Feeding the Larger Low-Birthweight Infant in a Resource-Poor Environment

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Abstract
The high low birthweight prevalence in resource-poor countries (16.5%) places a burden on overstretched resources. Labor ward must have written guidelines to triage these infants for optimal nutritional support to the special care nursery (SCN; 1,500–1,800 g and <34 weeks) and postnatal ward (PW; >1,800 g and ≥34 weeks). Separation of mother and infant should be prevented. Initiating breastfeeding and kangaroo mother care (KMC) in labor ward by skilled nurses in the latter group is a priority and continues in the PW. SCN infants receive an intravenous 10% glucose-electrolyte solution and, if stable, commence with expressed colostrum and breast milk (EBM) feeding and intermittent KMC which progresses to continuous KMC and breastfeeding. Enteral feeding is advanced more slowly in unstable infants. Parenteral nutrition is only administered to infants with bowel obstruction or feeding intolerance. EBM of HIV+ mothers in the SCN is pasteurized. The decision to discharge a mother-infant dyad should be individualized. Infants in the SCN are discharged at 34 weeks, a weight of 1,600–1,800 g and are gaining adequate weight. Discharge from the PW usually takes place after 48 h, often before the infant has regained his birthweight but breastfeeding must be established. Multivitamin- and iron-containing syrup is continued for at least 12 months. The clinics in the community must provide post-discharge nutritional support.

Introduction
More low-birthweight (LBW) infants are born in developing countries (16.5 vs. 7%) than in First World countries, and they are often born to women with serious antenatal risk factors; yet, they are delivered at hospitals with limited facilities and medical and nursing expertise [1].
LBW refers to infants <2,500 g. Small for gestational age (SGA) refers to the infant with a birthweight (BW) <10th centile for gestation while intrauterine growth restriction (IUGR) only to those infants with BW and/or birth length below the 10th percentile for gestational age (GA) with a pathologic restriction of fetal growth. IUGR forms a subset of cases of SGA infants [2].

The prevalence of LBW in India has been reported as 26% with 54% IUGR [3, 4] (prevalence in the United States: 6.9–8.1%) with one third of these suffering from IUGR [5].

This paper will deal with the larger (≥1,500 g) LBW infant who is born prematurely (<38 weeks). Due to limited neonatal intensive care facilities, these infants are predominantly managed in the special care nursery (SCN) and postnatal ward (PW). Readmission to hospital due to feeding difficulties and jaundice is common in LBW infants born preterm as many are discharged at low GAs before lactation is fully established [6].

**Management of Low-Birthweight Infants in Labor Ward**

Triage in labor ward is essential directly after birth. The triage of the supposedly well infant into those that require incubator care and parenteral glucose administration versus kangaroo mother care (KMC) and breastfeeding is complicated by factors such as uncertain GA, growth restriction, ill mother, etc. Labor ward must have written guidelines for the midwives for triaging LBW infants either to the SCN or PW. The attending pediatric doctor should assess all infants <2,000 g. As many women only attend an antenatal clinic late, GA is often uncertain and an attempt should be made to verify it [7]. To ascertain SGA, the weight of the infant should be plotted on a growth chart [8].

**Triage and Transfer from Labor Ward**

Only broad guidelines can be provided for triaging these infants into 4 groups of which the management differs substantially:

- **Group 1:** infants with BWs between 1,500 and 1,800 g and <34 weeks’ gestation. They are transferred by incubator to the SCN, and their mothers follow once they are stable.
- **Group 2:** infants with BWs between 1,800 and 2,000 g and <34 weeks. They are transferred to either the SCN by incubator (<34 weeks) or the PW (≥34 weeks) in the KMC position once the mother is stable. Teenage
mothers and mothers with multiple births are assessed and transferred individually.

- **Group 3**: infants >1,800 g with a gestation of ≥34 weeks or those >2,000 g. These infants are transferred in the KMC position to the PW with their mothers.

- **Group 4**: infants who require admission to the NICU. They are not discussed in this chapter.

  Due to an increased risk of feeding intolerance, hypoglycemia and hypothermia, infants with severe IUGR, regardless of weight or GA, should initially be transferred to the SCN with their mothers.

  If the mother is ill, her infant is immediately transferred to either the SCN or the PW in an incubator.

**Nutritional Management in Labor Ward**

Preventing the separation of mother and infant as far as possible and initiating breastfeeding and KMC in labor ward in the infants who are to be transferred to the PW is a priority. Early skin-to-skin contact increases the success of the first breastfeeding [9], allows frequent suckling and prevents hypothermia. Breastfeeding is commenced in the stable HIV− mother’s infant or in the baby of the HIV+ mother who has chosen to breastfeed. Labor ward nursing personnel must be well versed in breastfeeding support of mothers of premature infants [10]. The HIV+ mother who opts for formula feeding will also practice KMC and will be provided with preterm formula for her infant.

**Labor Ward Observations**

Although these infants appear stable as they do not suffer from respiratory distress, etc., they do require close observation as they are sleepy, do not latch and suckle as well as term infants and can become hypothermic and hypoglycemic very quickly [6]. A blood glucose level should be determined on every baby within 1 1/2 to 2 h of age. Earlier measurement has not been shown to be of benefit.

  Growth-restricted infants require close observation for hypothermia and hypoglycemia. They should be transferred to the SCN for parenteral glucose administration if they have symptomatic hypoglycemia or a blood glucose level <2.4 mmol/l [11].
Nutritional Management in the Special Care Nursery

These infants are nursed in an incubator and receive an intravenous 10% glucose-electrolyte solution on admission at a volume of 70 ml/kg per day. An orogastric tube is also placed.

Breast milk, with its low risk of necrotizing enterocolitis (NEC), can be advanced rapidly to increase enteral protein intake in resource-constrained environments where there is a scarcity of parenteral nutrition (PN).

The infants in the SCN are divided into 2 groups depending on their clinical condition. Those on either nasal CPAP or nasal cannula oxygen are categorized as ‘unstable’. However, they are only kept nil by mouth if there is a medical or surgical contraindication to enteral feeding. Incubator care is continued until oxygen therapy is discontinued and intermittent KMC and expressed breast milk (EBM) feeding can be commenced. Stable infants commence with intermittent KMC, EBM and breastfeeding immediately, which progresses to continuous KMC and breastfeeding once the mother is producing adequate volumes of milk for the intravenous infusion to be discontinued. Infants are weighed daily.

Colostrum, Expressed Breast Milk and Pasteurization

Once a mother is stable, she is assisted and instructed in the technique of KMC, the aseptic technique of manually expressing colostrum and breast milk and the correct labelling of bottles and of refrigeration. All colostrum is administered by syringe or teaspoon directly into the mouth of both the stable and unstable baby.

EBM in the SCN is used in the form of unpasteurized own mother’s EBM from HIV– women, pasteurized own mother’s EBM from HIV+ women and donor EBM. Due to the risk of HIV transmission through EBM to her own baby or to another baby in the ward in the event of the inadvertent administration of EBM to the wrong baby, the HIV status of every mother must be known on admission of her baby to the ward [14, 15]. Mothers are supplied with sterilized wide-rimmed glass containers for milk expressing. The use of breast pumps is not allowed as they may be shared, and in so doing HIV, CMV, hepatitis B, etc. may be transmitted [16]. The SCN should have a milk kitchen with ample refrigeration and freezer facilities as well as the necessary equipment for the ‘flash heating’ method of pasteurization.

EBM must be refrigerated immediately after expressing. Human milk may be stored at 4 °C for up to 96 h or should be frozen [17]. If cooling or freezing fa-
facilities are not available, preterm EBM may be stored for up to 4 h at room temperature [18].

HIV+ mothers are taught to pasteurize their breast milk immediately after expressing [19]. A wall chart should be available in the milk kitchen for reference.

EBM of mothers who refuse to be tested for HIV must also be pasteurized. The nursing staff must teach the mothers the correct way of labelling the milk bottles. A designated colored sticker is applied to the bottles containing pasteurized EBM from an HIV+ mother. The baby’s name, surname, hospital number, date and time of expressing as well as date and time of pasteurization must be noted on a label applied to the milk bottle.

Only pasteurized EBM from an HIV+ mother may be placed in the refrigerator or freezer. Cooled pasteurized EBM can be used immediately or stored in the designated milk refrigerator for up to 96 h where after it should be frozen. If no freezer facilities are available, pasteurized EBM may be stored at room temperature for 24 h [20].

Strict protocols must be followed to ensure that EBM is administered to the correct baby. Protocols must also be in place for the management of an infant during the inadvertent administration of HIV+ EBM to another mother’s baby.

Pasteurized Donor Expressed Breast Milk

As it is a scarce commodity, pasteurized donor EBM is generally only available for VLBW infants and is only an option for LBW infants >1,500 g with feeding intolerance and IUGR whose mothers are unable to provide EBM.

Formula Feeding in the Special Care Nursery

If mother’s own breast milk is unavailable due to maternal illness or death, formula is commenced.

Formula milk is associated with complications such as NEC; it does not confer anti-infective properties such as IgG, secretory IgA, oligosaccharides, etc. to the infant [21], is unaffordable to the majority of parents and is associated with gastroenteritis if good sanitation and clean water are not available at home. It is the HIV+ mother’s informed choice to decide whether she is going to breastfeed, feed the baby pasteurized EBM or give formula.
Administration and Advancement of Expressed Breast Milk in the Special Care Nursery

Infants with BWs >1,500 require 60–80 ml/kg per day on day one. For all infants, total fluids (intravenous + enteral) are increased by 25 ml/kg per day to reach 150–160 ml/kg per day by 5–6 days of age. Breast milk intake in the SCN is commenced according to what is available, is advanced by 25–30 ml/kg daily and administered by orogastric tube as a bolus. The daily intravenous glucose volume is decreased as the EBM intake increases. The EBM intake can be increased to a maximum of 180–200 ml/kg per day if the weight gain is <20 g/kg per day once BW is regained. If the weight gain is still suboptimal, a commercially prepared fortifier or coconut oil may be considered. If a fortifier is not available, 2.5 g skim milk may be added to 100 ml of EBM [22]. Hindmilk has a higher fat and caloric content than foremilk and may also be used to increase caloric intake [23].

Special attention should be paid to the infant with severe IUGR as feeding intolerance and an increased risk of NEC may necessitate a smaller daily increment in milk volume and a continuous infusion of EBM by orogastric tube instead of bolus feeding [24]. It may be necessary to supplement caloric intake with PN.

Kangaroo Mother Care and Breastfeeding in the Special Care Nursery

While the infant is receiving intravenous feeding and gavage feeding of EBM and is stable, the mother practices intermittent KMC and begins to initiate breastfeeding. The first step is nipple contact during KMC which stimulates the let-down reflex and assists with manual expressing of colostrum, and later of breast milk.

Once the infant is gaining weight adequately, intravenous fluid has been discontinued, he/she is off oxygen and the nasogastric tube has been removed, he/she is removed from the incubator to his/her mother’s bed for continuous KMC and full breastfeeding. The infant is still weighed daily as there is often a decline in daily weight gain due to the increased activity of full breastfeeding. Feeding by cup is also introduced to provide top-up EBM feeds for the infant with suboptimal weight gain.

‘Milk handlers’ are designated nursing assistants who obtain colostrum and EBM from a mother separated from her baby (e.g. mother in obstetrical high care, etc.). They also train and support mothers in manual expressing of breast milk and pasteurization, in the correct labelling and storing of milk bottles with EBM and identify potential milk donors.
Cup Feeding in the Special Care Nursery

Although infants are discharged at weights of 1,600–1,800 g and a GA of 34 weeks, they will not yet have attained maximal oral feeding skills (35–37 weeks for most premature infants). As they are often unable to empty a breast and to obtain sufficient amounts of breast milk to meet their nutritional requirements, they need top-up feeds. Immediately after the breastfeed, the mother expresses milk from the partially emptied breast into a sterilized cup. This ensures that the breast is fully emptied to maintain a good milk supply and she can give her baby a top-up feed by cup.

Parenteral Nutrition

PN is usually not available for LBW infants treated in low-resource institutions due to the high costs and lack of medical and nursing expertise. It is reserved for the infant with enteral feeding intolerance, bowel obstruction, NEC, etc. An admixture unit in the hospital for daily mixing of tailor-made PN solutions is unaffordable. A commercially prepared 3-in-1 lipid-aminoacid-glucose preparation for LBW infants for short-term use (<3 weeks) is an affordable alternative.

Supplementation of the Infant in the Special Care Nursery

Electrolyte levels are only determined in these LBW infants when there is a clinical indication such as those with feeding intolerance, etc. A fortifier may be added to the EBM of the more immature LBW infants. Calcium and phosphate are not routinely supplemented. Enteral iron, at a dosage of 2 mg/kg per day, should be commenced at 2 weeks of age, in hospital for infants who have not been discharged and at clinics for those that have. A multivitamin supplement, containing at least 400 IU vitamin D, should be commenced once the infant is on full enteral feeding. Both are continued until 12 months of age.

Nutritional Management in the Postnatal Ward

Expressed Breast Milk and Breastfeeding

LBW infants ≥34 weeks’ gestation are managed with term babies in the PW. The latter are discharged early, i.e. between 6 and 24 h of age. Due to limited neona-
tal facilities in resource-constrained countries, LBW infants are usually discharged after 48 h. By the time they are discharged, feeding, be it breastfeeding or bottle feeding, must be established.

Establishing breastfeeding in LBW infants is a challenge due to their poor muscle strength, latching, suckling and swallowing. This may result in poor emptying of the breast, low milk intake, poor weight gain, dehydration, jaundice and lactation failure after discharge.

Breastfeeding support should be provided by skilled, sympathetic nursing staff. Initiating and establishing breast milk production when the mother is exhausted or ill or when infant and mother are separated is particularly challenging.

There are important differences in the principles for supporting breast milk feeding in these infants compared to those used in term infants [26].

Whereas term infants are encouraged to latch and suckle as frequently as possible in order to stimulate breast milk production and emptying of the breast, this may result in the opposite in these infants. This is due to the fact that the infant is weaker, latches poorly and slips off the nipple of the mother repeatedly, falls asleep easily and therefore is unable to generate suction pressure to remove milk from the breast. Waking the LBW infant frequently to feed is counterproductive as his/her limited energy stores are not replenished during the low milk volume intake of the first 48 h, and this approach may deplete his/her limited glycogen and fat stores even further and result in hypoglycemia. Instead, the mother should respond to feeding cues by allowing the baby to latch and suckle when he/she is awake. This should be approximately every 3 h. The infant should not be woken more frequently. If latching remains a problem, a nipple shield should be used as it will compensate for weak suction pressures [27]. Teach the mother the correct technique of manually expressing breast milk as this will stimulate breast milk production and help to empty the breast. Expressing breast milk should be done when the baby is asleep and directly after a feed in order to empty the breast. The mother should express 6–8 times/24 h until her breast milk production is established well enough to maintain breastfeeding.

If excessive weight loss, jaundice or hypoglycemia occurs, the doctor should be consulted to assess the infant.

The teenage mother, those with multiple births or where the introduction of breast milk feeding was delayed due to maternal illness will require longer hospitalization in order to establish breastfeeding.
Supplementation of the Infant in the Postnatal Ward

As these infants are discharged within the first week of life, multivitamin and iron supplementation at 2 mg/kg per day is provided at the clinic.

General Principles Applicable to Both Special Care Nursery and Postnatal Ward Infants

General Principles of Formula Feeding

Formula should be prescribed according to strict criteria which include:
- The mother has died or is too ill to breastfeed
- The HIV+ mother chooses not to breastfeed
- The HIV+ mother does not have facilities to pasteurize at home and changes to formula on discharge
- A mother has had twins or triplets and there is a need for supplementation with formula milk
- Supplemental feeding for the infant whose mother is experiencing ongoing low milk production, e.g. due to late initiation of breastfeeding
- As donor milk is not readily available for LBW infants >34 weeks in resource-constrained settings, breastfeeding may be supplemented by formula feeding by cup.

A standard infant formula should be prescribed. Mothers who will formula feed should be educated by the nursing staff in the hygienic and correct mixing of formula milk and of sterilizing bottles and teats [28].

General Principles of Predischarge Planning

Every infant must have a durable card containing all his neonatal and feeding information, supplementation and medication such as antiretrovirals, a summary of his neonatal management, etc. to present to the clinic at every visit.

The HIV+ mother who is breastfeeding should practice exclusive breastfeeding until she discontinues breastfeeding. She should be informed of the risks of supplementing breastfeeding with anything other than water [29].
**General Principles of Discharge**

Although there are guidelines for the early discharge of late preterm infants in a developed country [30], none exist for the LBW infant in a resource-constrained setting. Discharge principles are determined according to admission to the SCN or the PW.

**Discharge from the Special Care Nursery**

The decision to discharge a mother-infant dyad should be individualized. Infants are discharged home when they reach a GA of at least 34 weeks, a weight of 1,600–1,800 g, are gaining adequate weight, are fully breastfed or bottle fed and the mother is confident to care for her baby at home.

The timing of assessment at the community clinic is determined according to factors such as discharge weight or GA, teenage mother, etc.

**Discharge from the Postnatal Ward**

Discharge usually takes place after 48 h, often before the infant has regained his/her BW. Whether the mother-infant dyad is ready for discharge is determined on an individual basis. If the infant is discharged before day 3, i.e. while he/she is still losing weight, he/she should be assessed at the clinic within 24 h.

**Nutritional Support at the Community Clinic**

The clinics in the community function as an extension of the hospital management. The clinic nursing staff should also conduct home visits. The mother’s breasts should be examined for engorgement and her technique of breastfeeding observed. The baby should be assessed and weighed and the weight loss or gain should be interpreted according to the postnatal age. The infant should be referred to the hospital if there is excessive weight loss, lethargy, jaundice, poor feeding, etc.
Conclusion

Optimal nutrition can be provided to LBW infants in resource-constrained environments by maintaining the mother-infant dyad in hospital and providing skilled breastfeeding support. The clinics in the community must provide post-discharge nutritional support.

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References