Breastfeeding Support Devices in Low-Resource Settings

Beverly Ann Curtis and Margaret Nakakeeto-Kijjambu

Abbreviations

CRCT	Creamatocrit
NG	Nasogastric
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

1 Case I Example

Baby boy Adroa was born at 36 weeks' gestation after spontaneous labor. His birth weight is 5 lb. 2 oz (2268 gm). You observe him with his mother on the lying-in ward in Uganda at the first feeding. You notice that Adroa is having difficulty latching. He roots for the breast but cannot seem to achieve a deep latch and suck and it is painful for the mother. His mother states concern that he does "not want to breastfeed." She wonders aloud if "he likes it and how come it hurts?" How can you help Adroa's mother to understand the baby's behavior and to initiate successful breastfeeding?

B. A. Curtis (✉)
Keystone Pediatrics, Chambersburg, PA, USA

M. Nakakeeto-Kijjambu
Ministry of Health and Government Consultant on Neonatal Health Care, Kampala, Uganda

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2 Introduction

Exclusive breastfeeding (breast milk) is recommended for the first 6 months of life and has significant benefits for infants and mothers. Breastfeeding reduces morbidity and mortality. Breast milk is the best nutrition to improve growth and provide protection against disease. Infants that do not breastfeed, or only partially breastfeed, have a higher risk of mortality due to gastrointestinal infections and other infections. Breastfeeding can be lifesaving, especially in low-resource settings, where sanitation and safe water are often not available [1–3].

Early breastfeeding can also be lifesaving for mothers. It helps prevent maternal bleeding by causing the uterus to contract. It also assists in mother-infant bonding and promotes successful and exclusive breastfeeding by establishing a breast milk supply that meets the infant's needs for nutrition and growth [1, 4, 5].

The World Health Organization (WHO) and UNICEF recommend early initiation of breastfeeding within 1 hour of birth. Exclusively breastfeeding infants for the first 6 months of life allow them to achieve optimal growth, development, and health. After 6 months, infants should receive safe and nutritious foods to meet their evolving nutritional requirements while continuing to breastfeed for up to 2 years or longer [1, 2, 5].

This chapter focuses on some adaptations useful in low-resource areas but is not meant to be a comprehensive review of feeding or breastfeeding. For details on how and when to feed premature and sick neonates, consult additional references such as these [6–8].

3 Breastfeeding Basics

In this chapter, first we will discuss breastfeeding the full-term well infant including positioning for feeding, latching the infant, assessment of milk transfer, and methods to build and maintain milk production.

3.1 Procedure for Feeding the Well Newborn

For full-term or well infants, encourage the first feeding within the first hour of life with skin-to-skin care. If after the first hour the infant is sleepy, wake the infant to feed.

- Teach the mother to stimulate the rooting reflex by having the baby face her and resting the nipple on the infant's top lip under the nose. The infant should open wide and can be moved onto the breast.
- Tap the infant's heels, softly touch their feet, rub their back, or have the mother talk softly to help wake them up.

- Remove the infant's clothing to increase skin-to-skin contact, keeping the diaper in place: this helps wake the baby. Cover the infant's back with a blanket.

Rationale

- *Colostrum (the first milk) is low in fat and high in sugars (carbohydrates). This helps prevent hypoglycemia of the infant because it is easy and quick to digest.*
- *Colostrum is high in antibodies and helps protect the infant from infection.*
- *Early and frequent breast stimulation helps to establish a substantial milk supply that supports continued breastfeeding success.*
- *Skin-to-skin contact improves parent-infant bonding and infant feeding by decreasing newborn stress and increasing milk production. This is important in both the first hour of life and the first few weeks of life.*
- *Skin-to-skin contact stimulates the infant's hunger response. Skin-to-skin contact helps control the infant's temperature and vital sign stability.*

3.1.1 Positioning

Help the mother hold the infant's body close to her body with the infant's nose in the sniffing position with the head slightly tilted up and chin touching mother's breast. The ear, shoulder, and hip should be in line. The infant's feet should be tucked in close to the mother. This technique (Fig. 1) is used no matter how the mother holds the baby for feeding.

Common positions that work well for small infants:

1. Cross-cradle hold: The mother supports infant's body on its side so that the front of the infant's body is touching the front of the mother's body. Her arm or hand guides the infant's mouth toward the nipple, while the opposite hand holds her breast.
2. Under-the-arm hold: The infant is placed on its side, tucked under the arm on the side of the mother's body, with the infant's neck and shoulders supported by the mother's hand (same side). The mother's opposite hand is holding her breast.

Rationale

- This body position for the infant leads to successful breastfeeding, breathing, and attachment (latch).
- Head tilt in a sniffing position places the chin close to the breast tissue for good attachment. This position also prevents aspiration (milk from going into the lungs) by proper positioning of the head and neck [9].
- Small infants have weak neck muscles and large heads compared to their body size. If their head and shoulders are not supported, they will have difficulty staying attached.

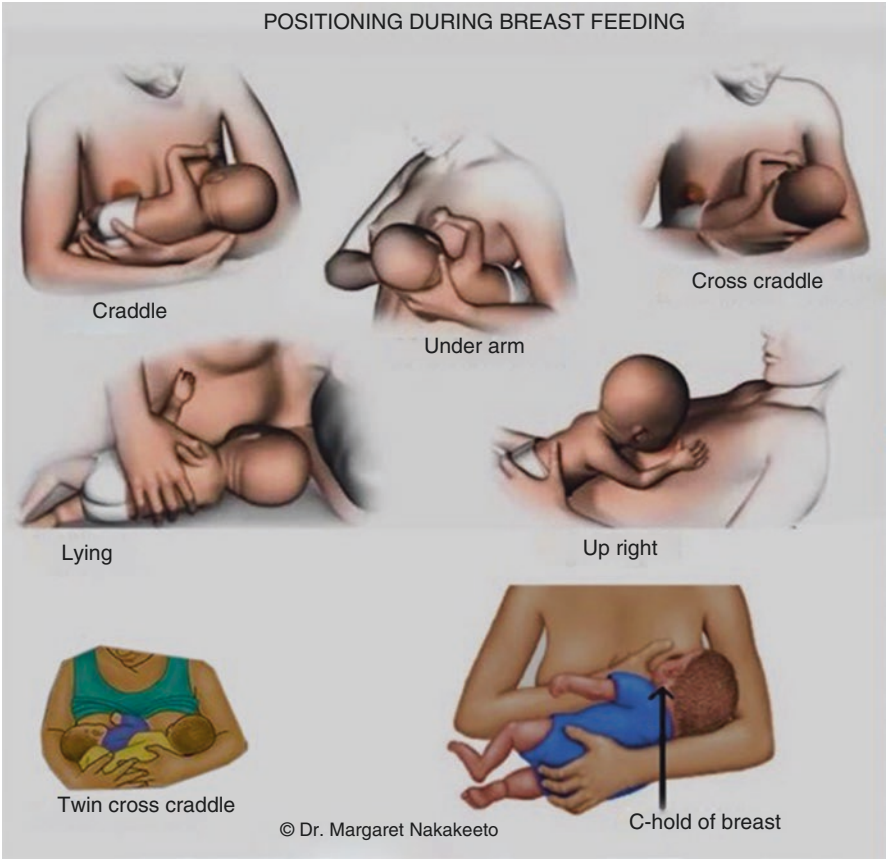


Fig. 1 Positioning during breastfeeding

3.1.2 Methods for Latching

Proper positioning and strong attachment of the infant to the breast is called a "latch" (Fig. 2). The following video from Global Health Media may also be helpful "Attaching your baby at the breast": https://globalhealthmedia.org/portfolio-items/attaching-your-baby-at-the-breast/ [10]:

1. Shape the breast: Teach the mother to shape her breast with her hand, by lightly compressing the breast. The mother's hand should be in the shape of a letter C (Fig. 1).
   - Depending upon the position of the infant's mouth, the mother's hand may need to be rotated so her thumb is in line with the infant's upper lip. Her fingers and thumb should be about 5 cm away from the nipple.
   - When compressed, the oval shape of the breast should match the oval shape of the infant's mouth.
   - Once attached, the mother should *not* release this hold, but continue to compress the breast into this shape during the feeding.

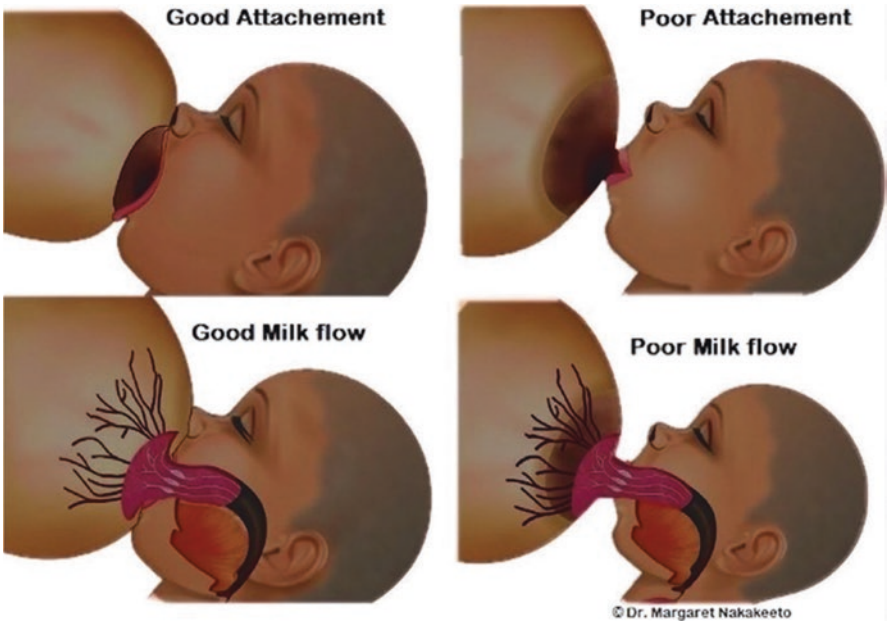


Fig. 2 Breastfeeding latch and attachment

Rationale

- Shaping the breast helps the infant to attach onto the areola rather than just the nipple (Fig. 2). Continuing to hold the breast with compression helps the milk to be expressed and helps the infant stay properly attached.

2. Encourage milk flow: Ask the mother to express a drop of milk, if possible, and rest her nipple gently on the infant's upper lip.

Rationale

- The smell of milk triggers the infant's hunger. This encourages the flow of milk.

3. Establish the latch: When the infant begins to root, and their mouth is wide open, pull the infant onto the breast, with their chin and lower jaw coming into the breast first.
    - The chin and lower jaw should be touching the mother's breast with the entire nipple in the mouth.
    - When the infant is properly positioned at the breast, more of the mother's areola (dark part around the nipple) should be visible above the infant's mouth than below.

- The infant's head should be tilted slightly back, so there is a small space between the infant's chin and chest (Fig. 1). This facilitates good jaw movement for milk transfer.
- The entire nipple should be in the infant's mouth along with as much of the areola as possible.

Rationale
- Proper positioning is necessary for a successful latch and the ability of the infant to remove milk from the breast when sucking.
- Attaching only to the nipple (and not the areola) can cause blistering, breakdown of the skin, and discomfort.
- Maintaining a space between the infant's chin and chest helps to align internal oral anatomy to best protect the infant from milk going into their lungs.
- This position aligns the tongue under the breast tissue.

4. Evaluate comfort: Talk with the mother about any concerns she may have with breastfeeding pain:
    - If attachment is causing pain, break infant's seal by placing a clean finger in between the corner of the infant's mouth and breast tissue. Attempt to reattach (Fig. 2).

Rationale
- Initiation of breastfeeding can be painful if positioning and latching are not appropriately done. It is important to address these problems early to prevent the mother from wanting to stop breastfeeding.
- Ensuring a proper latch will decrease pain.
- Pain may indicate a shallow attachment and need for repositioning.
- Shallow attachment can lead to mother's skin breaking and/or sores on the nipple.

3.1.3 Assessing and Teaching Milk Transfer

Look at the infant's neck to visualize suckling and swallowing; swallow sounds may be heard as well. Watch for movement of the lower jaw. The infant will often start out with fast sucks at the beginning of the feeding. Once the milk is flowing, the infant will change to slow, rhythmic sucking with swallowing and brief pauses to breathe.

- Preterm or small infants may have problems coordinating sucking, swallowing, and breathing. Care must be taken to monitor for choking or apnea with feeding. The breastfeeding should be discontinued if this happens.

- Preterm infants may look like they are sucking but are not able to remove much milk from the breast. The muscles of their mouth and cheeks are not as strong and they are not able to draw out as much milk as term babies.

Rationale
- The lower jaw compresses the underlying milk ducts of the breast, while the lips create a seal around the areola.
- Fast suckling helps the mother's hormones to signal the milk to start flowing.
- Slower, dynamic, rhythmic suckling sustained with a suck, swallow, pause pattern along with breathing is "nutritive" suckling, meaning the infant is taking in more milk.
- For preterm or small infants, sucking is often a reflex. This means they will continue to suck but they are not swallowing the milk (milk will spill from the sides of the mouth or the infant will cough or choke) and do not breathe (observed by not seeing the chest rise, followed by a gasping breath). Both put the infant at risk for aspiration of milk into the lungs.
- Preterm or small infants have weaker muscles and get tired easier than term infants.
- Small infants have smaller mouths and can have difficulty attaching to the areola. Fat pads on the inside of an infant's mouth help to create an airtight attachment, helping to draw out milk.

3.1.4 Feeding Frequency and Cues

- Neonates should be fed about every 2–3 hours or 8–12 times a day [11, 12].
- Breastfeed until the infant is satisfied, usually 10–15 minutes on each breast.
- In the first weeks, if the infant is sleepy, wake them to feed every 3 hours if they are not waking on their own.
- Breastfeed the infant when there are signs of hunger: active and awake, mouthing, or rooting. Crying is a late sign of hunger.

3.2 Common Breastfeeding Problems

While breastfeeding in general goes well, there are some common problems associated with breastfeeding. Table 1 provides an overview of some issues with some specific adaptations for low-resource settings. Inverted nipples can also be an impediment to the implementation of feeding at the breast. Table 2 provides options for treatment.

Table 1 Interventions for common breastfeeding problems

	Procedure	Rationale
Decreased milk supply	Ask the mother how frequently she is breastfeeding or hand expressing her milk At least eight times in a day and night cycle? Encourage the mother to not let the infant sleep longer than a 3-hour period, particularly in the first 2 weeks to 1 month after delivery	The body makes more milk only after the milk in the breast is removed The first month is the most important time to establish a full milk supply for breastfeeding
Pain with breastfeeding – latch	Ask permission to observe the mother breastfeeding and help determine if the infant is attached correctly Is she experiencing pain? Do her breasts feel "full" after the infant has nursed? *Nipple pain video provides more helpful information: Nipple Pain* https://globalhealthmedia.org/portfolio-items/nipple-pain/?portfolioCats=191%2C94%2C13%2C23%2C65 [13]	Improper attachment can lead to decreased milk supply because the infant is not able to empty the breast. This signals the mother's body to make less milk Shallow attachment can cause skin breakdown and blisters. These can lead to infection and make it difficult to remove milk completely from the breast
General maternal breast pain	Ask the mother if her breasts stay full after the infant nurses. Can she feel lumps? Is she experiencing pain in her breast tissue? Teach her to gently massage lumps in breast tissue prior to and during breastfeeding Applying pressure on the lump while the infant is breastfeeding or while she is hand expressing can help the milk to start flowing Apply warm compresses prior to expression and cold compresses to help decrease the swelling following expression of the milk If the mother has a fever, red streaking on her breast tissue, and/or extreme tenderness and pain in her breast tissue, she may have an infection Help her try to express the milk that is clogged, provide comfort measures of cold and hot compresses, and if possible, direct her to be seen by her doctor, as these are signs of infection and she may need treatment	If the mother has full breasts and/or lumps in the breast tissue that are causing her pain, the milk is most likely stuck due to clogged ducts If the milk is not able to be excreted, this signals to the body to make less milk Milk that remains stuck in the breast can lead to an infection of the breast tissue called mastitis Early symptoms are red streaking of the breast tissue, fever, and pain. Antibiotics may be required. It is safe and encouraged to continue to breastfeed

Sources: [5, 9, 11, 14, 15]

3.2.1 Breastfeeding Tips and Pearls

- Begin establishing a milk supply within an hour after birth, with frequent stimulation of the breast by breastfeeding the infant and/or hand expression. Emptying the breasts of milk is important, as this tells the mother's body to make more milk [11, 12].
- Breastfed infants usually nurse every 2–3 hours or 8–12 times a day [11, 12]. Proper positioning and appropriate latch are required for the infant to transfer milk, gain weight, and the mother to build and maintain a milk supply.

Table 2 Inverted nipples

	Procedure	Rationale
1.	Teach the mother to massage her breast, then pinch, and roll fingers directly on nipple When attempting to get the infant to attach, it is especially important for the mother to compress her breast, hold her hand in a "C" shape, and keep her fingers and thumb 5 cm from the nipple	To encourage the nipple to extend out Shaping the breast will help the infant achieve a deeper attachment and hopefully pull the nipple out
2.	Teach the mother to hand express for 5 minutes prior to breastfeeding to start milk flow and help her nipple to come out	Starting the flow of breast milk by hand expression will encourage the milk to flow and draw the nipple out
3.	If other methods do not work, then use a syringe to help pull the nipple out (Fig. 3) Remove the plunger Cut the end off with the tip Place the plunger in the end where the tip was cut off Place the opposite end of the syringe over the nipple Gently pull back on the syringe, using suction to revert the nipple	Back pressure of the syringe will create a suction that may pull the nipple out. Be aware that this may be painful and can cause skin breakdown

Sources: [9, 14]

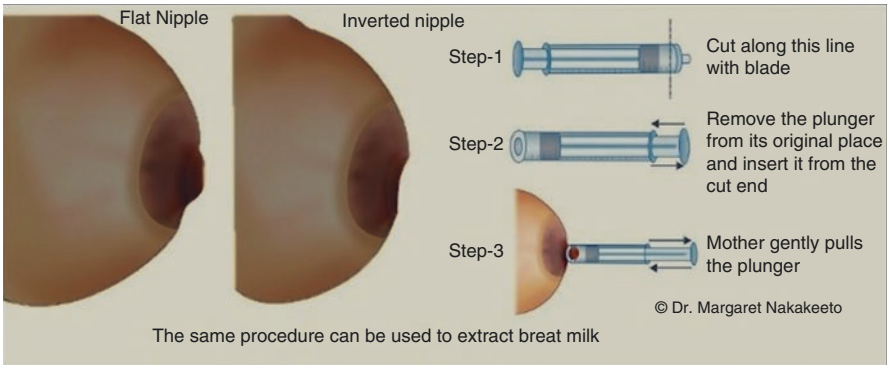


Fig. 3 Inverted nipples

- Assist mothers in hand expression if the infant does not breastfeed well in the first 6 hours of life, to help signal her body to produce milk [2, 3, 14].
- Teach mothers that expected volumes of milk start at drops to milliliters on the first 3 days after birth. Milk comes "in," meaning around 20 ml expressed, on days 3–5. On days 5–14, supply should continue to increase to around 750 ml by day 14. Between 4 and 6 weeks, milk supply is established [2, 11, 12].
- Wake infants, especially those born early, every 3 hours for feeding. They should not sleep longer than 4 hours between feedings [11, 14, 15].
- Making breast milk requires extra energy from the mother. Counsel the mother to eat healthy foods, drink enough water, and rest as much as possible between feedings [5, 12].

- Counsel the mother to drink enough fluids to satisfy her thirst. The amount of hydration depends on the environment and the person. Ten cups a day is a healthy volume [2, 14, 15].
- Have fluids available to the mother while she is breastfeeding. It is common for mothers to experience thirst at onset of let-down, and extra fluids will help the milk flow [12].
- Encourage the mother to leave her breasts open to air and light when possible. This helps to keep the nipples dry, helping to prevent irritation and potential infection [2, 5, 15].
- Nursing pads or cloths can be worn to catch leaking breast milk. These should be changed often. Nipple infections may occur from contact with dried milk on clothes and pads [5, 7, 14].
- A comfortable bra without underwire can be helpful for support if available to the mother [5, 8, 14].

3.3 Case I Resolution

The mother was instructed on how to wake the baby for feedings. She was instructed on the use of the cross-cradle hold ensuring she could move the baby onto the breast and utilize breast compression to assist the baby with transfer of milk. The mother was instructed on how to assess appropriate latch by observing the baby opening wide and moving onto the breast using an asymmetric latch with the chin into the breast and nose with a minimal space away from the breast. She was instructed not to press down on the breast to make an airway as this will cause stress on the nipple creating nipple soreness. With appropriate positioning, with the baby's chin in and nose tilted away from the breast, a sufficient airway was obtained allowing the chin to move freely for better milk expression. The mother was instructed to observe the baby's mouth open at an angle of 160 degrees or more during breastfeeding sessions, ensuring a deep latch. Mother observed the baby with a sustained suck, swallow, pause pattern with six to eight suckles in a row and a pause repeating the pattern for 20 minutes. The mother did not experience nipple pain during latch or with sustained suckle.

3.4 Case Example 2

Malechi born at 37 weeks to a G1P1 O+ mother. Antenatal course was uncomplicated until mother went in to labor 3 weeks prior to her due date. Infant at delivery required brief stimulation and then was stable for the neonatal hospital course. Mother breastfed on demand in the hospital after initial skin-to-skin care. Now mother and baby have been home for 2 weeks, and mother presents to your nearby neighborhood clinic for baby's first exam after a community peer support person

thought the baby was not having enough wet diapers and stools. The mother is concerned because he is still very sleepy with feeding and having difficulty waking up. He also cries with gas pains. BW was 2600 grams (5# 12 ounces) and today's weight at 14 days of life is 2500 grams (5 # 8 ounces), 4.3% below BW on day 14 of life. In observing the baby's feeding, you see a baby who is poorly positioned at the breast, latched to the tip of the nipple, very sleepy, and a maternal breast that is soft prior to feedings.

3.5 Building and Maintaining Milk Supply

Some infants may not be able to breastfeed 8 to 12 times in a 24-hour period due to (1) immaturity (lack of coordination, strength, and alertness, (2) respiratory distress, or (3) other medical issues. In such situations, one of the options for the mother is hand expression. Table 3 walks through the process of how to hand express. And delivery of the milk can be via alternative methods including NG tube (Fig. 6), or if

Table 3 Steps and recommendations for hand expression

	Procedure	Rationale
1.	Have the mother wash her hands and breasts with warm water	Hand expression should be performed as a clean procedure to prevent infection
2.	Instruct her to massage her breast tissue in an inward motion toward the nipple (see Fig. 3), like the spokes of a bike	Massaging prior to and during hand expression helps the milk to flow out of the groups of alveoli (also called lobules) down and the ducts (Fig. 4) Helps soften the breast tissue when engorged or full
3.	Teach the mother to hold her breast with a "C"-shaped hand. Her fingers and thumb are placed toward the edge of her areola, about two finger widths from the nipple. Instruct her to: Press her fingers and hand into her breast (toward her chest wall) Then move her fingers toward her thumb. Hold for a few seconds Every minute, massage entire breast (Fig. 4) and repeat "C" hold and continue massage in a downward motion Repeat this motion several times. Milk will not always appear with first to start milk flow	Milk is produced by lactocytes and stored in the alveolus. These are located deep in the breast tissue (Fig. 5). By pressing into her breast tissue, the alveoli empty down into the ducts to be expressed It will take at least two cycles before milk starts to flow down through the ducts from the alveoli Mothers may need encouragement to continue in order to see milk flow Changing hand position on the breast will help to empty ducts in different areas of the breast tissue
4.	Instruct the mother to express for 15 minutes on each breast – even if no breast milk is seen. Teach the mother to perform hand expression every 3 hours if infant is not breastfeeding, even if the infant is also being fed by NG tube after breastfeeding attempts	Frequency of breast stimulation is needed to signal the body to make more milk Fifteen minutes is the average time it takes to empty the breast

(continued)

Table 3 (continued)

	Procedure	Rationale
5.	Place a clean cup under the breast with the nipple in the cup to catch the flow of milk. Expressed breast milk not needed immediately for a feeding can be stored in a clean, covered container	Expressed milk can be given to the infant by alternative feeding methods (e.g., NG tube, cup, bottle) or used for oral care of the infant. (Fig. 6) Infants who are not yet feeding by breast or cup will progress to oral feedings faster if held while being fed by NG tube [12] (see chapter "Kangaroo Mother Care in a Low-Resource Setting" on KMC) See chart below for milk storage times

Sources: [2, 11, 12, 14]

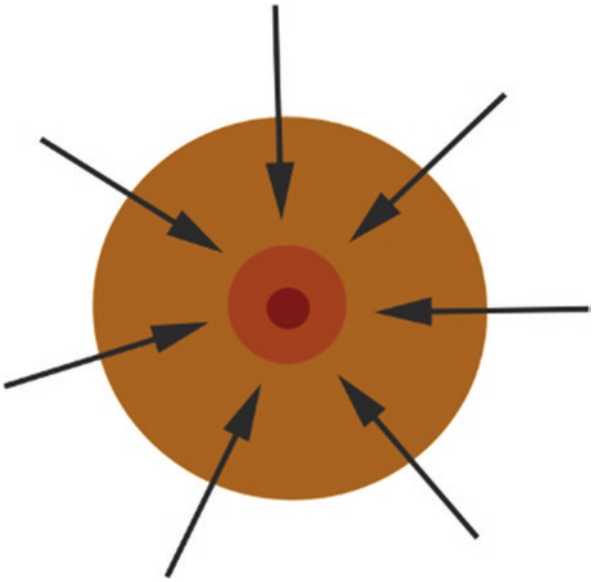


Fig. 4 Hand expression massage motion

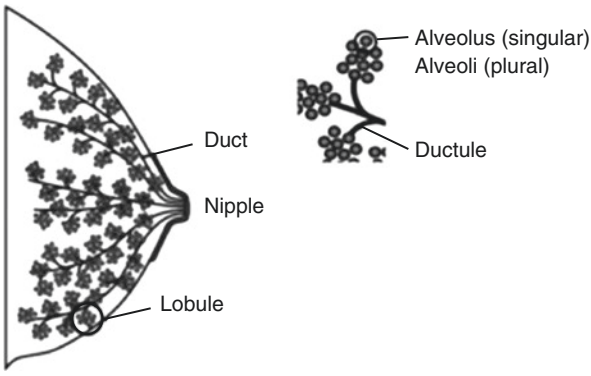


Fig. 5 Breast anatomy. (*Image credit: Mariko Langan*)

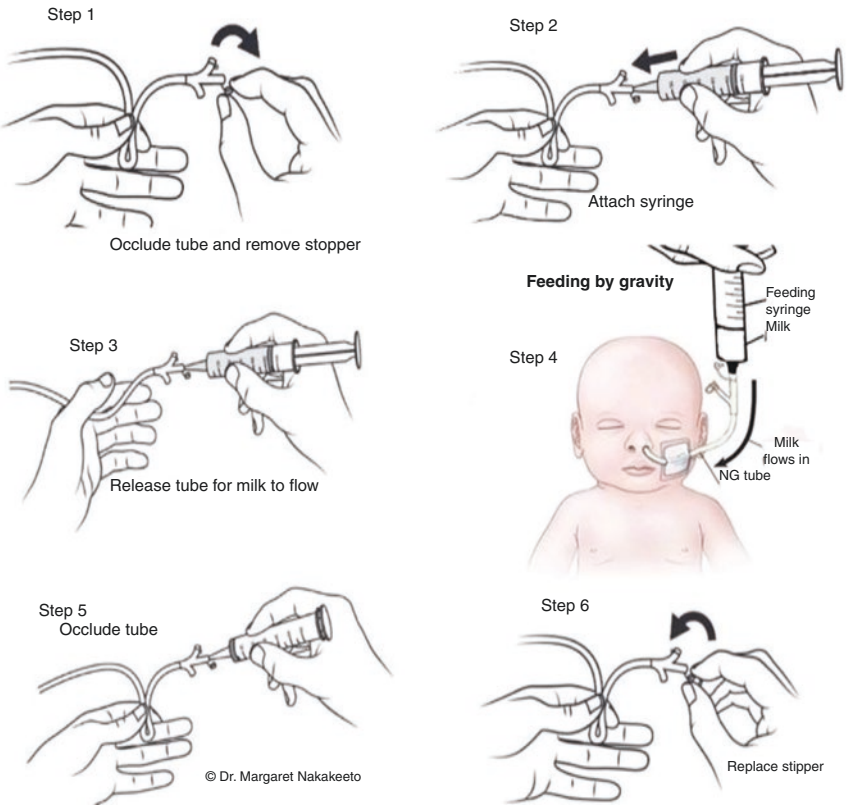


Fig. 6 How to feed an infant using a nasogastric tube. The following Global Health Media video maybe helpful for additional guidance to observe these guidelines in practice [1]: "Breastfeeding the small baby" https://globalhealthmedia.org/portfolio-items/breastfeeding-the-small-baby/. *Sources*: [1, 5, 9, 11, 12, 14, 19]

they are showing feeding cues but lack the strength to transfer milk from the breast, the infant can be offered a cup feeding after breastfeeding attempts. Hold infant in kangaroo mother care (KMC) during NG feeding or following cup feeding. See chapter "Kangaroo Mother Care in a Low-Resource Setting" for more details on KMC as well as this website in addition to the video references below [16]. As the neonate matures, it will be appropriate to transition them to the breast.

Additional resource is the video: hand expression and hand expression for the preterm infant. Again for details beyond the scope of this chapter, see additional resources [6–8, 17, 18].

Rationale

- An infant who is not feeding well from the breast or not ready to breastfeed can still receive the benefits of expressed breast milk.
- Removing the milk from the breast tells the body to make more milk. If the breast is not emptied, the body will gradually make less milk.

3.5.1 Use of Galactogogues

Some mothers experience low milk production. This makes them frustrated and anxious. Anxiety further makes the problem worse. Many mothers have found that some vegetables increased milk production. A vegetable commonly eaten in Eastern and Northern Uganda named "Marakwang" (*Hibiscus sabdariffa*) is used to initiate and/or increase milk production. Normally, milk flow is improved within 2–3 days. We have no scientific evidence but it has worked for many mothers. A study was published in November 2020 from Ghana identifying local foods that are used as galactagogues. Studies have been done elsewhere, but in Uganda these foods are used through community beliefs and observed outcomes [20].

4 Case 2 Resolution

You begin by observing the feeding and instruct the mother on proper positioning and latch in the cross-cradle hold. You explain about observing activity at the breast and how her infant is very sleepy during feedings. You have mother change breasts frequently during feeding to keep baby awake and actively suckling. She feeds for 20 minutes and then hand expresses milk for the infant which she feeds to the infant from a cup. Mother begins to snack on a local vegetable thought to help with milk production and begins to increase her fluid intake. Within 4 days, baby has begun to gain 30 grams per day and mother feels her breasts are fuller before breastfeeding and softer afterward. Within 7 days, baby is actively feeding at the breast with a sustained suck, swallow, pause pattern. Mother is instructed to continue hand expressing after breastfeeds and offering cup feeding after breastfeeds until the baby is fully taking his entire feeding from the breast. Baby's weight and feeding continue to be monitored twice weekly until baby returns to birth weight and has demonstrated appropriate growth. The community health worker notices that the baby is having an appropriate amount of yellow seedy stools and wet diapers. Mother is happy because baby seems to cry less and the gas pains are gone.

5 Case 3

Baby girl Abbo is born at 28 weeks' gestation weighing 1250 grams. She requires bubble CPAP for 3 days but did well and was able to transition to room air on day 5 of life. She is cared for in kangaroo mother care (KMC) (see chapter "Kangaroo Mother Care in a Low-Resource Setting") in the room beside your Special Care Baby Unit in Swaziland by her mother and grandmother using nasogastric tube feeds. Your nurse plots her on the growth chart (Fig. 7) *and notes on day 10 of life and notes she has fallen off the growth chart and now weighs only 1150 grams. Her*

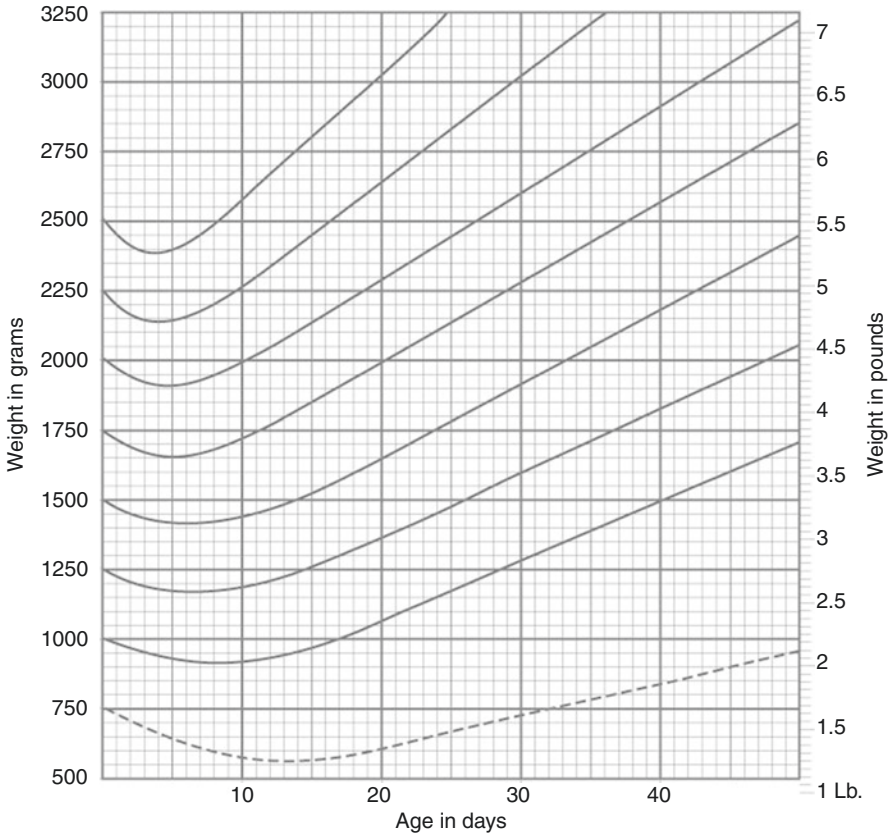


Fig. 7 Example of a growth chart still used in some low-resource setting without access to total parental nutrition and/or breast milk fortifiers [21]

mother states they need to go home soon as they are using their older children's school fees on baby Abbo. She is producing more milk than needed to feed Abbo using a combination of hand expression and the hospital-grade electric breast pump in your nursery with her own pump tubing that she cleans appropriately. Your hospital is baby friendly. How can you attempt to improve Abbo's weight without using formula or other supplement except vitamins?

5.1 Creamatocrit

Breast milk fat content or lipid and caloric concentrations account for the largest part of an infants' energy source. However, individual breast milk specimens may vary in lipid concentration and caloric density, depending upon the time of day

when collection occurs, the type of breast milk collection technique utilized and the efficiency of breast milk collection. The creamatocrit (CRCT) is a measurement for estimating the fat content and caloric content of a milk sample. Performing a creamatocrit is a useful evidence-based method to identify the lipid and calories in individual breast milk specimens provided by parents of neonates in special care nurseries. The creamatocrit procedure provides an accurate, rapid, simple, and inexpensive measure of lipid and calorie analysis of individual breast milk samples useful for volume restricted infants, or infants with slow weight gain or growth restriction [4, 11, 15].

5.2 Measuring a Creamatocrit

Creamatocrit is done by utilizing a microcentrifuge. A breast milk sample is placed in a microhematocrit tube and spun in a microcentrifuge for 15 minutes. When finished spinning, the layer of fat in the tube is measured as a percentage similar to the measurement of a blood hematocrit. Table 4 provides a detailed step-by-step instruction on how to measure a creamatocrit.

Table 4 Detailed creamatocrit procedure

1. Mother pumps fresh milk into container and shakes well for 5 seconds 2. From this sample, pour about 1/2 cc into a sample cup 3. Mix sample by shaking again for 5 seconds 4. Fill two non-heparinized microhematocrit capillary tubes with milk	

Table 4 (continued)

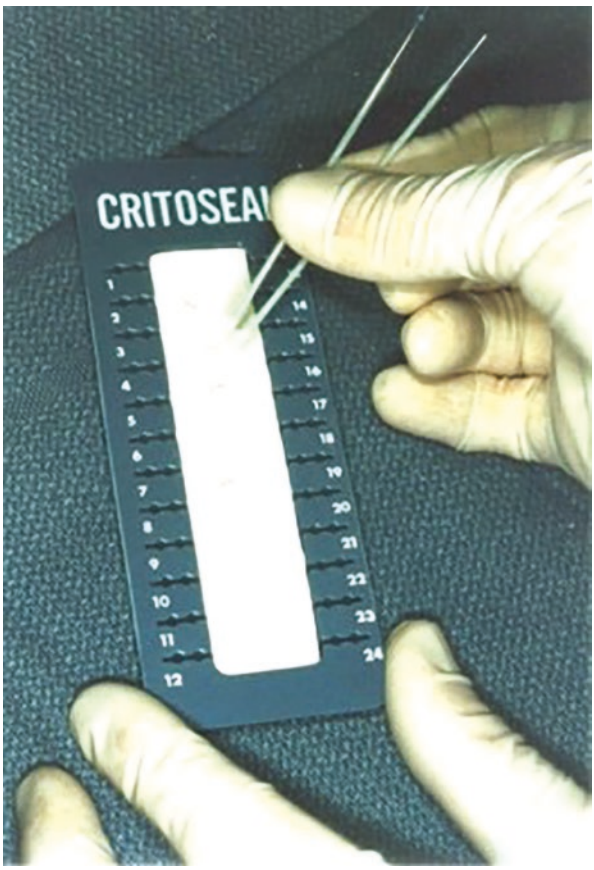
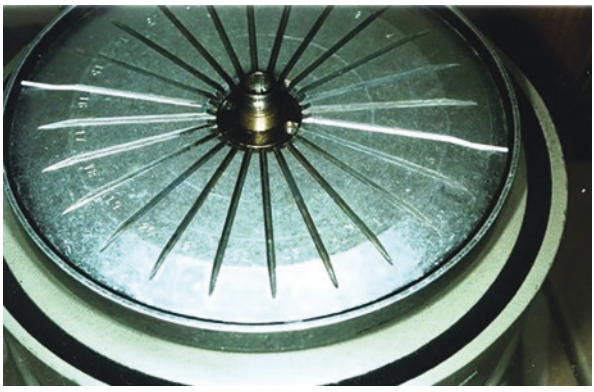
5. Seal capillary tubes at one end with the Critoseal	
6. Place tubes with sealed end to the outside of the centrifuge, in a counterbalanced position	

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Table 4 (continued)

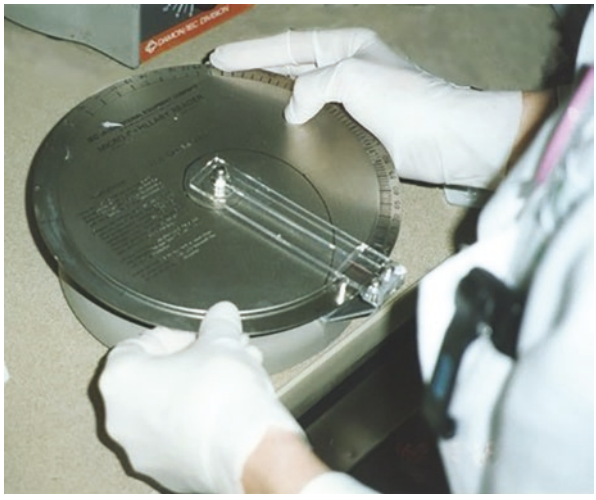
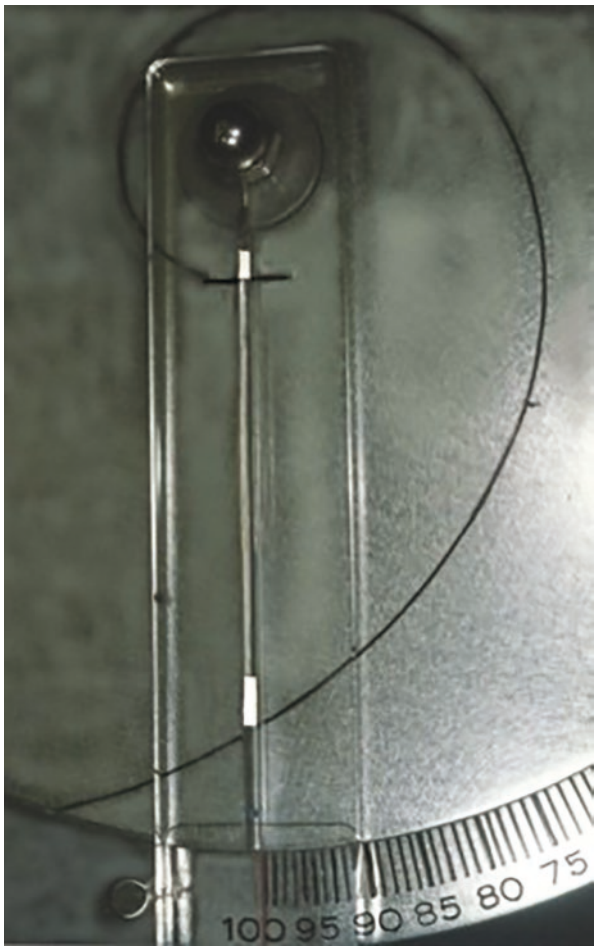
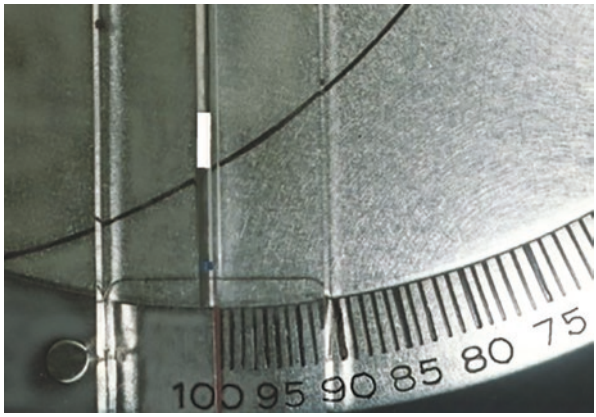
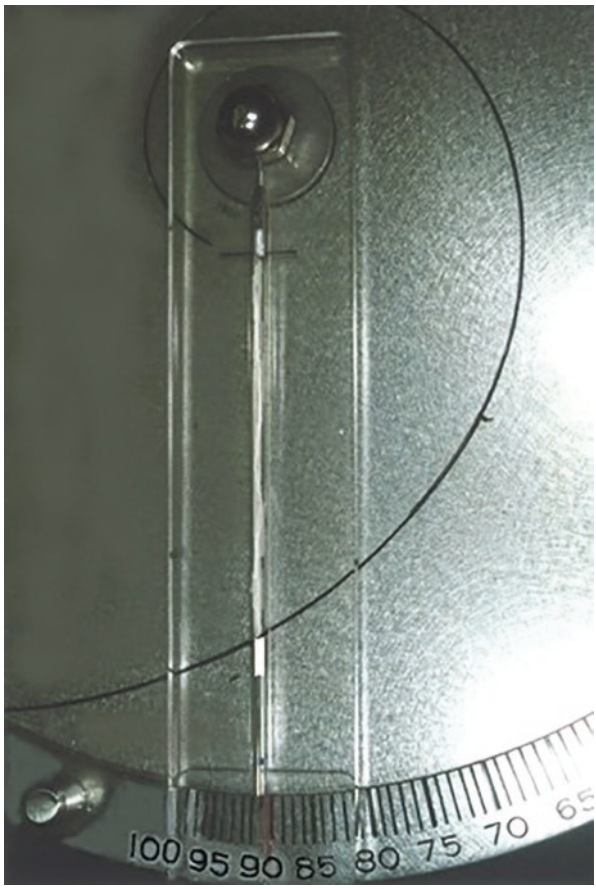
7. Screw lid in place 8. Close top of centrifuge 9. Set timer for 5 minutes 10. When spinning stops, remove tubes from centrifuge	
11. Place tubes on hematocrit reader with Critoseal end at the top 12. Place the intersection of sealant and milk at the cross-point of the curved line	

Table 4 (continued)

13. Rotate upper disc so that bottom of curved line intersects *bottom* point of milk in the capillary tube	
14. Set lower percentage disc at 100%	

(continued)

Table 4 (continued)

15. Rotate percentage disc until curve line intersects the cream layer of the milk 16. Subtract this percentage (usually 85–95%) from 100%. The result is the creamatocrit (usually 5–15%)	

Adapted from Lucas et al. [22]. Procedure and pictures are adapted by and used with permission from Dr. Paula Meier PhD, RN, FAAN Rush University, Chicago, IL, USA

5.3 Estimating Calories Based on Creamatocrit

Once the steps to figure out the creamatocrit percentage have been completed, the calories in the breast milk can be estimated based on the measured creamatocrit. See Table 5 for estimations.

Ideally, each center should construct the regression graph based on their own samples as was done by the researchers who developed the Creamatocrit plus™ [11]. The Creamatocrit plus™ is an instrument that does the calculations automatically and eliminates the need for multiple steps and "cumbersome" equipment [11].

Table 5 Creamatocrit and calories

Creamatocrit %	3	4	5	6	7	8	9	10	11	12
Gr of fat/ml	0.017	0.023	0.03	0.037	0.044	0.051	0.058	0.064	0.071	0.078
Cal/ml	0.49	0.56	0.62	0.69	0.76	0.82	0.89	0.96	1.02	1.09
Cal/oz	15.7	17.8	20	22.1	24.3	26.4	28.5	30.7	32.8	34.9
% of Cal – fat	22	37	44	48.2	52.1	56	58.2	60.4	62.6	64

Notes: Based on regression equations in Lucas et al. [22]
For additional details regarding the use of creamatocrit in low-resource settings, consult resources including these [7, 8, 23, 24]

Table 6 Milk storage guidelines

Location	Temperature	Maximum recommended duration
Room temperature	16–29C (60–85F)	4 hours optimal → up to 6–8 hours acceptable under very clean conditions
Refrigerator	4C (39.2F)	4 days optimal → up to 5–8 days under very clean conditions
Freezer	<–4C (24.8F)	6 months optimal → up to 12 months acceptable

Source: ABM Clinical Protocol #8: Human Milk Storage Information for Home Use for Full-Term Infants, Revised 2017 [3]

5.4 Breast Milk Storage

Breast milk storage is problematic in many low-resource areas due to the lack of dependable electricity. One of the challenges of using expressed breast milk and promoting the use of hindmilk is that breast milk that is not keep at the proper temperature must be discarded (Table 6) [1]. However, mothers must be encouraged to completely empty their breasts whether using hand expression or electric breast pumps or a combination of both in order to maintain their milk supply over time.

Exercise caution in settings with unreliable freezer temperatures. For details on this and other specifics of breastfeeding and using breast milk in premature and sick infants, consult additional resources such as these [6–8].

6 Case 3 Resolution

Mother is taught now to tell when her breast milk changes from low-fat foremilk to hindmilk. Your nurses run a creamatocrit on her hindmilk collected after 5 minutes of milk expression and note that the hindmilk has a creamatocrit of 9 which translates to a caloric count of approximately 28.5 calories/mL. She begins to feed Abbo this hindmilk with the volume you prescribe topping up with foremilk if she does not have an adequate volume of hindmilk. Abbo grows well and at 16 days is up to 1300

and back on the growth chart. She is discharged on day 20 using nasogastric feeds in KMC care. She will be followed up every 3–5 days in KMC clinic but is expected to do well and to transition without difficulty to cup and spoon and then full breast-feeding at the breast.

6.1 Complications

Complications of breast feeding and the use of breast milk are rare beyond those listed in common problems above. Additional complications are primarily limited to infections such as maternal to child transmission of human immunodeficiency virus (HIV), herpes, or tuberculosis. Some such as MTCT of HIV have been addressed and no longer pose extreme risk to infants. Details of this and other infections are beyond the scope of this book but will worth working to solve as we attempt to use breast milk for the majority of infants globally.

6.2 Conclusion

Breast feeding and use of breast milk is recommended and important worldwide. It is critical to the survival of infants in LMICs. Tackling problems associated with breast feeding and the use of breast milk should be a top priority in our efforts to decrease neonatal morbidty and mortality globally.

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