGURE 3: External pacing for feeding (bottle is tipped down to slow liquid flow)



9. THICKENED FEEDS

- The use of thickened feeds is recommended for two main NICU populations (18, 19):
 - infants with swallowing incoordination/ dysfunction (**dysphagia**) – thickened feeds are more cohesive, so are less likely to enter the airway during swallowing
 - infants who display symptomatic gastroesophageal **reflux** – thickened feeds are more dense, so are less likely to be refluxed back into the esophagus after a feed



- Approximately 5-10% of the BWH NICU population require thickened liquids during their inpatient stay. These babies usually have had long length of stay, and feeding problems are eventually what is keeping them in hospital.
- In the NICU environment, thickening is generally *not* the frontline management for dysphagia or reflux management -
 - Thickening is difficult to implement effectively (there are multiple factors to be considered – see below)
 - Thickening is generally only used *after trying full therapeutic feeding compensations*
 - Thickening is generally *not* implemented before 37/40 weeks corrected GA (early on the focus of care is on optimizing nutrition/ growth; bolus/ PO feeds can be limited if problematic, and time can be allowed for other interventions to work and/or infant to mature)
 - Most of the time thickened feeds are implemented after feeding imaging studies (e.g. MBS) that demonstrates an overt need for thickening (e.g. aspiration on thin liquids, but not on thickened liquids). Occasionally, thickened feeds are implemented empirically after extensive discussion/review
- There are multiple considerations when an infant is placed on thickened feeds:
 - Different amounts of thickeners are needed for different liquids (e.g. breast milk versus formula, different types of formula, formula of different caloric content)
 - Some thickeners don't effectively thicken breast milk
 - Some thickeners can only be used in infants at a certain age
 - Different infants need liquids thickened to different levels for safe swallowing and/or reflux management
 - Most thickeners add extra calories to the feed
 - Some thickened feeds change thickness with time
 - Some thickened feeds will block NG tubes
 - Some thickened feeds require use of a faster flowing bottle nipple
 - Some thickeners/ thickened feeds are not readily available at home and/or are very expensive and difficult to access
- There are *multiple providers* who should be involved in discussions regarding the use of thickened feeds, to assist with effective implementation -
 - These include: MD, NP, RN, LC, feeding therapy, and nutrition/ dietetics
 - There is also a flow-on effect for other staff, including: Formula room, materials management, discharge coordination
 - There is also a flow-on effect for parents and outpatient providers
 - Staff often need to complete paperwork for insurance, WIC, and home enteral supply companies to help families access appropriate feeds at home
 - Parent education sheets/ instructions often need to be developed
- Hence, wherever possible it is recommended that:
 - Staff *avoid* starting/ changing/ or discontinuing thickened feeds at night or weekend, when many staff involved in operationalization are not present
 - Staff *avoid* implementing thickening plans inpatient without consideration for how this will be implemented outpatient

10. LOGISTICS OF MANAGING THICKENED FEEDS

Who recommends thickened feeds and how is it supplied:



- A MD order is required to commence thickened feeds.
- At times, infants will have one plan for PO (by mouth) feeds and another plan for PG (tube) feeds (e.g. thickened feeds PO for swallow safety, regular EBM PG).
- Nutrition/ dietetics and feeding therapy should be consulted before starting thickened feeds, to assist with operationalization (see general guidelines in TABLE 7 below).
- Feeding therapy should be involved before adjusting the bottle nipple. Some infants may not be able to safely feed with a faster nipple.
- If an infant goes home on thickened feeds –
 - Staff will write a *letter of medical necessity* so family can inquire if insurance will cover costs.
 - If appropriate, staff will provide a *WIC special feeding request form*, requesting Enfamil AR (brand specific), with appropriate ICD diagnosis codes: aspiration of milk (P24.31) oropharyngeal dysphagia (R13.12), gastroesophageal reflux (K 21.9)

TABLE 7: General feed thickening options

PRE-THICKENED	HAND-THICKENED	
If a baby is able to tolerate regular (cow's milk based) formula, in general:	If a baby needs a specialty formula, in general:	If Mom wishes to use breastmilk and baby is \geq 42 weeks corrected GA, in general:
Use <i>Enfamil AR*</i> formula made from powder + water	Add rice cereal to formula to thicken	Add <i>Gelmix**</i> to expressed breast milk (EBM) to thicken
The thickening agent in <i>Enfamil AR</i> is rice starch.	The primary ingredient in rice cereal is rice. However, some rice cereal may contain other potential allergens (e.g. soy).	The thickening agent in <i>Gelmix</i> is carob bean gum.
Pre-measured packets of formula powder can be ordered from the formula room. Pre-measured packets contain 1 scoop of formula powder – 9g. At home, families will use AR made from formula powder + water.	Pre-measured packets of rice cereal can be ordered from the formula room. Pre-measured packets contain 1 teaspoon of rice cereal – 1.3g. At home, families will use rice cereal and measure with metric teaspoon.	<i>Gelmix</i> can be provided by feeding therapy. Sticks contain 2.4g. If needed, formula room staff can split sticks into 2x 1.2g or 3x 0.8g. At home, tubs contain 1.2g scoops Tubs and sticks available from Amazon.com
Add AR formula powder to water	Add rice cereal to formula	Add <i>Gelmix</i> to EBM
Powder mixes better if liquid is already warm at time of mixing	Cereal mixes better if liquid is already warm at time of mixing	Powder mixes better if liquid is already warm at time of mixing
Use cap when mixing (to avoid powder getting into bottle nipple)	Use cap when mixing (to avoid powder getting into bottle nipple)	Use cap when mixing (to avoid powder getting into bottle nipple)
Wait at least 3mins before serving	Wait at least 3mins before serving	Wait at least 3mins before serving
<i>Enfamil AR</i> formula is $\frac{1}{2}$ nectar thick	Follow recipe instructions to make desired thickness	Follow recipe instructions to make desired thickness
20kcal/oz = 1 scoop of formula powder + 60mL water	Rice cereal adds 5kcal per teaspoon	<i>Gelmix</i> adds 10kcal per stick (2.4g).



24kcal/oz = 1 scoop of formula powder + 50mL water		Generally, 1 stick is added to several ounces of liquid (recipe depends on liquid and desired thickness)
Throw out whatever is not consumed	Throw out whatever is not consumed	Follow unit instructions for storing and re-heating EBM

NOTE: These are general recipes – sometimes recipe needs to be adjusted (e.g. if baby is on supplemental calories or certain types of formula). Nutrition/ dietetics and feeding therapy staff should be consulted to assist with operationalization.

* *Enfamil AR* formula measures as $\frac{1}{2}$ nectar thick at the time of consumption. Other pre-thickened formula (e.g. *Similac for Spit-Up*) does not measure as $\frac{1}{2}$ nectar thick. Hence, brand substitution is not appropriate for infants who need liquid to be $\frac{1}{2}$ nectar thick.

** *Gelmix* is a thickening agent that is made for thickening infant feeds. The manufacturer indicates it is not intended for use in infants aged below 42 weeks corrected GA. Generally, it is also advised not to use gum-based thickeners in infants with a history of *necrotizing enterocolitis (NEC)*.

- Note: *Enfamil AR* liquid ready-to-feed (liquid) is expensive and difficult to access as an outpatient. Hence, to facilitate a smooth transition to home, if an infant uses *Enfamil AR* as inpatient, they should use AR made from formula powder + water (not ready-to-feed)

11. LOGISTICS OF MANAGING THERAPEUTIC FEEDING EQUIPMENT

Who recommends feeding equipment and how is it supplied:

- The BWH NICU is *not* currently funded to supply reusable feeding equipment to *all* infants. Hence, an assessment of clinical need is required to support use, and a record of demand and supply should be kept.
- If therapeutic feeding equipment is required, *4 full sets* of necessary equipment should be supplied to allow time between cleaning. Ultra slow flow and very slow flow nipples and bottles are available in teaming stations throughout the BWH NICU. (Note: Ultra Preemie and Preemie nipples only work with matching bottle and vent).
- LCs will supple slow flow (newborn) bottle nipples, as needed, to mothers who intend to breastfeed, but who need to give some bottles for supplementation. (Note: Newborn nipples can be used with any standard bottle).
- Feeding therapists will supply any additional therapeutic feeding equipment (e.g. one-way valves), as required, based on assessment.
- If it has been determined a specialized bottle system is required post-discharge, the family should be provided with at least *4 full sets* to take home and be guided on where and how to obtain additional equipment. Feeding therapy staff can assist with this process.

When to discontinue therapeutic feeding equipment:

- Slower flowing bottle nipples are often used as infants are establishing suck-swallow-breath coordination.
- Collaboration is needed between the feeding therapist and RN in determining an infant's readiness to transition to a different flow rate -



- In general, the feeding therapist and primary RNs should be involved in the decision to advance an infant to a *faster* bottle nipple.
- Any staff member should consider transitioning an infant to a *slower* bottle nipple if concerns arise regarding suck-swallow-breath coordination.
- LCs may recommend a slower bottle nipple when mothers intend to breastfeed, but need to give their infant some bottles for supplementation.
- Some infants will require therapeutic feeding equipment beyond discharge.
- Once an infant is managing with a slow flow nipple, they will often be able to manage with a standard slow flow/ Level 1 nipple from most commercial brands.

Family preference for feeding equipment:

As discussed above, if therapeutic feeding equipment is required, this will be provided by the NICU.

If an infant is managing with standard feeding equipment (i.e. Level 1/ 'slow flow' nipple or faster):

In preparation for home, once the discharge date has been identified, staff should recommend the family brings in home bottle system 2-3 days before identified discharge date to ensure nipple flow is appropriate and feedings are successful -

- *Disposable feeding equipment* available on the floor for inpatient use are manufactured to be *single use*. They are also not readily available in the community and should *not* be given to parents to take home with them.
- If the re-usable system brought in by the infant's family is not appropriate, staff should provide guidance on this (note: this usually relates to nipple flow rate, and a slower flowing nipple for the same bottle system may be available).
- If an infant uses their own feeding equipment for more than 1-2 trial feeds, 4 sets of necessary equipment should be supplied by family to allow time between cleaning.

Cleaning feeding equipment

Only able to find NWH 'Cleaning and Sterilization of Reusable Feeding Equipment'

See existing Nursing Guidelines. <https://hospitalpolicies.ellucid.com/documents/view/3234/15996/>

12. FEEDING PROGRESSION

A MD order is generally required for all feeding types (PN, PG, PO). Other staff should be aware of orders that are in place, and discuss with the MD if they believe a patient is ready to commence PO feeding, or if clinical assessment suggests they should remain NPO/ all PG.

Commencing PO feeds:

An order to start PO feeds should only be placed when the infant is **physiologically stable** (e.g. not requiring positive pressure respiratory support, tachypneic, or displaying increased work of breathing) and presenting with **feeding readiness cues** (e.g. waking for feeds, alert, sucking on pacifier).

Feeding progression for low-risk infants:

Research shows most healthy preterm infants follow a feeding progression, typically achieving full PO feedings around 37/40 weeks corrected GA (20, 21).

Feeding progression for high-risk infants:



It should be acknowledged from the onset that infants who are at high-risk of feeding and swallowing difficulties may require a longer amount of time to show feeding readiness and to progress to full PO feeding (18, 19).

In general:

Literature suggests that progressing PO feeds based on a **cue-based approach** may shorten the transition time to full PO feeding by up to a week (22).

Cue-based feeding involves:

- Offering PO feeds when the infant displays **engagement cues** (e.g. physiological stability, flexed position, quiet alert state).
- Discontinuing PO feeds when the infant displays **disengagement cues** (e.g. physiological instability, extension patterns, loss of tone, sleepy, irritable, or hyper-vigilant state).
- **Semi-demand feeding** involves offering the infant the opportunity to PO feed on a schedule (e.g. every 3 hours, q3hr). An assigned volume is provided at each feed (whatever is not taken PO is given PG). A PO feed only progresses when the infant shows feeding readiness cues before the feed and engagement cues during the feed, and it is discontinued based on disengagement cues. Progression of the number of PO feeds and the amount offered is determined by the infant's cues and physiological stability.
- **Demand (ad lib) feeding** involves offering PO feeds based entirely on the infant's cues. Infants are fed PO as much (or as little) as they want, and as often as they demand, provided they meet minimal daily fluid and energy quotas.

Cautions regarding the transition to demand feeding:

- A discussion regarding an infant's suitability to transition to demand feeding is required between medical, nursing, nutrition/ dietetics, and (where appropriate) feeding therapy staff.
- When an infant is transitioned to demand feeds, a minimum amount of daily fluid and energy intake needs to be agreed on by the team (usually 120 mL/kg/day or 100kcal/kg/day as a minimum).
- A gavage tube will generally need to remain in situ until the patient has achieved PO intake equivalent to 75% of the total energy goal, but not less than 120 mL/kg/day.
- Close management is required by all disciplines to ensure the infant is medically stable and obtaining all fluids, energy, and nutrients required for appropriate growth and development.
- Infants should not go more than 5 hours (and not more than once in a 24-hour period) in between feedings. There should continue to be close monitoring of hydration status, weight gain, and blood glucose.
- In general, the length of a demand feeding trial should be no longer than 48 hours. If an infant is not meeting their fluid and energy minimum, they should be transitioned back to a semi-demand schedule (which often involves re-insertion of a gavage tube).

13. FEEDING ASSESSMENT

Feeding readiness

The first step in a feeding assessment is to establish the infant's **readiness to feed**.

- Observations are first made across the four areas of functioning, as outlined in the *Synactive Theory* (23), both at rest and during activity, such as handling:



- Physiological stability
- Motor organization
- State control and attention
- Self-regulation
- (See TABLES 8 and 9 for indicators of stress across different areas of functioning, as well as common physiological descriptors)

TABLE 8: Indicators of infant stress across different areas of functioning

Physiological/ autonomic stability: Changes in HR, RR, SpO2; gulping, coughing, ‘choking’, gagging; color changes (e.g. red, pale, or blue); yawning, hiccupping
Motor organization: Extension patterns (arching, finger splaying), increase or decrease in tone
State control and attention/ interaction: Extremes of state: hyper-vigilance, irritability or shut down; rapid changes in state
Self-regulation: inability to calm, requiring high levels of co-regulation

TABLE 9: Common terms related to physiological functioning

Bradycardia: Reduced heart rate (HR)
Tachycardia: Increased heart rate
Tachypnea: Increased respiratory rate (RR) (>70BPM)
Apnea: Cessation of breathing. An apnea event is the cessation of breathing for >20 seconds or >10 seconds with SpO2 desaturation or bradycardia
Typical vital signs in neonates and young infants: <ul style="list-style-type: none"> ● Respiratory rate: 30-60 breaths per minute ● Heart rate: 110-160 beats per minute
Hypoxemia: Reduced O2 (oxygen) in the blood <ul style="list-style-type: none"> ● Usually, hypoxemia is defined as an SpO2 saturation <95%. ● Note: Refer to unit guidelines for optimal target saturation levels
Cyanosis: Blue tinge to skin or mucous membranes associated with hypoxemia
Increased work of breathing (WOB): Physical presentation of respiratory distress. Signs include: nostril flaring, neck extension, head bobbing, tracheal tug, subcostal recession, accessory chest muscle use, and grunting
Stridor: High-pitched sound originating in the larynx, trachea, or bronchi, caused by a narrow or obstructed airway. Can be inspiratory, expiratory, or biphasic
Stertor: Coarse sound originating in the pharynx by a narrow or obstructed airway
Fremitus: Vibration caused by partial airway obstruction (often secretions) that can be felt from outside the body

Clinical feeding examination

If it is determined that an infant is showing readiness to feed, the infant undergoes a direct feeding assessment to allow an assessment of the infant’s nutritive sucking and suck-swallow-breath coordination is performed.

In general, an assessment of feeding in the NICU setting will involve a description of *how the infant was fed* (feeder, infant position, equipment used, and any strategies used), as well as a rating of the following:



- Sucking (i.e. lip seal, tongue cupping, sucking strength, sucking rhythm)
- Suck-swallow-breath coordination (i.e. beginner/ intermediate/ mature pattern, see TABLE 10)
- Physiological status (i.e. any changes in HR, RR, SPO₂, or WOB during feed)
- Stress cues (i.e. any changes in motor organization, state control and attention/ interaction), and self-regulation ability (i.e. ability to return to an optimal state of functioning after a stressful event).

TABLE 10: Stages of preterm suck-swallow-breath coordination (24)

Mature	Integrated suck-swallow-breath pattern (1:1:1)
Intermediate	Bursts of multiple suck-swallows followed by a self-imposed break to catch breath (infant displays <i>self-pacing</i>)
Beginner	Bursts of multiple suck-swallows without a break to catch breath; the feeder needs to assist the infant to take breaks to catch their breath or adverse event (SpO ₂ desaturation, apnea, bradycardia event, or aspiration) may occur (infant requires <i>external pacing</i>)

14. STANDARDIZED FEEDING ASSESSMENT TOOLS

Standardized feeding assessments should ideally be performed at standard time points to allow comparison of infants' progress against available norms and analysis of trends. The BWH NICU routinely scores infant's feeding skills using the **Boston Infant Feeding Scale** (see TABLE 11). Another example of a standardized feeding assessment tool is the *Early Feeding Skills Assessment Scale* (25).

Assessments will be performed by feeding therapists or RNs trained in using this tool.

- Results should be recorded in the infant's medical record using standard templates.
- Results may be used for research studies, with IRB approval.

TABLE 11: Boston Infant Feeding Scale (24)

Overall PO feeding status:	
1	Competent feeder
2	Functional feeder with therapeutic compensations (any or all of the following): <ul style="list-style-type: none"> • Slower flowing bottle nipple (i.e. slower than a slow flow/ Level 1 bottle nipple) • Altered positioning (e.g. side-lying position with horizontal milk flow) • External pacing (i.e. tipping the bottle down and/or removing from the infant's mouth to slow milk flow and impose break in sucking for them to catch breath)
3	Struggling/ beginner feeder despite compensations
4	Not ready for PO feeds
Current route for feeds:	
A	PO
B	PO with close monitoring
C	PO with PG top-up as required
D	All PG with conservative PO trials
E	All PG (nothing by mouth)

15. REFERRAL TO FEEDING THERAPY

BWH NICU feeding therapists provide services to the following populations:

**Blanket referral -**

- All infants born <34/40 weeks GA
- All infants who fall in the high-risk category for aspiration/ adverse events during PO feeds (see TABLE 3)
- Infants with craniofacial malformation (e.g. cleft lip/ palate, Pierre Robin sequence)

As needed, with MD referral -

- Any infant where there is a concern regarding aspiration or adverse events during PO feeds
- Infants aged 36/40 weeks GA who do not show readiness to feed PO
- Infants aged 40/40 weeks GA who are not fully PO feeding
- If physiological instability is observed with PO feeding despite compensation strategies (i.e. therapeutic feeding equipment, positioning, strategies)

NICU attendings can request feeding therapy services for any other NICU patients, on a case-by-case basis.

16. FEEDING IMAGING STUDIES

- Imaging studies allow direct visualization of the pharyngeal stage of the swallow. They allow an objective assessment of swallowing physiology, and risk of airway compromise during the swallowing process. See TABLE 12 for further details.
- Feeding imaging studies should be considered when there is concern regarding **aspiration during swallowing**. Concerns often arise based on clinical *signs* (e.g. SpO₂ desaturation/ bradycardic events during feeds) or *symptoms* (e.g. unexplained supplemental O₂ requirement, failure to progress with %PO).
- Eligible infants should be assessed by a NICU feeding therapist first, who will make a recommendation and facilitate the study.

TABLE 12: Feeding Imaging Studies

Modified Barium Swallow (MBS) assessment (also known as Video Fluoroscopic Evaluation of Swallowing (VFSS)) <ul style="list-style-type: none"> • Swallowing is assessed using fluoroscopy (video x-ray) • The infant drinks liquid barium (a sweet, chalky liquid) to allow the liquid to be visualized on the x-ray
Fiberoptic Endoscopic Evaluation of Swallowing (FEES) assessment <ul style="list-style-type: none"> • Swallowing is assessed using an endoscope (camera), which is passed through the nose • The infant drinks regular liquid (often colored green or blue with food dye to allow improved visualization)
Key terms - <ul style="list-style-type: none"> • Laryngeal penetration – liquids enters the larynx (voice box) • Aspiration – liquid passes below the vocal folds into the lower airway • Silent aspiration – aspiration without an effort to clear airway (i.e. no cough)

Testing conditions

- Using either imaging study (MBS or FEES), different feeding conditions are trialed, as needed (e.g. bottle nipples of various flow rates, liquids of various level of thickness, different feeding positions).



- Currently, imaging studies are conducted at an outside facility (Boston Children's Hospital) that has access to the necessary equipment. A NICU feeding therapist and RN attend the study, to guide testing conditions, and to facilitate the integration of findings into the infant's care plan.
- A MD order is required for imaging studies to proceed.
- Generally, MBS and FEES studies are not performed before 37/40 weeks corrected GA (if concerns arise prior to this time, consider an empiric trial of therapeutic feeding compensations and/or PO rest).

17. SUB-SPECIALTY CONSULTS RELATIVE TO FEEDING

NICU attendings may consider referral to the following sub-specialties, as needed:

- **Pediatric OtoRhinoLaryngology (ORL)**
 - Where there is concern for airway anomalies (e.g. laryngomalacia, laryngeal cleft)
 - In cases of presumed vocal fold dysfunction
- **Pediatric Gastroenterology (GI)**
 - For infant with prolonged NG/ NJ tube feedings, and anticipated need for long term gavage feedings +/- surgical tube placement (G or GJ)
 - In cases of symptomatic GERD and/or milk allergy/ intolerance
- **Pediatric Plastic Surgery**
 - For infants with cleft lip / palate
 - For infants with significant micrognathia/ retrognathia +/- glossptosis impacting breathing or feeding

18. MANAGEMENT OF ANKYLOGLOSSIA (TONGUE-TIE)

Effective milk transfer from the breast or bottle requires the infant to use their tongue to express milk from the breast or bottle nipple. For fully functional suckling, the tongue tip should be able to extend beyond the lower gum line and be able to move backwards along the roof of the mouth in a stripping action. A lingual frenulum that attaches close to the tip of the tongue, or that is thick and immobile may prevent effective tongue movement during sucking. This is referred to as **ankyloglossia** (or tongue tie).

Criteria for consideration of frenulectomy:

1. Infant receiving at least some PO feeds
2. Ankyloglossia (tongue tie) noted on clinical exam, and
3. Clinical signs of tethering of tongue and restriction of tongue movement noted:
 - Difficulty latching effectively and/or staying latched at the breast
 - Painful breastfeeding (e.g. blisters, other nipple trauma, mastitis)
 - Poor extraction of fluids from breast or a bottle (e.g. latch difficulties, tongue clicking, chomping style sucking).

Steps to follow:

1. LC and feeding therapist consult
2. If it is assessed that infant meets the criteria above, and the attending MD agrees, ORL or a qualified provider is consulted to perform the procedure
3. Parental consent is obtained for procedure
4. Frenulectomy is performed
5. LC/ feeding therapist re-evaluates feeding



19. FEEDING AND GROWTH DISCHARGE PLANNING MEETINGS

In keeping with currently recommended multi-disciplinary family-centered care practices, there should be a weekly encounter of feeding therapy, nutrition/dietetics, LC, RN, MD and parents (where ever possible) to assess infants feeding and growth progress, and review readiness for discharge.

- Goals should include:
 - (1) to flag active feeding and growth issues, and
 - (2) to identify infants likely to be discharged home within the next 1-2 weeks in order to allow enough time for coordination of outpatient follow-up care.
- Ideally, meetings should occur at the bedside.
- When meetings cannot occur at the bedside, the MD and NP representatives can bring any concerns that various staff have raised regarding an infant to this meeting, and then feedback the information from the meeting to team members at the next morning rounds and/or sooner as required.

20. TRANSITIONING TO NUTRITION FEEDING REGIMEN FOR DISCHARGE

See APPENDIX C: Guidelines for Nutrition Feeding Regimen for Discharge flow diagram

The duration an infant may require nutrient dense feedings is dependent upon a variety of factors including any estimated nutrient deficits accumulated during the infant's NICU course, biochemical data, and postnatal growth trajectory. (26-30)

- Infants considered at **low nutrition risk** at and/or approaching the time of discharge from the NICU are those who have:
 - 1) no known nutrient deficits,
 - 2) received <2 weeks duration of parenteral nutrition, and
 - 3) have achieved an appropriate growth trajectory
 - Note: Appropriate growth trajectory is defined as a decline in weight Z-score of 0.8 or less from birth to discharge (29) along with proportional length and head circumference growth. The Z-score is the standard deviation above or below the mean. Therefore, a Z-score of "0" would equate to the 50th percentile.
- Infants considered at **high nutrition risk** at and/or approaching the time of discharge from the NICU are those who have:
 - 1) estimated accumulated nutrient deficits,
 - 2) received parenteral nutrition for >2 weeks,
 - 3) have a documented sub-optimal growth trajectory (example: <20 g/day x 7 days in the 7-14 days preceding discharge)
 - 4) a weight of <2 kg at discharge, and/or
 - 5) a gestational age at birth of <28 weeks and discharged <37 weeks post-menstrual age
 - Note: Additional considerations include known steroid and/or diuretic course/metabolic bone disease of prematurity and/or MRI findings, such as white matter injury and/or increased extra-axial space.

Adjustments to the discharge feeding regimen will be made by the outpatient primary care provider, in conjunction with an outpatient dietitian when indicated, based on the infant's ongoing growth trajectory.



A *Neonatal Nutrition Discharge Summary* may be completed by the dietitian (with input from the LC, as appropriate) based on determination of risk and forwarded to the appropriate outpatient care provider/s.

21. NEONATAL NUTRITION DISCHARGE SUMMARY

See APPENDIX D: Neonatal Nutrition Discharge Summary

Infants considered **high nutrition risk** and/or those being discharged on preterm infant feeding products or any other complex feeding regimens may benefit from a *Neonatal Nutrition Discharge Summary*.

The *Neonatal Nutrition Discharge Summary* includes:

- Birth and discharge anthropometrics (Olsen and/or WHO growth charts)
- Change in weight percentiles and Z-scores from birth to discharge
- Brief summary of NICU course with emphasis on nutrition-related morbidities and interventions
- Recommended discharge regimen (including recipe)
- Recommended vitamins and mineral supplementation
- Suggested duration of recommended regimen or time frame to reassess needs
- If a specialty product is being used, amount family has on hand and plan for securing more product, if appropriate
- Suggested growth monitoring
- Suggested laboratory monitoring (if appropriate)
- Scheduled nutrition-related follow-up date(s), time(s), and whether an RDN is included on those appointments

NICU dietitians should be made aware of pending discharges several days prior to discharge via growth, development and discharge planning meetings and/or via alternate communication from primary care team.

Target audience includes parents, primary pediatrician, and receiving dietitian (for example, as part of a multi-disciplinary clinic). The intention is to provide a review of the discharge nutrition feeding regimen, as well as a summary of the patient's growth while in the NICU.

The *Neonatal Nutrition Discharge Summary* will be entered as part of patient's overall discharge summary and/or as a progress note in the chart by the dietitian. It will be electronically available to any eCare using facility, and/or faxed to the pediatrician along with other discharge summary documents. It can also be faxed to other health care providers, as deemed appropriate.

22. DISCHARGE ON GAVAGE TUBE FEEDS AND/OR SUPPLEMENTAL OXYGEN

Discharge from the NICU is dependent on physiological stability and adequate growth. Historically many NICUs would *not* consider discharging an infant who continued to require gavage tube feeds or supplemental O₂ to meet their nutritional and respiratory requirements. However, more recently, an increasing number of NICUs have begun to allow infants to be discharged with a feeding tube in situ and/or with nasal cannula, provided that:

- (a) the infant is physiologically stable,
- (b) the parents are willing and trained in how to use these support systems, and
- (c) appropriate support and follow-up is in place.



With regards to enteral **tube feeds**, a decision often has to be made prior to discharge regarding whether to continue with a *temporary gavage tube* (e.g. NG tube) or whether to transition to a *surgical feeding tube* (e.g. gastrostomy).

- Different facilities use different guidelines to determine when to transition to a surgical feeding tube.
- In the BWH NICU, we consider an infant taking <50% PO at 44/40 weeks corrected GA and/or the expected need for tube feeding for greater than 3 months post-term age to justify transitioning to a surgical feeding tube.

See **NICU NG feeding guidelines**, and existing G tube feeding guidelines

<https://hospitalpolicies.ellucid.com/documents/view/3205/15783/>

23. POST-DISCHARGE FOLLOW-UP

Most infants with ongoing feeding difficulties at or beyond their due date (40/40 weeks GA) would benefit from monitoring beyond discharge.

The NICU medical team may consider *outpatient referral* to the following health professionals:

- **Feeding Therapist:** If the infant has demonstrated difficulties achieving full PO feeds, aspiration risk, and/or feeding aversive behaviors at any point during their hospital stay, and/or if the infant is discharged home on therapeutic feeding equipment (e.g. Ultra Preemie nipple), special feeds (e.g. thickened feeds), or tube feeds.
- **Dietitian:** If the infant has demonstrated difficulties gaining weight, and is discharged home on: 1) tube feeds, 2) preterm feedings, and/or 3) is discharged home at <2 kg
- **Gastroenterologist:** If the infant has growth faltering, need for any kind of tube feedings, severe reflux, or any other GI-related medical diagnosis that requires follow-up.
- **Pulmonologist** if the infant has a history of aspiration, severe lung disease and/or supplemental O₂ requirement at discharge.
- **Otorhinolaryngologist:** if the infant has suspected or confirmed vocal fold dysfunction or other structural airway issues (e.g. laryngomalacia, laryngeal cleft).
- **Plastic Surgeon:** if the infant has cleft lip/ palate, or significant micrognathia/ retrognathia.

Of note, infants may be referred separately to feeding, dietetics, or medical programs. However, for *medically complex babies* with multiple challenges, a **multidisciplinary clinic** (where available) is likely to best meet their needs and provide a *comprehensive and consistent plan* for the family.

For all eligible babies, referrals to other specialist outpatient programs (e.g. infant developmental follow-up) should be made in addition, as clinically indicated.

24. DOCUMENTATION IN ELECTRONIC MEDICAL RECORDS

Ideally, standard feeding assessment and therapy templates should be available to allow *consistent reporting*. Other efforts should also be made between the various health professionals involved in infant feeding to facilitate consistent reporting.

- At a minimum, infants should be rated on the *Boston Infant Feeding Scale* (24) as being either a:
 - Competent feeder
 - Functional feeder with compensations



- Beginner feeder/ struggling feeder despite compensations
- (See TABLE 11 for further details)
- Details of any *therapeutic feeding compensations* required (e.g. ultra/ very slow flowing bottle nipple, side-lying, and external pacing) should be documented.
- The occurrence of, and rationale for, any deviations from agreed plan should also be documented.

25. PARENT EDUCATION MATERIALS

It is important that parents of infants within the NICU receive *accurate and consistent feeding information* from NICU staff. Ideally, parents should be provided with written copies of evidence-based feeding information to complement discussions and education provided by NICU staff. Staff should be considerate of potential differences in parent education levels, experience, and adult learning styles. Staff should also be aware of the need for repetition of important information to assist with parent understanding and retention of information. Parent education materials may be provided in the format of handouts, bedside posters, videos, or in other formats.

Feeding topics that should be addressed in parent education materials include explanation of the *BWH NICU high-risk and low-risk feeding protocol*, as well as explanations of various *therapeutic feeding compensations* (e.g. slower flowing bottle nipples, side-lying positions, external pacing). See **APPENDIX E**.

Other useful topics for parent education include:

- Recognizing infant cues (e.g. feeding readiness, engagement, disengagement)
- Long-term tube feeding options
- Feeding recipes, including instructions for safe preparation and storage
- How to obtain specialized preterm infant formula products at/after discharge, including WIC information

26. STAFF TRAINING

It is important that staff within the NICU provide accurate and consistent feeding information. Staff should undergo regular training and self-education in this area. Training may take the form of written material, seminars, courses/ conferences, or case discussions.

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