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ABM Clinical Protocol #12: Transitioning the Breastfeeding Preterm Infant from the Neonatal Intensive Care Unit to Home, Revised 2018

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A central goal of the Academy of Breastfeeding Medicine is the development of clinical protocols, free from commercial interest or influence, for managing common medical problems that may impact breastfeeding success. These protocols serve only as guidelines for the care of breastfeeding mothers and infants and do not delineate an exclusive course of treatment or serve as standards of medical care. Variations in treatment may be appropriate according to the needs of an individual patient.

Introduction and Background

The practice of breastfeeding or providing expressed mother's milk to preterm infants is promoted because of the considerable benefits to their health and well-being.[1–3] Ideally, preterm infants in the neonatal intensive care unit (NICU) are fed their own mothers' milk or donor human milk fortified with multiple nutrients and calories to optimize growth and development.[4] Breastfeeding at the breast in the NICU before discharge should be encouraged as it may increase the breastfeeding duration.[5] Near the time of discharge, a decision must be made as to how preterm infants should feed in the postdischarge period.

Growth faltering has been observed in some preterm infants in the NICU and in the postdischarge period if they receive exclusive human milk feedings without nutrient and caloric fortification.[4,6–10] Of concern, evidence also suggests that such a nutritional deficit may adversely affect the head circumference,[7,10,11] a finding that is associated with poorer neurodevelopmental outcomes.[11,12] In addition, these infants are at risk for developing metabolic bone disease osteopenia or even rickets.[7,10,13]

Unfortunately, there are few systematic studies on the impact of postdischarge fortification for preterm infants.[8–11,13,14] A 2011 Cochrane review of published studies stated that there is not enough evidence to conclude that fortification improves infant growth.[15] In addition, studies suggest that overly rapid early growth may be detrimental for NICU graduates, increasing the risk of long-term health problems such as obesity, diabetes, heart disease, and metabolic syndrome.[16]

As such, the following guidelines are a consensus of best practices that include recommendations for monitoring and providing optimal nutritional support for preterm infants after they are discharged from the hospital. This protocol addresses the care of preterm infants born at a gestational age less than 34 weeks who are discharged home after a stay in the NICU. The American Academy of Pediatrics has recommended that preterm infants be discharged after achieving three physiologic competencies: oral feeding sufficient to support appropriate growth, the ability to maintain normal body temperature in a home environment, and sufficiently mature respiratory control.[17] These competencies are achieved by most preterm infants at a postmenstrual age (PMA) between 36 and 37 weeks, but may take longer. This protocol does not distinguish infants born appropriate for gestational age from small for gestational age, but bases decisions on current nutritional status and body weight. Quality of evidence [levels of evidence IA, IB, IIA, IIB, III, and IV] is based on levels of evidence used for the National Guidelines Clearing House and is noted in parentheses.[18]

General Strategies

A. The goal of the discharge feeding plan recommendations for preterm infants is to enable the mother to exclusively breastfeed or provide as much human milk as possible while protecting and supporting the mothers' decisions. Specific recommendations on supporting breastfeeding in mothers of premature infants are given in the Support for Breastfeeding Mothers of Premature Infants section.

B. In addition, the feeding plan should correct deficits that arose during the NICU stay and minimize further nutrient deficits after discharge. As the nutritional status of preterm infants varies widely, creating individualized feeding plans is the best approach.

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Table 1. Biochemical and Growth Monitoring for Premature Infants in the Postdischarge Period

Parameters	*Goal*	*Action values*
A. Growth		
1. Weight gain	20 g/day	<15 g/day
2. Length increase	0.5–0.8 cm/week	<0.5 cm/week
3. Head circumference increase[a]	0.5–0.8 cm/week	<0.5 cm/week or >1 cm/week
4. Weight/length		>85%[c]
B. Biochemical markers		
1. Alkaline phosphatase[b]	<450 IU/L	>500 IU/L
2. Blood urea nitrogen	>10 mg/dL	<8 mg/dL
3. Phosphorus	>5 mg/dL	<5 mg/dL
4. Vitamin D level	>30 ng/mL	<25 ng/mL
5. Hemoglobin	>11.5 g/dL	<11 g/dL

Modified from Hall[44] and Schanler[45]
Conversion factors for biochemical markers:
1. Milligrams/deciliter (mg/dL) to millimoles/liter—divide by 18.
2. Nanograms/milliliter (ng/mL) to nanomoles/liter—multiply by 2.5 (i.e., 1 ng/mL = 2.5 nmol/L).
3. International units to micrograms—divide by 40.
[a]Changes in head circumference require cranial imaging, such as a cranial ultrasound.
[b]High alkaline phosphatase levels may indicate a need for bone imaging, such as a bone x-ray.
[c]This is an indication of overnutrition and a cue to stop supplementation.

C. All preterm infants should be routinely supplemented with iron, 2–4 mg/kg/day.[19] Vitamin D supplementation of 400 IU per day is recommended by the American Academy of Pediatrics,[20] while 800–1,000 IU/day is recommended by the European Society for Paediatric Gastroenterology Hepatology and Nutrition.[20] Higher doses of iron are recommended, up to 5 mg/kg/day, if hemoglobin is <11 g/dL (Table 1), and higher doses of vitamin D, up to 1,000 IU/day, are recommended in infants with evidence of metabolic bone disease, with an alkaline phosphatase >500[21] (IIA).

D. Enriched formula or human milk fortifier is used when fortification is necessary because it provides greater nutrient intake than human milk alone or term infant formula. Although the current published studies on postdischarge supplementation utilized human milk fortifiers,[8,9,11,14] fortifiers are usually not given at home due to lack of availability and expense. The new liquid human milk fortifiers derived from human milk can be tailored more and could potentially be useful in this population; however, they are not readily available and are very expensive. Therefore, enriched formula mixed with expressed human milk generally is a more practical plan to provide fortification in the postdischarge period (IIA).

Predischarge Feeding Assessment

Before the actual day of discharge, a general plan for feeding at home should be developed. Rooming-in by the

Table 2. Assessment of Breastfeeding Adequacy and Troubleshooting Problems

Parameter of adequacy	*Suggestions*
1. Latch and milk transfer	Assess for a proper latch and for evidence of infant swallowing and improve as necessary.
2. Volume of milk production	(a) If the supply is low, interventions may be necessary to increase milk volume. (b) If baby is not adequately draining the breast, recommend expressing milk after feeding and/or triple feeding to augment or maintain the mother's milk supply. Triple feeding is a three-step process in which the mother breastfeeds, supplements with expressed breast milk, and pumps to remove any remaining milk. Triple feeding or pumping after every feeding requires careful follow-up as it is difficult to sustain for many mothers, especially during the night. (c) Consider the use of galactogogues.[46] (d) If the frequency of feeds at the breast is too low, the infant may be a sleepy preemie who requires to be woken more often or that the mother may be missing subtle feeding cues and not putting the baby to the breast enough.
3. Optimize any breastfeeding that is occurring	(a) Instruct the mother to massage the breast and express some milk to begin letdown before the infant begins the feed. (b) Instruct the mother to massage the breast and employ breast compression during the feeding to increase the fat composition and volume of milk consumed.[47,48]
4. Volume of milk intake	(a) Nipple shields: Conflicting data report improved milk transfer[41] and, more recently, an association with decreased exclusive breastfeeding.[42,43] A mother who is discharged using a nipple shield should be monitored closely by a trained lactation professional and its use should be discontinued as soon as possible due to the risk of decreased supply, insufficient emptying, and other breastfeeding problems[49] (IIB). (b) Nursing supplementer/feeding tube device while at the breast. (c) Some have used a nipple shield and nursing supplementer together effectively (IV).
5. Weight gain	Consider pre- and postfeeding test weights after some breastfeeds to assess the quantity of milk transferred.[35] Infants are weighed immediately before the feed on an electronic scale, with accuracy at minimum of ±5 g, and then reweighed immediately after the feed under the exact same circumstances, including the same diaper.

mother for a few days before discharge during this transition period is strongly recommended[17] (IV). Feeding plans should reflect shared decision-making by the mother, the infant's clinician, and any others involved in feeding support (nursing, lactation consultant, and dietitian). Appropriate plans may include exclusive breastfeeding, breastfeeding combined with expressed human milk (fortification may be necessary) or formula, or a combination of all. This shared decision must consider parental perceptions and preferences, which address work and family needs, as maternal satisfaction can increase breastfeeding duration.[22] Whenever unfortified human milk is stated in this protocol, it includes breastfeeding and/or the feeding of expressed human milk.

Assessment of the following parameters should be considered when making discharge feeding plans (IV).

A. Current nutrition
   1. Diet: unfortified human milk, fortified human milk, formula, or a combination
   2. Milk intake (mL/kg/day) should be assessed, if not at or close to ad libitum on demand with adequate weight gain
   3. Oral (breastfeeding, bottle, cup, nursing supplementer [also known as supplemental nursing system], or other method).

Note: there are some facilities that supplement discharged breastfeeding preterm infants with tube feedings and report improved breastfeeding rates.[23–25]

B. Nutritional assessment: optimal versus suboptimal. Parameters for growth and biochemical measures are listed in Table 1.
   1. Optimal (includes ALL the following)
      (a) Infant can feed orally, minimally 160 mL/kg/day (or growing well on exclusive breastfeeding at the breast).
      (b) In-hospital growth is normal or improving as per daily rate of weight gain and weekly rate of length and head circumference gain is calculated and/or plotted on appropriate growth charts (Table 1).
      (c) Biochemical measures of nutritional status are normal or normalizing and not indicative of ongoing protein or mineral insufficiency (Table 1).
   2. Suboptimal (includes ANY one or more of the following)
      (a) Infant's intake is <160 mL/kg/day.
      (b) Growth is less than adequate as per growth standards (Table 1).
      (c) Biochemical measures of nutritional status are abnormal, not normalizing, and are indicative of ongoing protein or mineral insufficiency (Table 1).

Discharge Feeding Plan (IV)

A. For infants with optimal assessment
   1. If the infant has been receiving fortified human milk, consider the following two options and ensure that the follow-up clinician understands the rationale for the approach prescribed:
      (a) Option 1: Change the diet to unfortified human milk, ad libitum about 1 week before discharge.
         (1) Monitor growth and milk intake (if not exclusively breastfeeding) during these days.
         (2) If intake and growth are adequate, continue this diet after discharge.
      (b) Option 2: If discharge follow-up can be arranged to assess the infant quickly (within a day or 2) and repeatedly, consider changing the diet to unfortified human milk ad libitum any time before discharge (without the need to monitor in the hospital for 1 week), and monitor growth and milk intake (if not exclusively breastfeeding) carefully after discharge.
   2. If the infant has been receiving unfortified human milk, continue this diet after discharge.

B. For infants with suboptimal assessment
   1. If the infant has been receiving fortified human milk, consider the following three options and ensure that the follow-up clinician understands the rationale for the approach prescribed:
      (a) Option 1: Change to unfortified human milk for most feedings, but add three feedings a day of preterm discharge formula prepared as per manufacturer's instructions (22 kcal/30 mL)[26] or one feeding of a 30-kcal/30 mL calorie formula per day (Table 3). This option allows for breastfeeding at the breast except for the formula feeds. It is important for mothers to express milk when the infant is receiving these feedings to maintain her milk supply.
      (b) Option 2: Add powdered preterm discharge formula to expressed human milk feedings to enrich it to 22 kcal/30 mL[27] (Table 3). This option will provide human milk with each feeding.
      (c) Option 3: Change to breastfeeding at the breast for all feedings while supplementing with 15 mL of preterm discharge formula (22 kcal/30 mL) for all feeds using a nursing supplementer (Table 3). This option will allow a baby to breastfeed at the breast for all feedings. Mothers should consider expressing milk after feedings if there is a concern that the infant is not adequately emptying the breast.
      (d) Nutritional information for the three options is given in Table 4.
      (e) For some mothers, a combination of different options may be preferable and more sustainable. For example, another caregiver gives one to two feedings of preterm discharge formula, then the mother breastfeeds with a nursing supplementer for most feedings, while breastfeeding without a supplementer for one to two of the feedings.
      (f) Assess adequacy of breastfeeding and address problems or potential problems. Optimize any breastfeeding that is occurring and consider the use of feeding devices to improve the volume of intake (Table 2).
      (g) Initiate these changes at least 1 week before anticipated discharge and monitor milk intake and growth during this week. If intake and growth are adequate during this week after changing the feeding plan, continue this diet after discharge.
      (h) If intake and growth continue to be suboptimal after 1 week, enhance fortification as per Table 3.

Table 3. Three Options for Fortification of Human Milk

Option	*Initial fortification*	*Enhanced fortification*
1: Some formula feeds	Unfortified human milk for most feedings, with three feedings per day of preterm discharge formula (22 kcal/30 mL) or one feeding of a 30-calorie formula per day.	Increase the number of feedings a day of preterm discharge formula and/or increase formula concentration to 24 kcal/30 mL or higher.
2: Enriching feeds	Add powdered preterm discharge formula to expressed human milk feedings to enrich it to 22 kcal/30 mL.	Increase the amount of powdered preterm discharge formula added to expressed human milk to enrich it to 24 kcal/30 mL or higher.
3. Nursing supplementer	Change to breastfeeding at the breast for all feedings while supplementing with 15 mL of preterm discharge formula (22 kcal/30 mL) in all feeds using a nursing supplementer.	Increase the amount of preterm discharge formula given through the nursing supplementer during breastfeeding.

For each option, start with initial fortification. If the infant does not improve, enhance the fortification.
We recommend an unfortified human milk diet for infants with an optimal nutritional assessment.

2. If the infant has been receiving unfortified human milk at the breast and/or by another feeding method, consider the following:
   (a) Assess the adequacy of breastfeeding, address problems or potential problems, optimize any breastfeeding that is occurring, and consider the use of feeding devices to improve the volume of intake (Table 2).
   (b) If addressing any existing breastfeeding problems does not result in optimal assessment, start fortification (Table 3). Initiate this at least 1 week before anticipated discharge and monitor milk intake and growth during this week.
   (c) If intake and growth are adequate during this week after changing the feeding plan, continue this diet after discharge.
   (d) If intake and growth continue to be suboptimal after 1 week, increase fortification (Table 3).
3. Special situation: An infant with chronic lung disease, especially on oxygen, will likely require fortification.[28]

Postdischarge Assessment (IV)

A. Nutrition monitoring as early as possible, preferably within 72 hours.[29] Again, ensure that the follow-up clinician understands the rationale for the approach prescribed.

1. Assess intake
   (a) Take a detailed feeding history on what the mother has been feeding her infant since discharge, including details on providing expressed human milk versus direct breastfeeding, a full pumping history, and the use of fortified human milk or formula. Ask the mother how she is coping with caring for the infant and discuss revising the feeding plan if it is not sustainable. Consider screening for postpartum depression as bringing a preterm infant home may be a difficult time for mothers.[30]
   (b) Measure weight, length, and head circumference. Length should be measured with a stadiometer. These growth data should be plotted on appropriate growth curves, preferably the new INTERGROWTH-21st Postnatal Growth of Preterm Infants Charts,[31–33] until 64 weeks' PMA. Other acceptable growth charts are the Fenton Preterm Infant Growth Charts[30] and the Olsen Intrauterine Growth Curves[34] until 50 weeks' PMA. After 64 or 50 weeks, use the World Health Organization (WHO) growth charts.
   (c) Observation of a feeding.

Table 4. Comparisons of Nutritional Intake for Selected Nutrients (per kg/day) Based on Total Daily Volume of 180 mL/kg/day

Feeding type	*Calories, kcal/kg/day*	*Protein, g/kg/day*	*Ca, mg/kg/day*	*Ph, mg/kg/day*
HM[50]	126	1.9	58	25
Option 1: HM +3 feedings/day of 22 kcal/30 mL preterm discharge formula[50,51]	129	2.6	89	47
Option 1: HM +1 feed a day of 30 kcal/30 mL preterm formula[50,52]	133	2.3	91	45
Option 2: HM enriched to 22 kcal/30 mL with preterm discharge formula[53]	132	2.3	67	34
Option 2: HM Enriched to 24 kcal/30 mL with preterm discharge formula[54]	144	2.6	78	42
Option 3: Breastfeeding +15 mL of 22 kcal/30 mL preterm discharge formula in all feeds using a nursing supplementer[50,51]	128	2.5	85	45

Calculations assume a volume of 180 mL/kg/day and 8 equal feeds a day. The option 3 calculation is based on a 2-kg infant.
HM, human milk.

(d) Consider test weighing to assess the quantity of milk transferred.[35]

2. Infants with adequate growth should be followed at 1 month following discharge.
3. For infants with inadequate growth since discharge (Table 1), consider the following:
   (a) Assess the adequacy of breastfeeding, address problems or potential problems, optimize any breastfeeding that is occurring, and consider the use of feeding devices to improve the volume of intake (Table 2).
   (b) If addressing any existing breastfeeding problems does not improve growth, increase fortification (Table 3).
   (c) Weekly follow-up until the infant has demonstrated appropriate growth on the feeding plan (Table 1).

B. Nutrition monitoring 1 month after discharge
1. Assess intake by following the same protocol as the first postpartum visit.
2. Draw laboratories and assess growth and biochemical measures of nutritional status (Table 1).
3. For infants with a suboptimal assessment in growth or biochemical measures, consider the following:
   (a) Assess and address breastfeeding problems or potential problems, optimize any breastfeeding that is occurring, and consider the use of feeding devices to improve the volume of intake (Table 2).
   (b) Consider starting or increasing fortification (Table 3).
   (c) Weekly follow-up until the infant has demonstrated appropriate growth on the feeding plan.

C. Frequency of nutrition monitoring

For all preterm infants, growth monitoring is recommended every month[25] until 6 months' corrected age, then every 2 months till 1 year. Biochemical markers should be followed 1 month after discharge and at 4 months' corrected age. Infants with abnormal laboratories may require more frequent monitoring.

D. How long to continue the use of enriched formula
1. Randomized trials showing benefits of fortification discontinued supplementation at 3 months[7,9] (1B). At a minimum, enriched formula supplementation should be continued until nutritional monitoring on the fortified diet has been adequate for several months.
2. In addition, it is important to prevent overnutrition. If the infant's growth is rapidly increasing such that the weight/length percentile is >85% (Table 1), revise dietary supplementation.

E. When to start complementary feeds

Most experts recommend starting complementary feedings at ~6 months' corrected age.

Support for Breastfeeding Mothers of Premature Infants

Both pre- and postdischarge

A. Optimal feeding, for preterm as well as term infants, is exclusive breastfeeding at the breast. With appropriate support, this goal is attainable for most premature infants.

B. Sustained suckling with swallowing for 5 minutes is one indicator that the infant may be ready to transition from the nasogastric tube to breastfeeding[36,37] (IB). Other studies suggest that early introduction of oral feeding hastens the development of oral motor skills[38–40] (IB). Nursing supplementers may provide additional volume.[38]

C. Monitor mothers for nipple soreness. If present, this may be an indication of a shallow latch. Temporary use of silicone nipple shields can be a helpful adjunct for milk transfer and more efficient latch-on for preterm infants with shallow latch,[41] although studies report an association with decreased exclusive breastfeeding[42,43] (IIB).

D. Refer and coordinate care, such as providing a written discharge summary for the parents and primary care physician that includes detailed nutrition support recommendations, community support referrals, visiting nurse, skilled lactation consultant visits, and social services.

E. Ideally, all mothers discharged from the NICU with a breastfeeding or human milk feeding infant should have follow-up examinations with a trained, skilled lactation professional within 2 to 3 days after discharge for ongoing support and troubleshooting.

Recommendations for Future Research

1. A survey of neonatologists and NICU dieticians is necessary to understand the global heterogeneity of fortification plans and breastfeeding postdischarge.
2. Comparative effectiveness studies of the different postdischarge feeding regimens are needed. We do acknowledge that the challenge in compiling and following growth parameters for at least 6 months using various protocols will be arduous and expensive.
3. Data on growth and follow-up of IUGR preterm infants need to be evaluated separately to measure the effectiveness of feeding regimens in this special subset of preterm infants.
4. QI evaluations are needed to determine the effectiveness of patient discharge instructions and communication to the outpatient follow-up team.

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ABM protocols expire 5 years from the date of publication.

The content of this protocol is up-to-date at the time of publication. Evidence-based revisions are made within 5 years or sooner if there are significant changes in the evidence.

The 2004 edition of this protocol was authored by Lori Feldman-Winter and Richard Schanler.

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