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Feeding Preterm and Low-Birthweight Newborns

A one-stop resource document for developing country- specific implementation guidelines, protocols, standard operating procedures, and job aids

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Foreword

Inappropriate newborn and infant feeding practices remain a great challenge to child health and survival globally. Optimal nutrition improves growth and neurological outcomes, and reduces the incidence of sepsis. However, the management of the feeding of small and sick newborns is beset with discrepancies, controversies and inconsistencies and there is significant heterogeneity in practices among clinicians. Practical standardized feeding protocols based on the latest evidence and international best practice are necessary to improve feeding practices and address these problems.

A mapping exercise of newborn care documents by the United Nations Children's Fund's (UNICEF) Eastern and Southern Africa Regional Office (ESARO) in 2021 revealed that information on the feeding of preterm and low-birthweight newborns was often scanty and scattered among different documents. The search for definitive guidance was like looking for the proverbial needle in a haystack.

This document provides information to assist clinicians in the drafting of contextually appropriate small and sick newborn feeding guidelines, protocols and standard operating procedures tailored to the level of care of their health facility. It is a living document that may undergo further revisions, but the information could in the meantime be used by health care facilities providing special care to small and sick newborns in eastern and southern Africa and beyond

The development of this resource document was a collaborative effort between UNICEF ESARO and the University of Pretoria and the Kalafong Provincial Tertiary Hospital, South Africa, including their Department of Paediatrics and the Research Centre for Maternal, Fetal, Newborn and Child Health Care Strategies.

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Glossary

Anthropometry	Anthropometry refers to the measurement of the human individual and includes height, weight, head circumference, body mass index, body circumferences and skinfold thickness.[1]
Adjusted age	See corrected age below.
Bacteriostatic	Bacteriostatic agents limit or prevent the growth or reproduction of bacteria, whereas bactericidal products kill bacteria. This distinction is also made in the description of different classes of antibiotics – some are bacteriostatic and others are bactericidal, with the latter being more effective in eliminating bacterial infections.[2]
Corrected age	The corrected or adjusted age is used when a baby is born before 40 weeks' gestation. The number of weeks that the baby is born early is subtracted from the chronological age, to adjust or correct for being born early.
Continuous positive airway pressure (CPAP)	CPAP is the application of a constant level of pressure greater than atmospheric pressure to the upper respiratory tract of spontaneously breathing neonates throughout the respiratory cycle. CPAP is a relatively simple and effective therapy for respiratory distress syndrome when used in the neonatal intensive care unit. CPAP delivered through the nose is called nasal CPAP or nCPAP.[3]
Chronological or actual age	The age of a baby calculated from the date of birth in days, weeks or months.
Enteral feeding or nutrition	Enteral feedings deliver milk directly into the stomach using a tube, either passed through the mouth (preferred) or the nose. The gastric tube is inserted into a patient with a functioning gastrointestinal tract who cannot swallow enough milk orally to meet daily caloric requirements. The feeding tube may stay in place as briefly as a few days or much longer.[4]
Extremely low birth weight (ELBW)	Birth weight below 1000 g.

Feeding tolerance	The competency of the newborn to process, assimilate and absorb milk feeds without difficulties and side effects. Feeding intolerance is the inability to digest, process and absorb enteral feeds with concomitant signs of increased gastric residual volumes, abdominal distension and/or vomiting. Feeding intolerance is commonly experienced in extremely low birthweight (ELBW) and very preterm newborns and frequently interferes with the progression of the enteral feeding strategy.[5]
Kangaroo mother care (KMC)	A care package for preterm and low-birthweight babies that includes skin-to-skin care, exclusive breastfeeding where possible and appropriate follow-up after discharge from the health facility.
Low birth weight (LBW)	Birth weight below 2500 g.
Microbiota	Microbiota usually refers to all the microorganisms that are found within a specific environment, including bacteria, viruses and fungi. The gut microbiota is the system of microorganisms in a person's gastrointestinal system and includes many bacteria, fungi, viruses and other organisms. The gut microbiota exists symbiotically within the human digestive system and helps support energy harvesting, digestion and immune defence.[6, 7]
Necrotizing enterocolitis (NEC)	NEC is an acute life-threatening inflammatory digestive tract disease that often leads to intestinal perforation, necrosis and peritonitis. The underlying causes of NEC appear to be multifactorial and the causes include intestinal mucosal injury, inflammation and the presence of abnormal intestinal colonization.[8]
Neonatal encephalopathy (NE)	'Neonatal encephalopathy' is the current desired name to portray central nervous system dysfunction in the newborn period. The American College of Obstetricians and Gynaecologists defines NE as a clinically distinct syndrome of disrupted neurological function in the initial days of life in infants born at or beyond 35 weeks of gestation. The syndrome is manifested by a substandard level of consciousness or by convulsions and is often accompanied by depression of tone and reflexes, and trouble with starting and sustaining respiration.[9]
Non-nutritive sucking (NNS)	When a baby sucks on the empty breast or the mother's little finger (health worker's gloved finger) or on a pacifier.[10] It is usually sucking without receiving any nutrition.

Oral feeding or nutrition	Oral feeding or nutrition comprises all techniques by which an infant receives the food (milk) through the mouth. The infant has to use oral muscles and coordinate the sucking-swallowing-breathing movements to ingest the food. Oral feeding modalities include breast, cup, spoon, syringe or bottle.
Preterm birth	Birth that occurs before 37 completed weeks of gestation.
Small for gestational age (SGA)	'A newborn whose birthweight is below the 10th percentile for gestational age, compared with a gender-specific reference population. An SGA newborn may be preterm or full-term.'[11]
Small newborn	'A newborn who is born preterm, small for gestational age, has an illness or suffers from a birth complication, and requires hospitalization during the neonatal period.[11]
Somatic-oral stimulation	Somatic stimulation involves the mother using three-to-four clean fingers to stroke firmly over the skin of the infant's four limbs and abdomen, starting at the feet and stroking upwards towards the direction of the infant's mouth.[12] Oral stimulation involves stroking perioral skin and intraoral mucosa over specific anatomical structures using one or two fingers. The stroking is delivered twice in each area, in a firm but careful action, using the mother's clean fingers. The stroking facilitates the enhancement and maturation of oral motor and sensory abilities necessary for sucking and swallowing. Stroking should stop immediately if the infant shows any stress signs.[13] (*See also Annex C.*)
Total parenteral nutrition (TPN)	TPN is a method of feeding that bypasses the gastrointestinal tract and provides special nutritional products such as glucose, amino acids, lipids and electrolytes intravenously to the infant.
Trophic feeds	Trophic feeding is the practice of supplying small volumes of enteral milk feeds (10-24 ml/kg/day) to the infant to promote the development of the immature gastrointestinal tract and is not considered to contribute to nutrition. It is also called minimal enteral nutrition (MEN).[14]
Very low birthweight (VLBW)	Birthweight from 1000–1499 g.

Abbreviations

AIDS	acquired immuno-deficiency syndrome
ART	antiretroviral therapy
ARV	antiretroviral
AZT	zidovudine
EBM	expressed breastmilk
eFe^{+}	elemental iron
ELBW	extremely low birthweight
ESPGHAN	European Society of Paediatric Gastroenterology, Hepatology and Nutrition
GRV	gastric residual volume
HIV	human immunodeficiency virus
HMF	human milk fortification
IV	intravenous
KMC	kangaroo mother care
LBW	low birthweight
MTCT	mother-to-child transmission
NE	neonatal encephalopathy
NEC	necrotizing enterocolitis
NNS	non-nutritive sucking
NVP	nevirapine
nCPAP	nasal continuous positive airway pressure
PMTCT	prevention of mother-to-child transmission
PSNS	parasympathetic nervous system
SGA	small for gestational age
SOP	standard operating procedure
STD	standard
TPN	total parenteral nutrition
UNICEF	United Nations Children's Fund
VL	viral load
VLBW	very low birthweight
WHO	World Health Organization

1. Introduction

Despite the fact that feeding small, sick and preterm newborns is an essential and unavoidable component of their management, it is an area that is afflicted with outdated practices, complexities, contradictions and inconsistencies. Many neonatologists and paediatricians adhere to disparate and divergent feeding practices for sick and small newborns. These heterogeneous practices are detrimental to these fragile infants. Providing optimal nutrition to these infants enhances their growth, improves neurodevelopmental outcomes, augments their immunity and reduces episodes of sepsis.[5] Well-researched standardized feeding protocols and standard operating procedures (SOPs) are necessary to improve feeding practices. A multidisciplinary approach involving the mother, neonatologist or paediatrician, medical officer, nurse, midwife, dietitian or nutritionist, and speech and language therapist, where they are available, is very important to enable the mother to establish oral feeds and breastfeed her preterm infant successfully.

This document is based on available World Health Organization (WHO) and international evidence alongside international best practice and current practice at a number of hospitals in Africa, notably a tertiary hospital in Pretoria, South Africa, to provide practical standardized feeding information for use in protocols and SOPs to improve health outcomes in sick and small newborns.[15, 16] More details on certain practices are provided in the annexes, as they could be used as job aids.

To make a significant impact on neonatal and infant morbidity and mortality, emphasis should be placed on improving the feeding practices of low-birthweight (LBW) and preterm neonates.[17] Recent evidence suggests that optimal nourishment in the first two weeks of life is crucial to achieve this. It was common practice to delay enteral feeding (tube feeds) in many sick and small newborn infants, relying for nutritional management on intravenous (IV) fluids and/or total parenteral nutrition (TPN). Delaying the introduction of enteral nutrition can result in an increased incidence of infection, feeding intolerance and nutritional deficiencies.[18] Enteral nutrition is therefore the preferred feeding method in all infants.[5] Suboptimal nutrition originating in utero and in the early neonatal period contributes to higher mortality, increased morbidity and postnatal malnutrition and growth deficits, all of which are risk factors for neurodevelopmental problems and cardiometabolic disease in later life. The sick, smallest and most premature infants are especially vulnerable.[19] Early parenteral nutrition in these babies continues to be vital in their management, but should be used as a supplement to enteral nutrition.[20] (See Sections 2.1 and 2.3 for further information on the management of TPN and enteral nutrition.)

The goals of nutritional support, optimal growth and development of sick and small preterm infants include managing the following:

- issues of high nutritional needs and growth velocity versus the difficulties of large enteral feed volumes;
- unbalanced metabolism due to immature organ systems (kidneys, liver and gastrointestinal tract);
- the immature and compromised immune system by the early introduction of colostrum, exclusive breastfeeding and kangaroo mother care (KMC);
- provision of the recognized nutritional requirements of the preterm infant during a sensitive phase of brain development and attaining an adequate standard of short-term growth; and
- delayed colonization and/or compromised infant gut microbiota (microorganisms in the infant's gut) by introducing colostrum and trophic feeds (small volumes of milk feeds) as soon as possible after birth to prime the infant's gut for enteral feeding and to prevent feeding-related complications, such as food intolerance and necrotizing enterocolitis (NEC), a life-threatening inflammatory bowel disease.[19]

The ultimate aim of feeding interventions is to establish exclusive breastfeeding by providing expressed breastmilk using alternative feeding methods such as a gastric tube or cup feeding and feeding directly from the breast. This will ultimately contribute to improved long-term outcomes related to psychomotor and mental competences and the occurrence of cerebral palsy and autism.[19]

This document provides information that pertains to different levels of health care, from tertiary to regional to district level. Compilers of feeding protocols and SOPs should be mindful of what their own facilities can offer and what complications of prematurity and LBW they would be able to manage locally. Any protocol should include referral pathways for sick and very preterm and very LBW babies. It is likely that only academic or tertiary level hospitals would be able to administer TPN safely.

Users of this document are urged to use best clinical judgement appropriate for their settings when applying this information. They are also advised to cross-check the information in this document against published reference material and to consult additional material and specialist consultants for complex cases.

1.1. Breastfeeding the preterm infant

Breastfeeding has many advantages that are particularly important for sick and small infants. Breastmilk provides important benefits by reducing the risk of late onset sepsis, NEC and ventilator-associated pneumonia. Unfortunately, prematurity, LBW and prematurity-related comorbidities are recognized obstacles to breastfeeding.

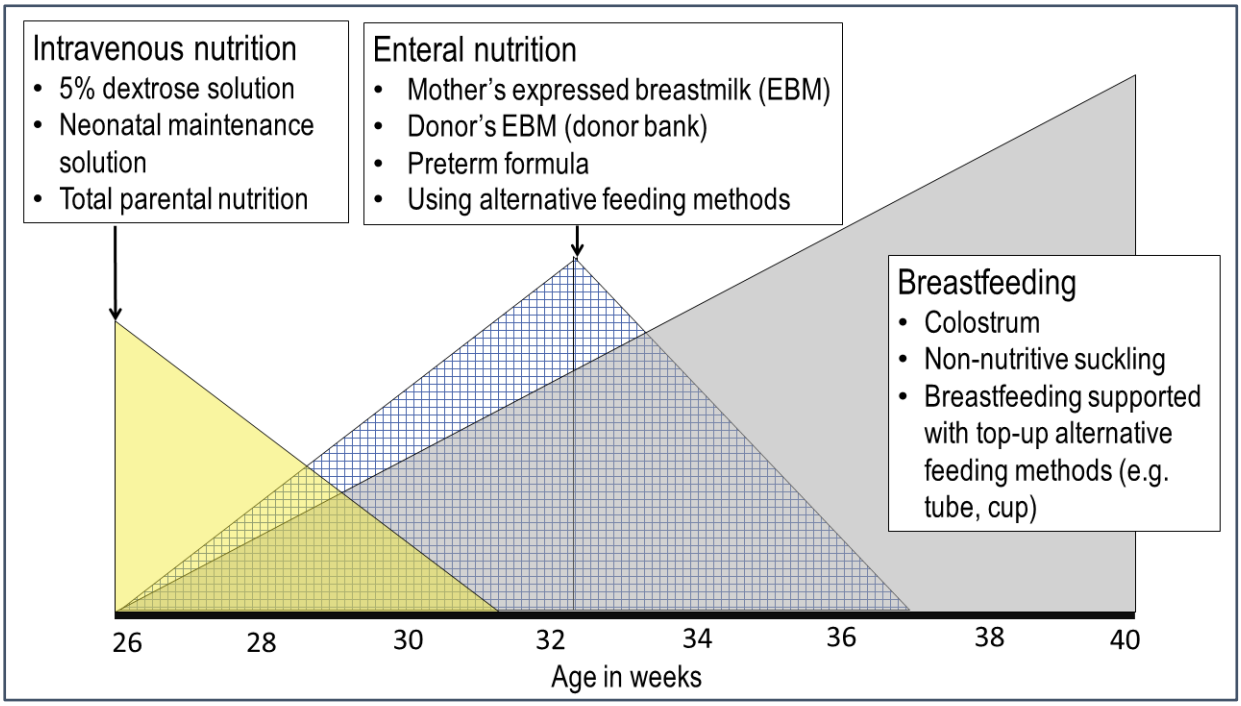
The first hours and days of a newborn's life are crucial for initiating breastfeeding and for providing the mother with the support she needs to breastfeed successfully.[21] Current WHO guidelines and implementation guidance state that all infants, including small, sick and/or preterm infants, should be fed human milk. Although preterm and ill infants may not be able to initially breastfeed at birth, they can still immediately receive the advantages of human milk, and eventually breastfeed.[22] It is recommended to introduce breastmilk feeding or breastfeeding as soon as possible in preterm and LBW babies, preferably straight after birth. Early introduction of breastmilk is not only protective for the preterm infant but also ensures adequate lactation in the mother.

Providing the preterm newborn with colostrum as soon as possible is lifesaving. Every drop of colostrum is crucial and should not be wasted. Colostrum primes the gut with protective microorganisms and provides important immunological protection. (See the benefits of colostrum in Table 4.) Although some sick and small babies will require gastric tube feeding, small volumes (0.5-2 ml) of colostrum should be introduced as soon as possible after birth to the baby's buccal (cheek) mucosa with a small syringe or dropper.[22]

Breastfeeding a very small baby can be challenging and it is often difficult to establish exclusive breastfeeding. Healthcare workers should support mothers to provide skin-to-skin care to the baby immediately after birth or as soon as practically possible. They should also assist mothers in initiating breastfeeding or expressing breastmilk and commencing enteral or oral feeds as soon as possible. For babies who cannot breastfeed or suckle well, alternative methods of feeding should be considered, including the use of cups, spoons or gastric tubes. The mother can administer these alternative feeds, with the support of the healthcare worker. Oral feeds should begin immediately when the condition of the baby permits.[23] The conditions that permit oral feeds are discussed in Section 2.10. Annex D contains an example of how feeding is incorporated in the ward routine of a KMC unit. Annex I is a case study that illustrates how feeding volumes are calculated daily and how feeding transition from enteral to oral feeds are accomplished.

2. Complexities of feeding small newborns

Small, sick and preterm newborns are at risk of developing extrauterine growth retardation, thus attention to their nutritional requirements is very important. Feeding these babies is multifaceted and can be complex; therefore, flexibility is required in managing their feeding requirements, taking into account the individual baby's feeding ability. Figure 1 demonstrates the different methods of preterm feeding from birth until the baby is mature and strong enough to breastfeed exclusively.[24]



Adapted from Boquien (2018)[24]

Figure 1. Preterm infant nutrition during early life from birth to 40 weeks gestation

How small babies are fed depends on their gestational age and birthweight, as well as on individual factors such as feeding intolerance, sepsis, respiratory distress, neurological maturity and chronic lung disease of prematurity. Feeding ability must always be individually evaluated and flexibility is required, taking into account the individual baby's feeding ability. Grouping infants into weight and gestational age categories is intended to provide guidance on the selection of the initial choice of feeding method. Always be understanding of possible feeding difficulties and be as supportive as possible towards the chosen feeding method. If the baby does not cope with solely breastfeeding or a combination of breastfeeding and top-up cup feeding, consider inserting a gastric tube to ensure the baby receives the necessary

enteral feeds required for good growth. One major advantage of gastric tube feeds is that the preterm or LBW baby does not expend any energy when feeding and thus utilizes all nutritional intake for growth. This is an advantage for very small infants with poor musculature, where breast and cup feeding may consume too much energy. Restricting time suckling on the breast and/or cup may improve weight gain.

The 2017 WHO recommendations state that very low birthweight (VLBW) "infants should be given 10 ml/kg per day of enteral feeds, preferably expressed breastmilk, starting **from the first day of life** with the remaining fluid requirement met by intravenous fluids" (our emphasis) (p 13).[25] These small feeds are called trophic feeds or minimal enteral nutrition (MEN). Trophic feeds can be given via gastric tube with the preterm or LBW baby in the KMC (skin-to-skin) position. Skin-to-skin contact benefits both baby and mother; the baby absorbs the feeds sooner and better, and lactation is stimulated by holding the baby skin-to-skin. According to the latest WHO recommendations on the care of preterm and LBW infants, "immediate KMC can be initiated before the infant is clinically stable unless the infant is unable to breathe spontaneously after resuscitation, is in shock or needs mechanical ventilation. The infant's clinical condition (including heart rate, breathing, colour, temperature and oxygen saturation, where possible) must be monitored" (p 12).[26]

2.1. Total parenteral nutrition

Only a small number of premature and LBW babies will not be able to take any enteral feeds at birth and may need to be fed intravenously (*see Figure 1*). These commonly include extremely preterm babies (< 28 weeks gestation) and extremely low birthweight (ELBW) babies (< 1000 g) and babies with signs and symptoms of NEC (*see Section 2.7.3*). As these infants may take some time to advance to full enteral feeds they are started on total parenteral nutrition (TPN) on day one of life, to prevent them from developing extra-uterine growth retardation. TPN bypasses the gastrointestinal tract and provides nutritional products such as glucose, amino acids lipids and electrolytes intravenously to the infant until the infant's digestive tract is able to cope with full enteral feeds.[27] (See also Section 2.3 for the high-risk criteria when considering the commencement of enteral feeding.)

> Infants who are candidates for TPN should be referred to a tertiary or teaching hospital with appropriately trained staff and equipment to offer TPN safely. TPN should not be initiated in facilities that do not have the necessary skills and amenities available.

In public sector hospitals, implementing TPN may be a challenge due to health care worker shortages; lack of training, skills and experience; overcrowding and infrastructure constraints;

and lack of laboratory facilities to carry out the necessary special investigations. A common complication of TPN is an increased incidence of sepsis and this adverse outcome is likely to worsen in the absence of appropriate sterile standardized practices.[28]

Another problem with TPN is that there is a significant cost factor in its widespread usage. In most high-income and some middle-income countries, TPN is formulated and dispensed by skilled central pharmacists. However, in many middle- and lower-income countries the TPN is mixed and reconstituted by health care workers on the hospital premises. The mixing of the TPN components does not always take place in suitable sterile settings using proper equipment and this carries a risk of sepsis and also a risk of faulty calculations when combining the different components.[28]

TPN composition has adverse effects in itself and fasting causes villous atrophy which is detrimental to the infant's gut health, often resulting in feeding intolerance. Adverse effects include:

- metabolic complications:
  - acute complications include hyper- or hypoglycaemia, hyperlipidaemia, metabolic acidosis, hypo-phosphataemia and other electrolyte disturbances; and
  - chronic complications include parenteral nutrition associated liver disease and metabolic bone disease;
- mechanical complications:
  - venous line complications such as tissue infiltration, extravasation and tissue necrosis, and thrombophlebitis; and
  - central line complications such pleural or pericardial effusion, cardiac arrythmias due to malposition of the catheter; and
- infectious complications, including bacterial and/or fungal infections.[27]

TPN treatment protocols are often based on the parenteral guidelines of the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN).[29, 30] Below is a brief summary of the recommendations.

- Babies who should start on TPN include all infants < 31 weeks gestational age where there is insufficient feed progression in the first 72 hours. Also, in infants with previously established enteral feeds which were stopped due to illness. Start on TPN if unlikely to restart enteral feeds within 48 hours in preterm infants or 72 hours in term infants. TPN should also be individualized depending on available resources.[28]
- TPN should be commenced as soon as possible after birth (if possible, within eight hours) in any newborn that qualifies.

- Very low birthweight (VLBW) infants (< 1500 g) have very high energy demands because of immaturity, growth requirements and high probability of hypothermia and hyperthermia.[27] Current evidence presents a wide range of energy requirements and the following is suggested:
  Day 1: 40-60 kcal/kg;
  Days 2-4: gradual daily increase to reach 75-120 kcal/kg/d;
  After Day 4: maintenance is 75-120 kcal/kg/d.[28]
- Directly after birth IV, start glucose administration with a range of 6-9 g/kg/day for the first four days, following which it is gradually increased to 9-16 g/kg/d as maintenance requirements for preterm neonates. In term infants, start with 3.6-7.2 g/kg/d and increase gradually to 7.2-14.4 g/kg/d. Dextrose provides 3.4 kcal/g and should provide 30-35% of daily caloric needs. Current evidence does not define what the target range for blood glucose levels should be when on TPN. The normal blood glucose level range is usually between 2.5-6.7 mmol/l.
- It is generally agreed that early suitable protein and energy intake is critical to prevent extrauterine growth restriction. Initiate amino acid administration for preterm infants over the first four days at 1.5-2 g/kg/d; then gradually increase it to 3-4 g/kg/d as maintenance. Term infant recommendations start with a minimum of 1.5 g/kg/d and a maximum of 3 g/kg/d. Preferred amino acid formulation includes bioavailable cysteine and taurine. Protein provides 4.0 kcal/g and should provide 10-15% of total energy intake.
- Essential fatty acids (omega-6 and omega-3) and long-chain polyunsaturated fatty acid (LC-PUFA) are necessary for central nervous system development and retinal growth. Deficiency of essential fatty acids is biochemically apparent in premature infants within 72 hours if they are not given any lipids. Lipid tolerance is ideal with a 20% formulation because of a lower phospholipid to triglyceride ratio; it is better endured and desired in neonates.[27] Lipids (Intralipid 20% or SMOFlipid 20% that contains fish oil) are started on the day after birth at 1-2 g/kg/day with stepwise increments of 0.5-1 g/kg/d to a maximum 3-4 g/kg/day.[28] Fat provides 9 kcal/g and should provide 25-40% of non-protein parenteral nutrition calories.[27]
- Electrolytes, such as sodium and potassium, can be started from day one of life if there is good urine output, but starting a little later is also acceptable. Supplementation should preferably be started during the stage of early weight loss in newborns, around day 2-3 of life and onwards.[28]
- Parenteral intake is gradually increased with ~20-30 ml/kg/day to reach the target fluid volume of 150-180 ml/kg/day.

- TPN are usually stopped when the infant receives enteral feeding volumes of 120-140 ml/kg/day. However, to reduce the risk of sepsis-associated adverse effects, in some middle- and lower-income countries TPN is stopped when enteral nutrition delivers two-thirds of the desired energy intake (about 100 ml/kg/day).
- Triglyceride and urea levels should be monitored regularly. Consider lowering parenteral amino acid administration temporarily if plasma urea concentrations go above 10 mmol/l. Interrupt the administration if the urea is above 14 mmol/l. Lipid administration is temporarily lowered when triacylglycerol concentrations are above 3 mmol/l and interrupted when above 5 mmol/l.

Further information on detailed TPN guidelines and complications (2018) is available at the following website: https://espghan.info/published-guidelines.

2.2. Non-nutritive sucking

Non-nutritive sucking (NNS) is when a baby sucks on the empty breast or the mother's little finger (health worker's gloved finger) or on a pacifier (non-nutritive tool). The baby does not receive any nutritional or fluid intake, but benefits in other ways, for example in self-regulation and organization, and pain relief. It is often a valuable forerunner to breastfeeding and is helpful for sick and preterm babies during stressful interventions.

As early as 13-16 weeks post conceptual age, the foetus starts making sucking movements, followed by swallowing-like movements. Respiratory-like movements also begin at this stage. These foetal movements are considered to be important precursors for respiration, sucking and swallowing.[10] At 28-33 weeks the foetus produces rhythmic bursts of NNS. The foetus' ability to suck, swallow and breathe gradually develops until 34-36 weeks (post conceptual age). There is an escalation in the configuration and control of the central nervous system (CNS) and the sucking rhythm matures. Babies born prematurely miss out on this opportunity to practise and develop their sucking and swallowing skills in utero. By offering them NNS we can help them gain this valuable skill which will mature sucking behaviour and improve absorption of enteral feeds. Although NNS is a precursor to nutritive sucking, it does not predict its success. The ability to feed depends on a coordinated sucking, swallowing and breathing pattern. In preterm infants of less than 32 weeks gestation, this ability is not synchronized enough to sustain full oral feeds. NNS facilitates the development of mature suck-swallow-breathe cycles.[31] Neonates exposed to NNS had a decreased hospital stay with no short-term negative outcomes, according to a 2016 Cochrane review.[31] Subsequent research has shown that when preterm infants are exposed to the smell and taste of milk while receiving NNS feeding in preterm infants are accelerated.[32] The clinical rationale for encouraging NNS is to offer its benefits to infants who have not fully established oral feeding.

2.2.1. Benefits of non-nutritive sucking

Many of the benefits listed below are mentioned in the 2016 Cochrane review.[31]

- NNS helps babies self-regulate, by improving state organization and physiological stability during interventions, including tube feeding.
- It delivers a developmentally supportive response to behavioural cues.
- It is useful for calming and soothing an infant. NNS stimulates the vagal nerve which is part of the parasympathetic nervous system (PSNS). Activation of the PSNS slows heart rate, lowers blood pressure, controls mood (calms baby and reduces crying), improves immune response and promotes digestion. The body enters a state of relaxation, which reduces stress. The more time spent in the PSNS state the healthier the baby.[33]
- NNS may provide a more stress-free or speedy transition from enteral nutrition (gastric tube feeds) to oral nutrition (feeds by mouth) with increased organization and proficiency of sucking.
- It can enhance the constructive connection between sucking and satiation.
- It facilitates digestion of enteral feeds. It is hypothesized that a number of enzymes and hormones such as lingual lipase, gastrin, insulin and motilin are secreted through vagal innervation in the oral mucosa by NNS. Gut motility is also increased through vagal stimulation, therefore decreasing abdominal distension and the likelihood of vomiting.
- Preterm babies are given a chance to practise sucking skills as they would in utero.
- NNS can be a short-term comfort for babies who cannot feed for medical reasons.
- It can be used in cases of neonatal abstinence syndrome by comforting the withdrawing baby.[34]
- By allowing a baby to suck on a clean finger or dummy during painful procedures, stress and pain experienced during the procedure may be reduced.[35]
- NNS may relieve the distress of a crying baby, whose respiratory status is affected by continued crying, i.e., respiratory distress syndrome (RDS) or transient tachypnoea of the newborn (TTN). It may be most appropriate to offer NNS, rather than have babies continue to cry and compromise their breathing.
- A baby with respiratory distress may have disrupted oro-motor development if routinely exposed to abnormal and even painful physical touch of the sensitive peri-oral and intra-oral skin and mucosa. These ‘bad’ touch episodes occur during prolonged periods of endotracheal intubation when the baby receives intermittent positive pressure ventilation (IPPV) and/or cannulation with nasal prongs for continuous positive pressure (nCPAP) treatment or the placement of nasal oxygen cannulae. NNS may assist in reducing or overcoming the negative influences of these abnormal tactile encounters.[31]

- Evidence of the relationship between feeding, NNS and speech development is limited.[36]

2.2.2. How to encourage non-nutritive sucking

When the mother starts practising intermittent KMC she should allow the baby to suckle on her emptied breast or little finger before giving the baby the expressed breastmilk feed via tube and/or cup. It is important to teach the mother about infection prevention, including keeping her fingernails short and always washing her hands before inserting a finger in the baby's mouth. The mother can also let the baby suck on her little finger while tube feeding. Initially the suckling on the breast is non-nutritive and baby receives very little milk. As the suckling action matures, the baby removes more milk from the breast.

It is very important to offer the breast as early as possible in order to establish successful breastfeeding when the baby is older and more mature. The end goal of feeding the preterm infant is to establish breastfeeding rather than expressed breastmilk feeding.

2.3. When to start enteral feeding

Enteral feeds deliver milk using a tube, either passed through the mouth (preferred method) or through the nose directly down into the stomach. The gastric tube is inserted into a patient with a functioning gastrointestinal tract who cannot swallow enough milk orally to meet daily caloric requirements. In preterm infants tube feeds should start as soon as possible after birth, ideally within the first 24 hours of life, except if there are clinical contraindications to prevent the introduction of enteral feeds.[17] There is increasing evidence corroborating the important benefits of speedy introduction of enteral feeding in the high-risk infant.[20] The 2022 WHO recommendations confirm early introduction of enteral or oral feeds: "Preterm and low-birth-weight (LBW) infants, including very preterm (< 32 weeks' gestation) and very LBW (< 1.5 kg) infants, should be fed as early as possible from the first day after birth" (p 17).[26]

Infants considered high-risk with regard to feeding commencement include the following (*see Table 1*):

- infants < 28 weeks gestation or < 1000 g birthweight;
- ventilated babies who are hypotensive and unstable;
- placental insufficiency with absent or reversed end diastolic flow (AEDF or REDF) in infants < 34 weeks gestation;
- infants whose oral feeds are reinstated after an incident of NEC;
- perinatal severe neonatal encephalopathy (NE) (hypoxic ischemic encephalopathy - HIE) with significant organ dysfunction;

- preterm small-for-gestational-age (SGA) infants (< second percentile and < 34 weeks gestation); and
- term severe SGA infants (< 0.4th percentile).[5]

Table 1. Actions necessary to accomplish successful breastfeeding with preterm babies

Actions taken for stable infants	Actions important in unstable babies
These babies are cardiorespiratory stable.	These babies have cardiorespiratory problems, temperature fluctuation, abdominal distension or acute severe illness such as NE or septicaemia; on life support.
Place baby in skin-to-skin contact with the mother immediately after delivery where possible and commence breastfeeding within the first hour of life.	These babies need IV fluids and TPN. Offer colostrum as soon as possible with a small syringe into the mouth of the baby.
Initiate and provide KMC consistently.	Offer expressed breastmilk by alternate methods (initially with a gastric tube, and later, when oral feeding is possible, by cup).
Breastfeed frequently: approximately every three hours (8-10 feeds per 24 hours) – ensure continued frequent feeding at night (at least every three hours).	Start with small trophic feeds (10-24 ml/kg/24h divided into three-hourly or two-hourly feeds) as soon as it is safe and possible.
Ensure correct positioning and latching; manage breast problems such as inverted or cracked nipples and breast engorgement.	Initiate intermittent KMC as soon as baby is hemodynamically stable, even if still on IV fluids or respiratory support.*
Provide non-nutritive sucking on the expressed breast in very premature infants with low muscle tone and little muscular effort.	Offer short periods of non-nutritive sucking on the emptied breast as soon as stable.

* If the hospital is already equipped to provide immediate KMC for unstable babies, KMC can start immediately.[37]

IV, intravenous; KMC, kangaroo mother care; NE, neonatal encephalopathy; TPN, total parenteral nutrition.

Adapted from the Government of India's 'Feeding Guidelines for LBW Infants' (2014) (p. 20)[38]

2.4. Early oropharyngeal colostrum application

Apply expressed colostrum using a 1 ml syringe or cotton bud to both the cheek (buccal) mucosae of the LBW or preterm infant as soon as possible after birth. This practice can be performed even in infants who have not received any oral feeds as yet. The volume of the colostrum is small (0.5-2 ml) and it is absorbed directly by the oropharyngeal mucosae.[22] The best time to collect colostrum is within one hour after delivery.

2.5. Trophic feeding or minimal enteral feeding

Trophic feeding is the practice of supplying small volumes of enteral milk feeds (10-24 ml/kg/day)[14] to the infant to promote the development of the immature gastrointestinal tract and is not considered to contribute to nutrition. Start trophic feeds within the first 24 hours of life if possible.[39] Every infant should be evaluated daily for feeding tolerance and judgement should be made with regard to continuance of trophic feeding or introduction of standard progression of feeds. Introduce progression of feeds no later than the fourth day of life, except if there are clinical reasons to prevent the advancement.

2.5.1. Indications or contraindications for trophic feeds

- Trophic feeds are contraindicated in intestinal obstruction or ileus.
- Proceed with trophic feeds in the following conditions: asphyxia; respiratory distress; sepsis; hypotension; glucose disorders; ventilation; nCPAP; and umbilical lines.[40]

2.6. Rate of advance of enteral feeding

In babies weighing < 1 kg at birth and other high-risk infants, start nutritional feeds at 15-20 ml/kg/day and increase by 15-20 ml/kg/day (trophic feeds). If the feeds are tolerated for about 2-3 days, contemplate faster advancement of feeding volumes (30-40 ml/kg/day).

For babies weighing ≥ 1 kg at birth, consider starting with nutritional feeds at 30 ml/kg/day and increase by 30 ml/kg/day.

2.6.1. Supportive evidence and justification

Available evidence and current best practice suggest that a faster advancement of feeding volumes is beneficial, and advancement of feeds should not be less than 30 ml/kg/day in all VLBW and LBW preterm infants. Slow progression of feeds (≤20 ml/kg/day) does not decrease the threat of NEC and may moderately heighten the risk of sepsis and invasive infection.[41] Individual research trials have also found that the 'fast daily increment group' regained birthweight and attained full enteral feeds sooner.[41, 42]

2.7. Assessing feeding tolerance

Feeding tolerance is the competency of the newborn to process, assimilate and absorb milk feeds without difficulties and side effects. Feeding intolerance is the inability to digest, process and absorb enteral feeds with concomitant signs of increased gastric residual volumes (GRV), abdominal distension and/or vomiting. Feeding intolerance is commonly experienced in ELBW and very preterm newborns and frequently interferes with the progression of the enteral feeding strategy. The causes of feeding intolerance may include intestinal immaturity,

microbiota imbalance, colonization of uncommon and sometimes pathological intestinal microflora, and reduced immune responses. Thorough clinical consideration is fundamental to avoid unwarranted restrictions of enteral feed initiation and advancement. Overreliance on intravenous fluids and parenteral nutrition results in delay in reaching full enteral feeding volumes and inadequate growth.[5]

The degree of gut maturity rather than gut dysfunction is implied by the gastric residual volume (GRV) and gastric aspirate colour.[43] As the colour and GRV differ in the early stages of feeding, substantial increases in GRV should not be applied in isolation when deciding to restrict progression of feeds.[44]

2.7.1. Recommendation

- Do not routinely inspect gastric residuals or measure abdominal girth.[19]
- It is pointless to inspect GRV until a minimum feed volume per feed is reached. The following volume thresholds are indicated, depending on the infant's birthweight:
  - < 500 g: 2 ml;
  - 500-749 g: 3 ml;
  - 750-999 g: 4 ml;
  - > 1000 g: 5 ml.
- Once-off green or yellow discoloured GRV is irrelevant.
- Continued vomiting of bile-stained fluid may be a sign of bowel obstruction or ileus.
- Haemorrhagic residuals or vomiting are significant and feeds should be withheld, as they may be an indication of a serious complication. The combination of GRVs and bloody residuals may be an early significant sign for the detection of VLBW infants at risk for NEC.[45] (See management in Section 2.7.4.)

2.7.2. Possible signs of intolerance

Possible signs of intolerance include:

- vomiting;
- gastric residuals > 50% of previous four hours feed volume, persistent or increasing;
- abdominal distension/increasing abdominal girth;
- abdominal tenderness;
- presence, absence or quality of bowel sounds; and
- presence of abnormal stools.

All the above signs can appear in a healthy premature newborn who is tolerating feedings.[45] It is therefore very important to consider these signs together in a clinical perspective.

2.7.3. Signs of necrotizing enterocolitis

Signs of necrotizing enterocolitis include:

- bile-stained or bloody vomitus and/or aspirates;
- visual bowel loops or abdominal discolouration;
- abnormal stools either watery or macroscopically bloody; and
- quick decline in infant's clinical condition.[45]

2.7.4. Suggested interventions if signs of intolerance are present

The following interventions are suggested if signs of intolerance are present:

- immediate clinical assessment by the specialist medical team, who will decide on other interventions that may be needed;
- consider septic screening investigations and/or abdominal x-ray; and
- consider continuing with trophic feeds rather than stopping feeds and keeping the infant nil per mouth. However, if there are clear signs of NEC, all enteral feeds should immediately be stopped and the infant should only receive intravenous fluids, and TPN should be considered. Also consider transferring the patient to a high-care facility if currently cared for in a low-care facility.

Available recommendations suggest undigested milk residuals should be re-fed and feeding continued if:

- residual volumes < 50% of previous four-hour feed volume; or
- residual volumes are present during low volume/trophic feeding.[46]

2.8. Transition from enteral to oral feeds

- Oral feeding is one of the most intricate and coordinated functions a preterm infant has to accomplish. Attainment of complete oral feeding is an essential and significant milestone for LBW and preterm infants as it is generally the most important measurement in evaluating discharge readiness. Feeding difficulties are the most common reason for protracted hospital stays as well as readmission after discharge.[44]
- At birth, very preterm infants are not neurodevelopmentally equipped to achieve the intricate coordinated oral feeding action. They do not have the cardiorespiratory and neurological steadiness, mature oral-motor skills, digestive tract maturation and suck-swallow-and-breathe coordination capability for oral feeding. Pathology that results in extended respiratory assistance, digestive tract immaturity and issues such as illness and sepsis can further postpone the initiation of oral feeding and have long-lasting consequences on growth and neurodevelopmental outcomes. The above factors, as well as distinctive morbidities, individual growth and developmental patterns influence

each infant to develop feeding readiness and competence on a diverse pathway and timeline.[47]

- Introducing preterm infants to breastfeeding is safe. It appears breastfeeding is less taxing and draining than bottle feeding based on heart rate, respiratory rate and oxygen saturation.[48] Evidence from research studies proves that the oxygenation and body temperature in breastfeeding infants are extra steady, in contrast to bottle-fed infants.[49] Even though less milk is suckled and transferred with breastfeeding, it is a preferred feeding method because of the physiological stability in the infant.[50] The mechanism behind the enhanced physiological steadiness with breastfeeding is mainly due to less disrupted respiration.
- As soon as infants are physiologically stable and able to suck-swallow-and-breathe in a coordinated manner, they should transition from enteral feedings (gastric tube) to oral feedings. The decision to introduce oral feeds should not be one-dimensional, based only on random weight or gestational age criteria, but should be holistic, and all feeding readiness factors should be considered.[31] Most infants can start oral feeding such as breast or cup feeding far earlier than hitherto believed, with some infants breastfeeding as early as 28 weeks and some reaching full nutritive breastfeeding at 36 weeks.[47]
- Signs of readiness in the infant for introduction to the breast include:
  - stability when handled and no signs of continuous physiological deterioration such as bradycardia or oxygen desaturation;
  - ability to swallow and control own secretions; and
  - evidence of sucking movements on a clean finger or the emptied breast.
- There is evidence that early efforts at oral feeding may accelerate physiological maturation of the complex sucking action.[51]
- Early introduction of skin-to-skin care has been shown to be safe and valuable in supporting physiological stability and breastfeeding in preterm infants.[52] It introduces, relaxes and prepares the mother to confidently hold her premature infant for future feeding.
- Skin-to-skin care, non-nutritive sucking and timely presentation of the breast after birth have been associated with improved breastmilk production and longer breastfeeding duration after discharge from hospital.[44]

2.9. Determining the primary method and timeline of delivering fluids and feeding

Figure 2 provides a graphic depiction of the timeline for introducing enteral feeds and the transition from tube to breast and cup feeding. Figure 3 provides more detail on the weight and gestational-age categories, transition and timeline of enteral feeds.

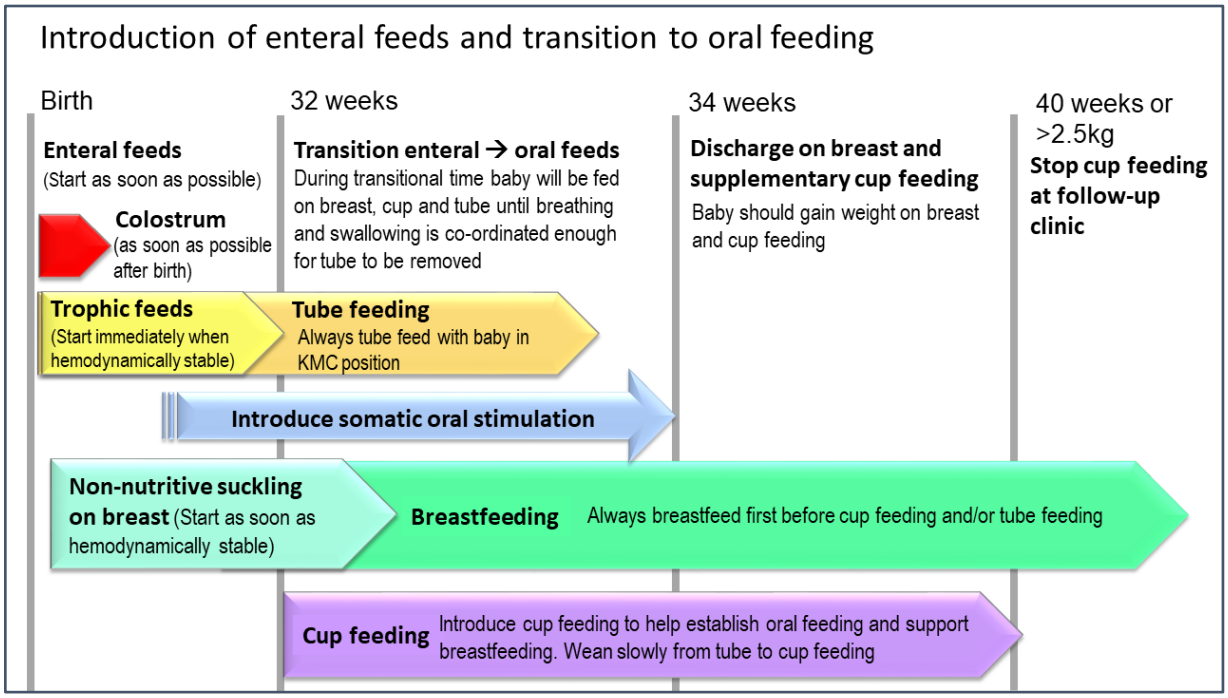
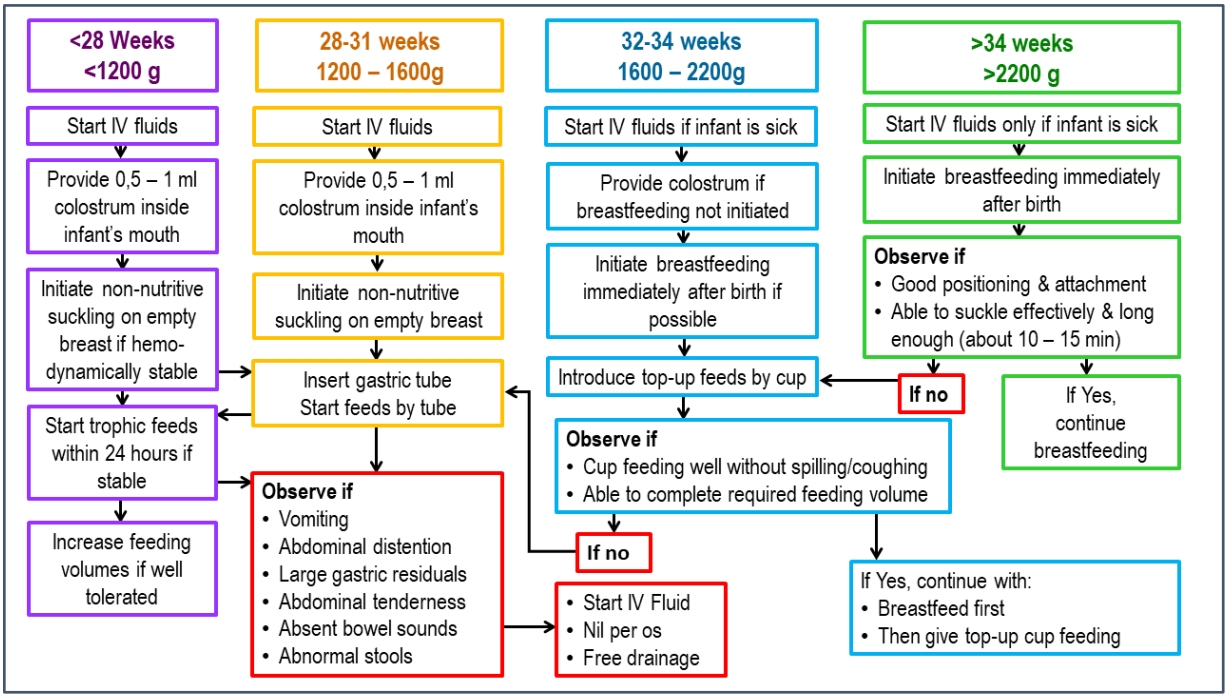


Figure 2. Timeline of when enteral feeds should ideally be introduced and the transition process from tube to breast and cup feeding

(This diagram is also reproduced in landscape format in Annex F as a job aid for printing.)

- Factors that influence the approach to selecting the method(s) of supplying feedings and fluids to newborn infants include birthweight, gestational maturity and physical condition (illness) of infant (*see Figure 3*).
- Most infants are able to coordinate suck-swallow-breathe actions by 34 weeks gestation. The majority of infants beyond 34 weeks (birthweight around 1800 g) should be able to suckle directly from the breast. However, these infants may not suckle strongly or in a sufficiently coordinated manner to take in the full volume of milk that is needed for them to gain weight and thrive. Initially they often need top-up cup feeding with expressed breastmilk after each breastfeeding session. Top-up cup feeds can usually stop as soon as an infant matures and reaches term gestation, or reaches a weight of > 2.5 kg.
- Infants with a gestational age between 30 and 34 weeks (birthweight above 1200 g) are commonly able to swallow well and synchronize breathing, but are often unable to suckle strongly and sturdily from the breast for a lengthy period of time. To ensure that these infants receive enough breastmilk for good growth, they are given expressed breastmilk with a cup, which is less tiring and is not reliant on a sucking action.
- Infants who are very premature at birth – below 30 weeks gestation or birthweight below 1200 g – are frequently unable to take feeds orally because of poor coordination of swallowing and breathing. They require enteral feeds through a gastric tube, as oral feeding carries the risk of lung aspiration.

- Additionally, small, sick and unstable infants (of any gestation or weight) who are unable to tolerate enteral feeds will need intravenous fluids and TPN provided to them while they are kept nil per mouth. Enteral feeds are commenced as soon as they are stable.
- All the above infants should receive colostrum as soon as possible after birth or as soon as the mother can produce colostrum. These include sick and unstable infants.



Adapted from the Government of India's 'Feeding Guidelines for LBW Infants', (2014) (p. 22)[38]

Figure 3. Flow diagram for providing fluids and feeds for preterm and LBW infants

(This diagram is also reproduced in landscape format in Annex F as a job aid for printing.)

2.10. Feeding progression and transition

As the infant's feeding proficiency improves and matures, there should be a stepwise progression from the first feeding option through the transitional alternatives until the infant is strong and mature enough to breastfeed exclusively. The end purpose of the feeding advancement and transition is to guarantee the establishment of direct, exclusive breastfeeding.

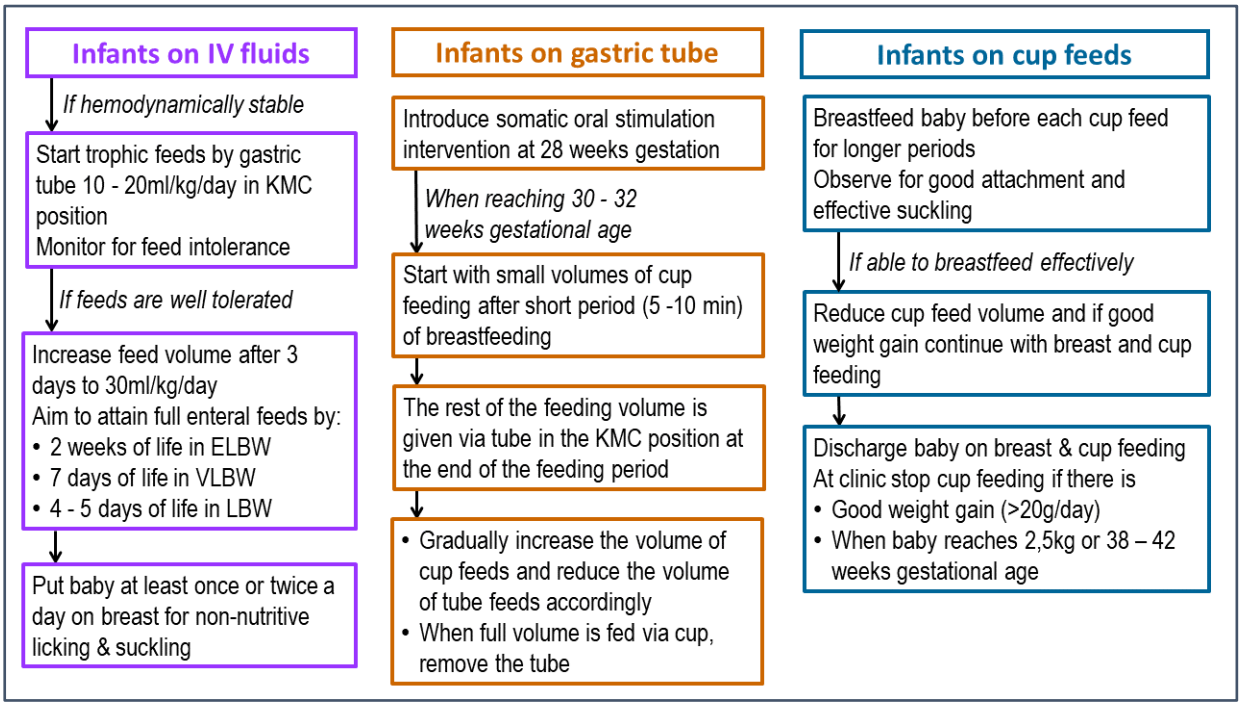
At first, LBW infants will start with separate feeding options dependent on their weight, gestation, feeding ability and any comorbidities that may influence their feeding ability. For advancement of feeding, it is crucial to episodically evaluate the infant's feeding skill in order to transition to the subsequent feeding mode. A 'feeding diary' based on the preterm infant breastfeeding behaviour scale (PIBBS)[53] is available to assess the infant's feeding ability and

progress in the different feeding modes when weaning from tube feeding and introducing oral feeds. An example of this feeding diary is included in Annex G.

The mother whose infant is breastfeeding efficiently at birth, should receive support and encouragement to breastfeed exclusively for at least six months. An infant receiving expressed breastmilk (EBM) via alternate enteral or oral methods (tube, spoon or cup) should be given numerous chances to suckle at the breast prior to being offered an alternative feeding method. When the infant starts to feed effectively at the breast, the alternative types of feeding are reduced gradually, over days or weeks, and eventually discontinued.

When a baby is on full-volume tube feeds, the baby is introduced to other oral feeding methods when mature enough. By this time the baby should have been practising non-nutritive sucking on the empty breast. Now the baby is placed on the breast to suckle for a short time before milk is expressed and the baby is allowed to complete the tube feed afterwards.

When cup feeds are introduced, mothers are advised to first breastfeed for 10 to 20 minutes; then cup feed the volume that the baby can manage; lastly, the balance of the feeding volume is offered via a gastric tube while the baby is secured in the KMC (skin-to-skin) position on the mother's chest. This cycle of feeding continues until the baby is weaned from tube feeds and the whole volume of top-up EBM is given via cup after longer feeding sessions on the breast (*see Figure 4*).



Adapted from the Government of India's 'Feeding Guidelines for LBW Infants', (2014) (p. 22)[38]

Figure 4. Principles of alternative feeding method transition from tube to cup to exclusive direct breastfeeding

(This diagram is also reproduced in landscape format in Annex F as a job aid for printing.)

An infant receiving IV fluids and/or TPN should preferably be started on trophic (small) enteral feeds as soon as the infant's condition allows it. With the proviso that the infant tolerates these feeds for several days (3-4 days), the volume can be advanced faster and IV fluids decreased. When 60-70% of the daily fluid requirement is tolerated as enteral feed (about 120-130 ml/kg/day), the IV fluids can be stopped and the volume of enteral feeds increased by 30-40 ml/kg/day over the ensuing days until a maximum volume of 150-200 ml/kg/ day is reached. When the infant displays readiness cues for introducing oral feeding, the infant should be allowed to suckle on the breast for short periods and small quantities of breastmilk can be introduced by an alternative oral feeding mode. The infant then advances to exclusive breastfeeding as described beforehand.

2.10.1. Scheduled versus responsive feeding

The latest 2022 WHO recommendations state that "in health-care facilities, scheduled feeding may be considered rather than responsive feeding (feeding on demand) for preterm infants born before 34 weeks' gestation, until the infant is discharged" (p 33).[26]

Feeding on demand or responsive feeding is the customary way of feeding healthy term infants irrespective of cultural settings and education levels. Practising responsive feeding requires family sensitivity and attentiveness to auditory and visual signs or cues from the infant. Most caregivers have an instinctive attentiveness to respond to these cues but caregivers can be taught and learn how to be responsive to their infants' feeding needs.

Preterm infants are often quiet, lethargic and sleepy for several weeks after birth. They are also much less responsive to stimuli from the mother and environment. Most parents of preterm infants find it difficult to understand and interpret these responses and feeding cues correctly, as they are much more subtle compared to term infants' cues. For this reason responsive feeding often does not meet the sick or preterm infant's nutritional needs and scheduled feeds are the preferred method of feeding these infants. If responsive feeds are to be considered, health care providers should receive careful and intensive training in supporting families in order to ensure that an infant's feeding needs are met. Current evidence is insufficient to understand the effects of responsive feeding compared to scheduled feeding on health outcomes in sick and small infants.[54]

2.10.2. Scheduled feeding: How often to feed

Sick and small newborns are normally fed every three hours (at least eight times in 24 hours). Research has shown that a three-hourly feeding timetable is just as safe as a two-hourly timetable in preterm neonates. The three-hourly schedule is less work intensive and allows nurses more time for other tasks. Mothers practising KMC find this schedule much less time-consuming and exhausting.[55] If the baby struggles to complete the full required feed volume

and spits up, the feeding frequency can be increased to 10 feeds per day. When giving 10 feeds per day, the baby will receive two-hourly feeds from 06:00 until 18:00. Thereafter the feeds are given every three hours during the night. This allows the mother to have some rest at night. If she has to feed her baby every two hours at night, she may not cope and could leave out feeds, which would be detrimental to the baby.

2.10.3. Scheduled feeding: How much to feed

Most guidelines have job aids providing tables or charts with daily fluid requirements for a newborn infant. The amount of each feed volume is determined on the basis of the daily fluid requirement charts.(*see Annex A, Tables 6-8*). It is important to use the baby's birthweight to calculate the feeds until the baby has regained birthweight; thereafter, use the daily weight.

It is usual clinical practice to start LBW infants of ≥ 1500 g on 60 ml/kg fluids on the first day of life. Infants < 1500 g usually start on 80 ml/kg fluids on the first day of life and infants ≤ 1000 g will receive 90-100 ml/kg fluids. The feeds and/or fluids are increased by 15-40 ml/kg/day to a maximum of 150-180 ml/kg/day by the end of day 5-10 of life, depending on the baby's maturity and weight (*see Annex A, Tables 6-8*). The 2022 WHO guidelines state: "In preterm or low-birth-weight (LBW) infants, including very preterm (< 32 weeks' gestation) or very LBW (< 1.5 kg) infants, who need to be fed by an alternative feeding method to breastfeeding (e.g. gastric tube feeding or cup feeding), feed volumes can be increased by up to 30 ml/kg per day" (p 36).[26]

To calculate the daily feeds: (weight x ml/kg) ÷ 8 (number of feeds in 24 hours) = ml per feed.

Annex I contains a case study that illustrates the calculation of feeding volumes.

2.11. Somatic-oral stimulation intervention

Much research has been done on improving the feeding action of small and preterm infants. Interventions such as oral and somatic stimulation in preterm infants have a beneficial impact on preterm infants' oral feeding successes and improve the progression of preterm enteral feeding by tube and the transition to breast and cup feeding.[13] A systematic review, for example, found that the adjustment time to full oral feeding and length of hospital stay were significantly shortened and feeding competence improved sooner.[56]

Somatic stimulation involves stroking the skin of the infant's four limbs and abdomen. The stroke action is firm and careful, with the stroke direction always towards the mouth. Two or more fingers should be used and the stroking action should only be done twice in each area to prevent overstimulation and stress in the infant.[12] See the full explanation and illustration of somatic stimulation in Annex C.

Before performing oral stimulation, the baby should be snugly swaddled in a blanket with hands close to the face. Swaddling helps to calm baby, reduce stress and ensure that baby's position is appropriately maintained, well-supported and contained when performing oral stimulation and when breast and/or cup feeding.[57] See Annex C for an illustration of the swaddling technique.

Oral stimulation involves stroking perioral skin and intraoral mucosa over specific anatomical structures. The stroking is delivered in a firm but careful action, using the mother's clean finger or the therapist's or health worker's gloved finger for a quantified period of time (three minutes), before each feeding session during the day (five feeding sessions). The stroking facilitates the enhancement and maturation of oral motor and sensory abilities necessary for sucking and swallowing.[13] A somatic-oral stimulation programme developed by the Speech Language Pathology and Audiology Department of the University of Pretoria in collaboration with the Department of Paediatrics at Kalafong Provincial Tertiary Hospital is included as a job aid in Annex C that explains and demonstrates the somatic-oral stimulation techniques for successful breastfeeding.

It is strongly recommended that a mother be coached to conduct the intervention for her own baby. When feeding is in the mother's hands, she becomes aware of her baby's day-to-day progress. She also gains experience and confidence to feed her baby before and after discharge. The practice of KMC is also very beneficial to the baby to establish oral feeds. The skin-to-skin position stimulates the secretion of oxytocin that has a neuroprotective function and causes stimulation of the parasympathetic nervous system (PSNS). The vagus nerve is the main nerve of the PSNS and vagal stimulation helps with absorption of feeds. This is the reason why the baby should always receive tube feeds while in the KMC position.[58-61]

Benefits of this intervention include:

- It helps to wake baby up and prepare for a feed.
- It helps baby to move from tube feeding to cup and breastfeeding.
- Baby calms down, breathes more easily and the heart rate slows down.
- Baby gains weight more quickly and may be discharged sooner.[56]

2.12. Nutritional considerations on discharge

All breastfed babies tend to lose weight after birth. Depending on birthweight and gestational age, they regain their birthweight within 7 to 21 days. The acceptable weight that a baby may lose after birth should not exceed 7-10 per cent of birthweight in term infants.[62] Preterm infants may also lose 7-10 per cent of birthweight, but may take slightly longer (10 to 21 days) to recover birthweight, depending on the weight at birth and the degree of prematurity. The smaller and more premature the baby, the longer it will take to regain birthweight.[63]

Example 1. Weight loss in babies after birth

- A term infant weighing 3500 g may safely lose 300-350 g and regain birthweight within five to seven days.
- A smaller baby of 1300 g should not lose much more than 130 g and may only regain birthweight at 14 to 15 days of life.
- A 1000 g baby may take 17 to 21 days to regain birthweight and should not lose more than 100 g.

Practical experience of over 20 years at Kalafong Provincial Tertiary Hospital suggests that it is best if babies with a birthweight of more than 1550 g are only discharged after they have regained their birthweight and breast- and cup feeding has been established properly. Three key questions to answer about the baby when considering discharge are the following:

(1) *Has the mother established direct breastfeeding and is she providing good volumes of expressed breastmilk for top-up cup feeds?*
When the baby has recovered from all medical problems, the main consideration for discharge is whether breastfeeding and supplementary breastmilk feeding (expressed milk via cup feeding) have been established successfully.

(2) *Is the baby gaining weight?*
An acceptable weight gain for small babies is 15-20 g/day, and for term infants, 20-30 g/day. It is important to see that the baby is thriving and gaining weight for at least three consecutive days before considering discharge.

(3) *Has the baby regained birthweight?*
If not, consider delaying discharge, or making special arrangements to closely follow up these babies. VLBW and ELBW babies should also preferably attain a weight of 1550-1600 g before discharge is considered. Babies could be discharged at a lower weight but then the baby should be followed up very closely and be seen at least twice a week. If close follow-up is not possible, the baby should stay longer in the hospital.

2.12.1. Criteria to consider for discharge

Criteria for discharge of preterm infants may vary between countries or hospitals, depending on the unique settings and circumstances. It is unwise to use a single factor, such as a baby's weight gain, as the sole criterion for discharge. The discharge criteria below draw from national and hospital protocols in Eswatini, Rwanda, South Africa and Uganda.

Discharge criteria regarding the baby

(a) Feeding and growth

- Consider discharge only if the baby shows mature feeding skills. The baby should suckle well on the breast and finish the full volume of top-up cup feeds at each feeding time.
- There should have been good daily weight gain of approximately 20 g/day over the last three consecutive days.
- All LBW and premature babies should preferably have regained their birthweight. Single infants with a birthweight of less than 1550 g must reach a weight of 1550 g before discharge should be considered. In the case of twins or triplets, discharge can be considered when the smallest baby has reached a weight of at least 1600 g.

(b) Physiological maturation

- All preterm babies should have a corrected gestational age of at least 34 weeks before discharge can be considered, regardless of weight gain. More immature babies are at risk of developing apnoea of prematurity.
- Physiological milestones usually attained between 34-36 weeks' corrected gestational age that are important indicators of discharge readiness include thermoregulation, control of breathing, respiratory stability (absence of apnoea), feeding skills and weight gain.
- There is individual variability with respect to babies reaching physiological maturity. This is particularly noted in extremely preterm infants (< 28 weeks' gestation), who often require more time to reach discharge readiness.[64]

(c) General

- The baby's condition should be stable, with vital signs within the normal range, and the baby should be passing urine and stool normally.
- There should be no illness or danger signs such as fever, lethargy, vomiting, diarrhoea, fast breathing, refusal to feed from the breast or cup, severe jaundice, purulent (pussy) discharge from eyes or umbilicus, and convulsions.
- Temperature should be within the normal range (36.5-37.5°C) whilst in KMC position for three consecutive days.
- There should be an absence of respiratory distress, breathing difficulty or apnoea. Infants who have been oxygen-dependent should be off all oxygen and maintain oxygen saturation between 88-95 per cent, day and night, for three complete days before discharge.
- Babies with neonatal encephalopathy (NE) complicated by convulsions should have had no further convulsions if on maintenance therapy, or for at least 72 hours after anticonvulsant therapy has been stopped.[65]

Discharge criteria regarding the mother

(a) Breastfeeding and feeding skills

- Make sure the mother has a good supply of breastmilk and that she has learnt to express breastmilk manually.
- Mothers should have mastered the skill of breastfeeding their babies directly from the breast and be confident in feeding top-up expressed breastmilk using alternative methods (i.e., cup feeding).
- Mothers of babies with feeding difficulties should have been trained in somatic-oral stimulation to ensure good feeding skills in the baby (*see Section 2.11 and Annex C*).
- In cases of severe NE or certain genetic conditions, it may be impossible to wean the baby from gastric tube feeding. If the medical team and parents agree, these babies may be sent home with the gastric tube in place. In such instances, the mother or caregiver should receive training in gastric tube care prior to discharge.

(b) General infant care

- Mothers should be practising KMC consistently. Keep a mother for at least three days in the KMC ward or unit together with her baby to enable her to learn how to care for her premature baby using KMC.
- Mothers should be confident in the care of their babies: holding the baby correctly by supporting the neck and keeping baby in a flexed position, changing the nappy, proper skin care, washing the baby, administering medicine, etc.
- Mothers should be knowledgeable in monitoring their babies and recognising danger signs.

(c) Social circumstances

- The social circumstances of the mother should be considered when contemplating discharge. Mothers from poor social circumstances and little family support should be kept in the hospital longer.
- A teenage mother should only be discharged once the degree of support she will have in caring for her baby has been discussed and established with her parents, family or other caretakers. If she intends to go back to school, the baby's caretaker should come to the hospital and be instructed regarding feeding, care of the baby and hygiene.
- Identify available community resources and support systems for teenage mothers and single caregivers.
- If a mother plans to return to a rural area and does not intend to bring the baby back to the follow-up clinic at the hospital, discharge should be delayed. Special arrangements for referral to the nearest health centre or clinic in her area should be made and steps for follow-up at this clinic should be communicated to the mother.

- Mothers who are ill should have recovered, or there should be an alternate home caregiver for the baby. This person should be instructed regarding feeding, infant care and hygiene.

2.12.2. Discharge arrangements

- The mother should understand the baby's follow-up immunization schedule and when she should visit the local clinic.
- All very preterm infants (< 32-34 weeks gestational age) should undergo ophthalmologic screening for retinopathy of prematurity (ROP), where available. Ensure that the mother knows the ROP follow-up plan.
- Ensure that routine cranial ultrasound screening for all newborns with a birthweight < 1500 g or born < 32 weeks gestation is, where possible, finished before discharge or that the baby has been booked as an outpatient at follow-up.
- Make sure that medications or supplements for the baby have been prescribed or given to the mother or caregiver. Demonstrate the correct dosage and administration of all prescribed medications to the mother. These include:
  - Multivitamin drops daily (Vidaylin 0.6 ml/day).
  - Iron prophylactic supplementation starting at two weeks of age and continuing until 12 months in all babies < 1800 g. High iron dosages can cause oxidative damage and may increase the complications of ROP. The dosage is expressed as elemental iron (eFe^{+}). There are differing quantities of elemental iron in different iron supplement formations.[30]
    - Ferrous sulphate (150 mg in 5 ml = 30 mg eFe^{+} equals 6mg eFe^{+}/1 ml).
      Prophylaxis: 2-3 mg eFe^{+}/kg/day (0.3-0.5ml/kg/day).
      Treatment dose: 3-6 mg eFe^{+}/kg/day (0.5-1 ml/kg/day).
    - Ferrous gluconate (350 mg in 5 ml = 42 mg eFe^{+} is 8.4 mg/1 ml).
      Prophylaxis: 23 mg eFe^{+}/kg/day (0.2-0.4 ml/kg/day).
      Treatment dose: 3-6 mg eFe^{+}/kg/day (0.4-0.7 ml/kg/day).
    - Where laboratory facilities are available, it is sometimes valuable to send blood for ferritin levels in the extremely preterm and ELBW infants close to discharge. If baby's ferritin concentration is < 60 μg/l, the iron dose should be increased to the treatment dose. If ferritin concentration is > 300 μg/l, iron supplementation should be delayed. (The high ferritin is often due to multiple blood transfusions.) Infants with high ferritin levels are prone to recurrent infections.
  - Vitamin D supplementation. Preterm infants should receive at least 800 IU vitamin D per day for improved calcium absorption from the gut. There is already 400 IU in

the multivitamin preparation. A further 400 IU should be added for premature and LBW infants.[30]

- Make sure the mother and other caretakers know the danger or warning signs of illness. Explain what they should do and where they should go if there are any worrying signs.
- Emphasize the importance of continuing with the practice of KMC at home, night and day. It is very important that the baby remains warm and does not become hypothermic. When not in the KMC position, the baby should be swaddled in blankets and placed on the back (supine), not on the side (lateral) or the tummy (prone).
- Confirm the feeding times and feeding methods with the mother while at home: preterm infants must be fed according to a three-hourly feeding schedule, day and night. Each feed entails milk expression, breastfeeding, and feeding the top-up breastmilk via cup. The mother should understand that each feed includes breastfeeding and giving the top-up breastmilk – she should not skip either of the two steps at any feed in a 24-hour day. Write feeding information down on the discharge documents so the information also reaches the follow-up clinic. (Feeding on demand is for healthy term babies.)
- The mother should breastfeed exclusively for six months and then introduce a soft diet. If possible, she should continue with breastfeeding until baby is two years old.
- Educate mothers and other caretakers on hygiene and infection prevention and control practices and explain the follow-up schedule for the baby at the clinic to monitor feeding and growth.

Discharge process

- All newborns discharged from the neonatal unit should have a complete physical examination prior to discharge.
- Prescribe the appropriate treatment (e.g., HIV prophylaxis) and supplements.
- The baby's weight, length and head circumference should be plotted on a growth chart starting on the day of birth and continuing throughout the follow-up of the baby. The growth chart is often part of the baby's immunization documents. If not, the chart should be attached to the follow-up documents that the mother brings to all follow-up appointments.
- Complete the neonatal file and a discharge summary or form about the baby's treatment on discharge.
- Make sure all follow-up appointments have been scheduled and the follow-up plan discussed and explained to the mother and her family.

2.13. Nutritional follow-up after discharge

It is important to ensure regular follow-up for the mother and the baby, either at the discharge hospital or health facility, at a local clinic, or by a skilled provider near the baby's home. The smaller the baby at the time of discharge, the earlier and the more frequent follow-up visits should be.

The principles for follow-up arrangements below reflect national and hospital protocols collected from Eswatini, Ethiopia, The Gambia, Rwanda, South Africa (Kalafong Provincial Tertiary Hospital), Tanzania and Uganda.

2.13.1. General principles for timing of follow-up visits

- Small preterm babies (< 1800 g) should be reviewed more frequently than term babies, with preferably weekly visits at the nearest health facility with a KMC programme.
- If weight gain at the first follow-up visit is adequate (> 20 g/day), the next follow-up appointment can be in two weeks' time, provided that the current weight is above 1800 g.
- If weight gain is 10-20 g/day, assess for possible causes of poor weight gain and schedule a follow-up visit within one week.
- If weight gain is < 10g/d or weight loss has occurred, investigate for an underlying infection and consider readmission for close supervision.
- Larger babies (between 1800 g and 2000 g) should be reviewed within 14 days post discharge. If weight gain is satisfactory (25-30 g/day), then follow-up can be stretched to 3 weeks.
- Babies between 2000 g and 2500 g can be seen after three weeks. If weight gain is adequate (25-30 g/day), babies can be seen again in four weeks' time.
- Continue follow-up until the baby reaches 45 to 50 weeks postmenstrual age or a weight of more than 3000 g in preterm infants. Term infants may be seen for at least 6-12 weeks and if necessary, referred for further follow-up. At some institutions, all premature babies are closely followed up for at least one year.

2.13.2. General procedures at the follow-up visit

Anthropometry *(Example 2)*

- Weigh the baby (naked), and measure the head circumference and body length.
- Calculate the daily weight gain using the baby's weight on the date of discharge and the current weight, by subtracting the weight gain and dividing by the number of days since discharge. A good average weight gain for premature babies is 20-30 g/day and for term babies, 30-40 g/day.

Example 2. How to calculate daily weight gain

A baby was born on 4 February with a birthweight of 1520 g and discharged on day 20 of life on 24 February with a discharge weight of 1650 g. At follow-up clinic on 4 March (day 28 of life) the baby weighed 1850 g.

The baby's weight gain from the discharge date was: 1850 – 1650 = 200 g.

There were eight days from the discharge date to the follow-up date. (February has 28 days, thus four days in February and four days in March add up to eight days.)

The baby's weight gain per day was: 200 ÷ 8 = 25 g/day.

Calculate corrected gestational age *(Example 3)*

- To correct or adjust for prematurity it is helpful if the baby's gestational age is known. At the follow-up visit, it is important to work out the current or corrected gestational age. By doing this, one automatically adjusts the baby's age according to how premature the baby was at birth.
- Most preterm infants' ages are corrected or adjusted when plotting their measurements on growth charts for at least the first year of life. Adjustment may continue up to two or even three years of age in ELBW and extremely preterm babies. The measurement is plotted according to the corrected age and not the chronological age. (The chronological or actual age is the age of a baby calculated from the date of birth in days, weeks or months.)
- The baby's age is corrected or adjusted by (a) subtracting the number of weeks that the baby is born early (before 40 weeks gestation) or (b) by adding the weeks to the gestational age at birth. Plotting is possible up to 50 weeks' gestation on the foetal-infant growth chart (*see Annex E, Figure 10*).

Example 3. How to correct or adjust a preterm baby's age

(a) For an example of how to adjust a preterm baby's age to match that of a term baby, consider a baby born 40 – 33 = 7 weeks early. Seven weeks can be subtracted from the baby's chronological age to correct it for prematurity. If the baby is 16 weeks old chronologically, the baby's adjusted age would be 16 – 7 = 9 weeks old.

(b) Alternatively, the gestational age can be computed to aid comparability between preterm and term babies. Consider a baby born at 33 weeks' gestational age. When baby is chronologically four weeks old, add four weeks to the birth age to calculate the gestational age. Thus 33 + 4 = 37 weeks. When the baby is eight weeks old the baby has a gestational age of 33 + 8 = 41 weeks.

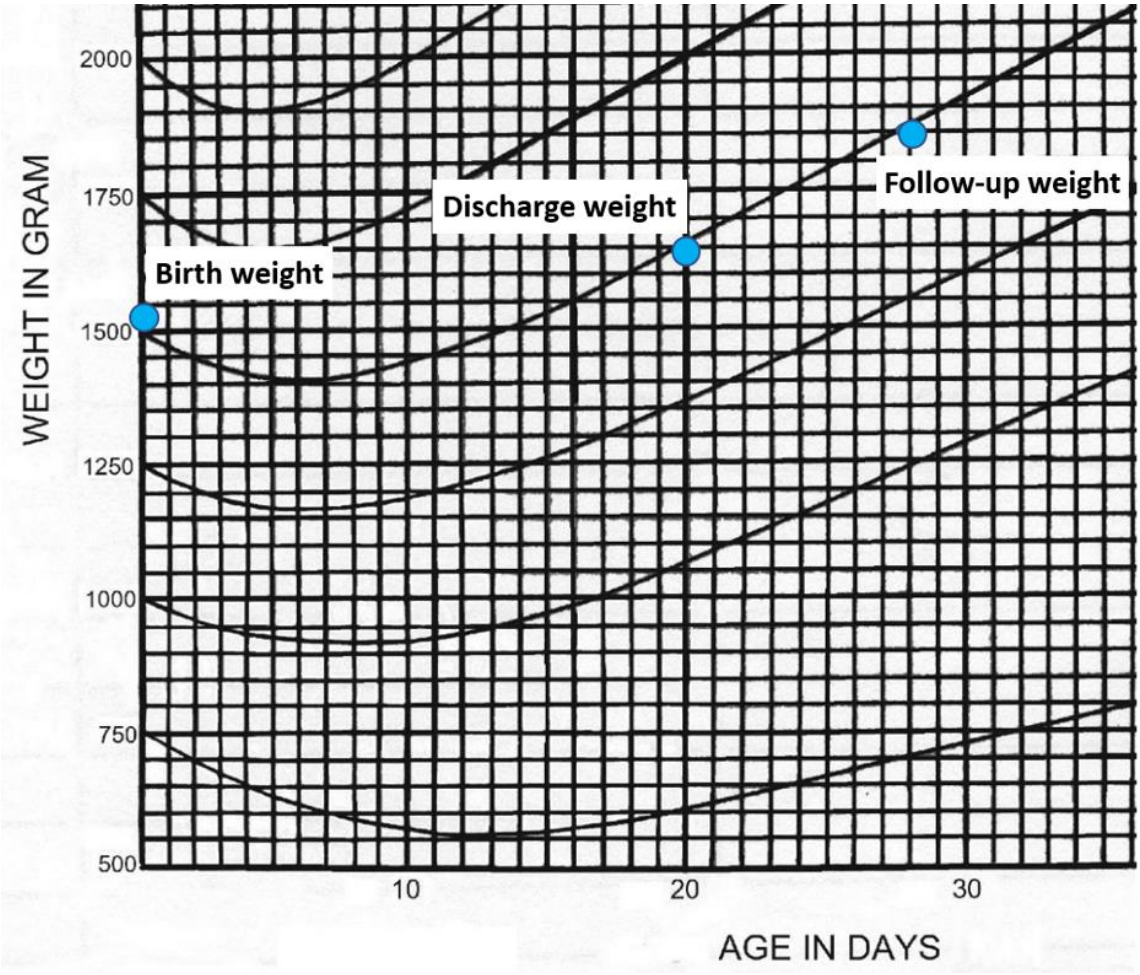
The baby in Example 2 above was born on 4 February with a birth gestational age of 33 weeks.

February has 28 days, thus baby was 24 days old on 28 February. On 4 March baby was 24 + 4 = 28 days old. Convert days to weeks by dividing total days by 7. Thus 28 ÷ 7 = 4 weeks. The corrected (adjusted) gestational age is 33 + 4 = 37 weeks.

Plot the measurements on the growth charts (*Examples 4 and 5*)

- It is always important to have more than one measurement point to be able to see the trend of a baby's growth. If possible, start with the birthweight and any other weight that is available. The more measurements one can plot, the better. (Blank templates of the daily weight chart and the foetal-infant chart can be found in Annex E, Figures 9 and 10.)
- Plot the weight on the daily weight chart if the baby is premature and less than 50 days old. This chart is often used while the baby is in hospital to plot weight gain daily. One can continue using this chart at follow-up if the baby is not older than 50 days.
- On the foetal-infant growth chart, the weight, head circumference and length can be plotted for all preterm and term infants. The foetal-infant growth chart continues until the baby reaches a gestational age of 50 weeks. Thereafter, use the WHO growth, head circumference and length charts to follow up the baby's growth at local clinics. The WHO growth charts can be obtained at: https://www.who.int/tools/child-growth-standards.

Example 4, Plotting the weight on the daily weight chart



This baby is growing well. The baby's weights follow the growth curve line closely.

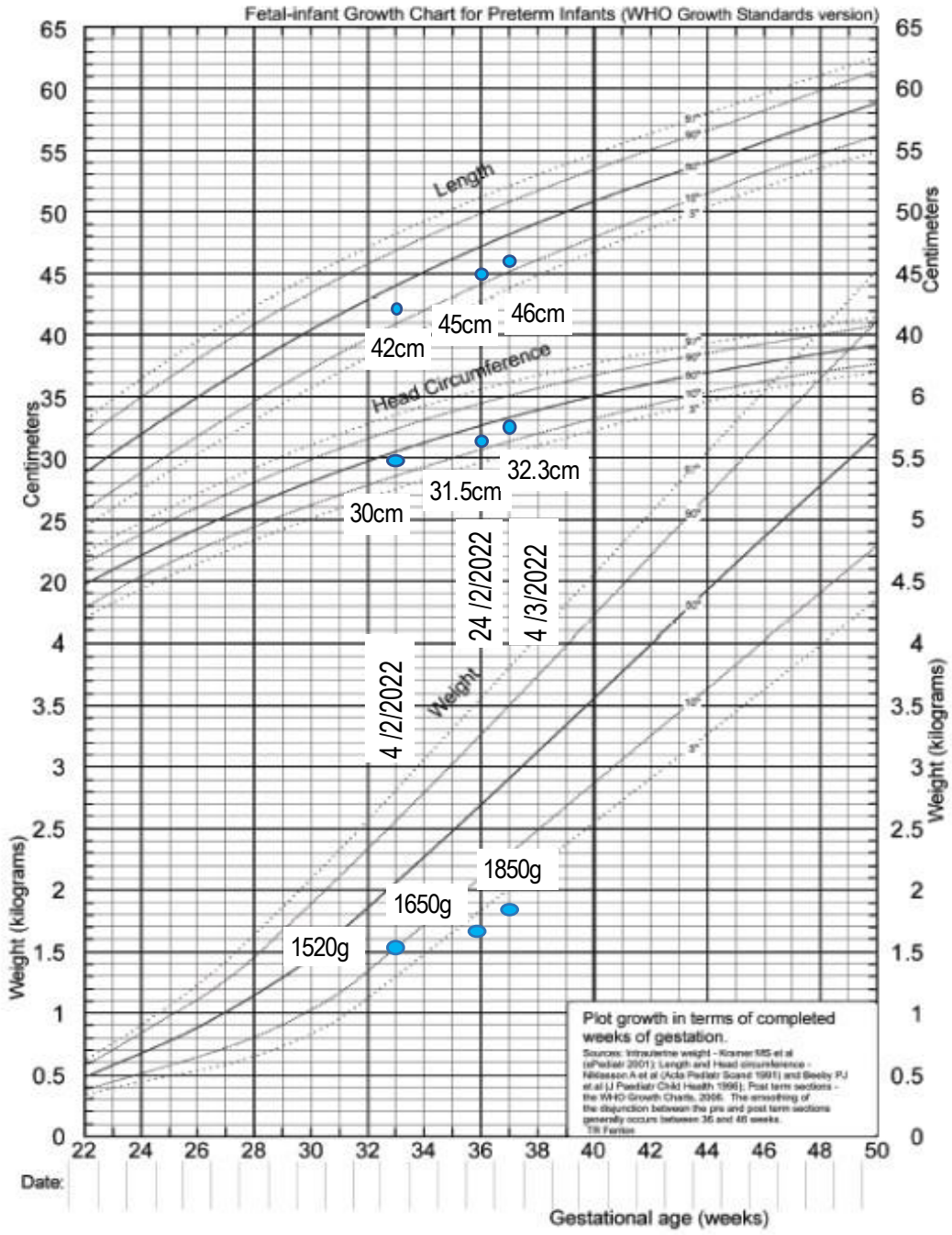
Obtain a feeding history from the mother or caretaker (*Example 6*)

Know whether the mother is following the feeding instructions that she received on discharge. This is only possible if the feeding instructions are documented in the baby's immunization booklet or clinical summary on discharge.

Asking the following questions can be very helpful in obtaining a feeding history:

- *Is the mother breastfeeding only or is she still topping up with expressed breastmilk?*
- *How much is the volume of top-up feeds and is she giving them at every feeding time?*

Example 5. Plotting the foetal-infant growth chart



- *Does the mother have a good supply of breastmilk? Is the mother struggling to express the required amount of top-up breastmilk for every feed?*
  - If the mother has problems with adequate breastmilk supply, the following advice can assist:
  - Encourage the mother to increase daily fluid intake. She should drink two to three litres of fluids every day.

- Stimulate milk production by encouraging the mother to drain her breasts after each feed by expressing until the breasts are soft and feel empty.
- Encourage the mother to eat a good diet containing sufficient protein.
- Where available, the mother can be given a galactagogue to stimulate milk production. These are medications that stimulate breastmilk production as a side effect.

- *How frequently is the mother feeding the baby? Is the mother breastfeeding at every scheduled feeding time?*
  - The mother should be feeding a preterm infant every three hours on a set schedule. The baby should be fed at least eight times per 24 hours.
  - As soon as the baby is over 40 weeks in gestational age and weighs more than 3000 g, the baby may be fed on demand.
  - Advise the mother to continue with the same feeding schedule. If the baby has reached a weight of 2500 g or a gestational age of 40 weeks, consider reducing and stopping the expressed milk top-ups. Reduce the volume weekly and stop all expressing after two to three weeks.

Example 6. How to reduce and wean top-up cup feeds at follow-up

A baby with a birthweight of 1520 g (at a gestational age of 33 weeks) visited the follow-up clinic, where it was confirmed, the baby was receiving breastfeeding and top-up expressed breastmilk of 30 ml with each feed (*see Examples 2 and 3 above*). The baby was discharged from hospital at 20 days of age and weighed 1650 g. At this first follow-up visit, eight days after discharge, the baby weighed 1850 g (gestational age of 37 weeks) and had gained 25 g/day. The mother was advised to continue with the same feeding regime.

At the second follow-up visit, 14 days later, the baby was growing very well and was gaining 35 g/day. As weight gain was strong, and seeing that the baby now weighed 2290 g, the mother was advised to reduce the top-up expressed milk volume to 20 ml per feed to prevent overfeeding the baby. The baby's gestational age was 39 weeks.

At the third visit, three weeks later, the baby had gained 40 g/day and weighed 3130 g. The mother was advised to stop expressing breastmilk and to breastfeed the baby on demand. The baby was now 42 weeks' gestational age.

Actions and considerations when a baby has poor weight gain or has lost weight

Poor weight gain at follow-up clinic is when a baby is gaining less than 20 g/day for preterm infants, or 30 g/day for term infants. Usually these babies will also have a poor growth curve when plotting their weight on a growth chart.

- Babies who have a weight gain between 15-20 g/day should be seen again within one week.
- If weight gain is between 10-15 g/day the baby should be seen within one week or even sooner. Consider excluding infection.
- Weight gain of less than 10 g/day or actual weight loss is serious and these babies should preferably be readmitted to the hospital and investigated to exclude an infection.
- Questions to ask and issues to consider with poor weight gain or weight loss:
  - *Does the mother have enough milk?*
    The baby may have few wet nappies per day (normal is 6-7 wet nappies per day) and may be very irritable or show feeding cues before scheduled feeding times.
  - *Is the baby suckling well from the breast?*
    A baby with a poor suckling technique may suckle with long resting times in-between suckling bursts or there may be an audible clicking sound while suckling.
  - *How long does the baby suckle actively on the breast?*
    Suckling for only 5-10 minutes is not sufficient. However, babies suckling too long on the breast may also not be getting enough breastmilk, or they may be using too much energy in feeding. The mother should feed the baby for 20-30 minutes on the breast.
  - *Does the mother switch the baby between breasts after a short period of time?*
    Premature infants do not have the suckling power to drain one of the mother's breasts at a feeding session. Changing the baby from one breast to another after a short period of time will result in the baby only receiving foremilk and not the rich hindmilk that is high in calories.
  - *Is the mother giving the baby feeds every three hours, day and night (eight feeds per 24 hours)?*
    If the mother misses' feeds, especially during the night, the baby's total milk intake per day may not be sufficient to grow well. The mother's milk supply may also decrease if the breasts are not stimulated often enough.
  - *Is the baby finishing the top-up cup feeds every time?*
    If not, the calorie intake per day may be insufficient, leading to poor weight gain or even weight loss.
  - *Is the mother keeping the baby warm by practising KMC continuously?*
    A cold baby will not have adequate weight gain, as the baby will use calories to stay warm instead of for growth. It is important to reinforce the practice of KMC at home. KMC stimulates the vagal nerve, which is also beneficial for the absorption of breastmilk.

- *Are feeds given in the correct order?*

  Poor weight gain may also result if the mother first gives the baby top-up cup feeds and then breastfeeds afterwards. Experience at Kalafong Provincial Tertiary Hospital found that weight gain is better when the baby first breastfeeds and is then given the top-up cup feed afterwards. Cup feeds use less energy and it is easier for the baby to get milk from a cup than to suckle on the breast. If the cup feed is given first, the baby is not as hungry anymore and may suckle from the breast for very short periods, resulting in inadequate breastmilk intake.

- *Is direct breastfeeding being omitted?*

  Some mothers may think top-up feeds are replacement feeds for the baby and may omit direct breastfeeding at some feeding sessions. The mother should understand that the top-up expressed milk is generally not the full volume that the baby needs at each feed. If she has omitted breast feeds, she should give the calculated full volume per feed (180 to 200 ml/kg/24 hours divided by 8 feeds) and increase the expressed breastmilk volume in those instances (*see Example 7*).

Example 7. How to calculate the full volume feed requirements for a baby

A baby with a weight of 1700 g is being breastfed and receives top-up cup feeds of 30 ml every three hours (eight times/day).

If the mother is not available to breastfeed the baby for one or two feeds, the mother should increase the expressed breastmilk volume to give her baby via cup:

Total volume for 24 hours: 180 ml x 1.7 kg = 309.6 ml

Volume of a single feed: 309.6 ml ÷ 8 feeds = 38.63 ml (round to 39 ml)

- *Is there nasal congestion?*

  Blocked nose in small babies is very common and may be serious as it causes problems with breastfeeding.[66] Most newborns are obligate nose breathers and this continues until three to six months of life. Sometimes the mother will mention that the baby has a blocked nose.[67] The way to treat the blocked nose is to squirt 0.3-0.5 ml saline or a similar volume of the mother's foremilk down each nostril before each feeding session. This treatment is usually very effective.

- *Is there an underlying infection?*

  It is important to exclude infection or sepsis in a baby with poor weight gain. Infection often results in poor weight gain. Urinary tract infections may be heralded by poor weight gain and only after a period of days or weeks will the baby present with signs of sepsis. It is therefore important to exclude infection through

appropriate screening with blood and urine tests. Malaria should also be excluded in endemic areas.

- *Does the baby have any of the danger signs covered in the Integrated Management of Newborn and Childhood Illness (IMNCI) chart booklet?*[68]
  Ask the mother whether she has noticed any worrying signs. Babies with gastro-oesophageal reflux disease (GORD) may vomit a large volume of milk with every feed and also have poor weight gain.[69]

2.13.3. Physical examination

Perform a full physical assessment of the baby by checking the respiratory system, listening to the heart and palpating the abdomen. In addition:

- Check for skin rashes in the nappy area.
- In boys, always check whether the testes have descended into the scrotum and check for possible inguinal hernias developing. Inguinal hernia is a common complication in preterm boys, but is seldom seen in girls.
- In preterm infants < 33 weeks' gestation, screening for ROP should be performed (if the service is locally available). Ensure that these babies are referred for screening by the ophthalmologist.
- Consider a referral to local occupational therapy, speech therapy and/or physiotherapy services if any abnormal neurology (high tone or spasticity) or feeding problems are present. These babies need long-term follow-up.
- Encourage mother and family to continue KMC and advise them to seek immediate care if there are any danger signs.
- Praise the mother for coming, and schedule the next visit.

2.13.4. Documentation at follow-up

Document the findings for each patient at discharge and at follow-up. It is important for policymakers and hospital management to describe the outcomes for babies receiving KMC and to identify any issues, such as poor growth, death, readmission or poor attendance at follow-up clinics. To ensure collection of relevant information:

- The weight, age at follow-up and outcome (alive/dead) should be recorded in the KMC unit register (if followed up at the hospital).
- If a separate clinic follow-up record is used at your health facility, also record the details there.
- Always record all the important details on the baby's handheld health record (e.g., road-to-health book or immunization booklet).

2.13.5. Discharge from follow-up clinic

- Consider discharging preterm babies from the nutritional clinic when they reach 40-50 weeks postmenstrual age or a weight of more than 3000 g and they are growing well. Term infants may be seen for at least 6-12 weeks and then referred for follow-up at other clinics. Babies with NE or Down syndrome may need longer nutritional follow-up, sometimes for 12-20 weeks (3-5 months).
- At some institutions, preterm and LBW babies are closely followed up for at least one year.
    - At the Kalafong Hospital follow-up clinic, it has been found that weaning from exclusive breastfeeding to a soft diet can be a challenging time period. Rates of weight gain and growth can be negatively affected. Babies need close observation and mothers and caretakers need guidance during this time.
    - If mothers do not receive good guidance on the choice of weaning foods and the continued importance of breastmilk, babies may end up with severe acute malnutrition within a few months' time.
    - Poor growth during this transition period is likely due to insufficient protein in the diet. Mothers often reduce breastfeeding too soon. It is important to know that breastfeeding continues to be the main source of protein for the first year of life. After the age of one year, protein-rich foods become the more important source of protein.
    - Mothers should be advised to first breastfeed and then give the baby soft foods until the age of one year. After one year of age, the baby receives the soft foods first and the mother breastfeeds afterwards.
- At the time of final discharge from the neonatal follow-up clinic, make appropriate arrangements for the ongoing medical support and follow-up of infants in need of further support and interventions. Services to consider, if available, include: neurodevelopment, neurology or general paediatric clinic; ophthalmology; audiology; speech and language therapy; psychology services; physiotherapy; and occupational therapy. Preterm infants can have a variety of long-term neurological and developmental problems, and will benefit from active surveillance and early identification of problems combined with targeted interventions.

3. Breastfeeding and breastmilk feeding

3.1. Benefits and advantages of breastmilk and breastmilk feeding

Current research substantiates that human milk is particularly beneficial for the small and sick newborn as it significantly reduces complications. The WHO recommends exclusive breastfeeding for preterm or LBW infants until 6 months of age.[26] Benefits of breastmilk include enhanced host defences (*see Table 2*), development and maturation of the digestive tract with reduction of feeding intolerance, unique and valuable nutritional components with reduction in retinopathy of prematurity, and improved neurodevelopmental outcomes.[21, 70, 71]

- Breastmilk contains immunological and anti-microbial components that are important to build resistance against infections. These host defence factors lead to fewer overall infections, a significant reduction in the severity of hospital-acquired infections and virtually no episodes of NEC. The practice of KMC enhances the creation of antibodies that defend against particular infections[72] (*see Table 2*).
- Breastmilk is well-tolerated and easily accepted and absorbed, particularly by extremely premature infants, and it supports speedy attainment of enteral feeding.
- Breastmilk contains growth factors and hormones that enhance and protect brain and neurodevelopment in the infant.
- Breastmilk contains special enzymes that improve the bioavailability of macronutrients and trace elements to the infants. The enzyme lipase improves fat absorption.
- Breastmilk hormones improve feeding tolerance by assisting with gastric emptying.

Table 2. Function of anti-infective factors in human breastmilk

Factor	Microbials active against*
L bifidus growth factor	*Enterobacteriaceae;* enteric pathogens
Secretory IgA	*E. coli* (+ enterotoxin); *C. diptheriae; C. tetani; Salmonella; Shigella*; *S. pneumoniae*
Lactoferrin	*E. coli; C. albicans*
Lactoperoxidase	*Streptococcus, Pseudomonas, E. coli*
Lysozyme	*E. coli, Salmonella*
Lipid (unsaturated fatty acid)	*S. aureus; Herpes simplex*; *Influenza*
Milk cells	Phagocytosis: *E. coli; C. albicans*

* Established in vitro, i.e. in a culture dish and not inside a living organism.

Sources: Quitadamo *et al.* (2021);[73] Morrin *et al.* (2020)[74]

- Low iron concentration in breastmilk averts microbial overgrowth, resulting in fewer infections.[75]

One of the greatly feared causes of severe preterm morbidity and mortality is necrotizing enterocolitis (NEC). This acute inflammatory digestive tract disease often leads to intestinal perforation, necrosis and peritonitis. There are many theories about the underlying causes of NEC. It appears to be multifactorial and the causes include intestinal mucosal injury, inflammation and the presence of abnormal intestinal bacterial colonization.

- Human breastmilk feeding has been associated with a reliable decrease in NEC in preterm infants. It is believed that human breastmilk reduces the frequency and severity of NEC through its bactericidal, immunologic, antioxidant and anti-inflammatory characteristics.
- In the past, enteral feeds were withheld from preterm infants for a period of 24 to 48 hours because of the fear of NEC. However, the introduction of small (0.5-2.0 ml) trophic feedings, started as soon as possible after birth, does not appear to increase the risk of NEC; it may actually facilitate attainment of early, full-volume feeds and reduce feeding intolerance.
- The protective effects of human milk occur through the synergistic actions of its unique nutritional, enzymatic, hormonal, direct immunologic, immunomodulatory, anti-inflammatory, anti-oxidant and growth factors.[8, 76] In a preterm birth the mother's mammary gland is still immature, with loose endothelial cell junctions that allow more and larger proteins to cross into the milk, and most of these factors appear to be concentrated in the milk of mothers who deliver prematurely.[77]

3.2. Constituents of human milk

Table 3 gives an overview of the major constituents of mature breastmilk.

Table 3. Major constituents of mature human milk

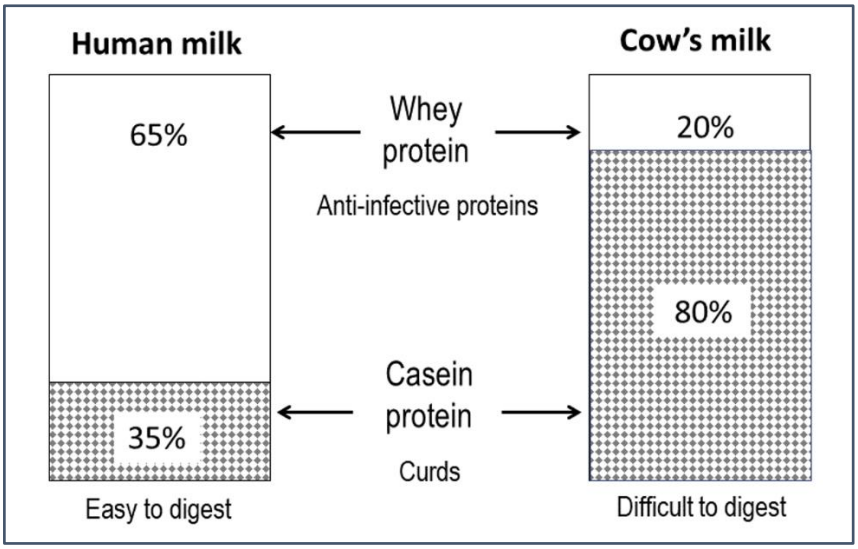
Component	Value	Percentage	Remarks
Calorie (kcal/100 ml)	60-75		
Protein (g/dl)	1.1-1.3	0.8-0.9	7-10 % of calories
Fat (g/dl)	3.8-4.5	3-5	~50 % of calories
CHO (lactose) g/dl	6.8	6.9-7.2	~40 % of calories
Mineral constituents		0,2	Na, K, Ca, Mg, P, Cl

CHO, carbohydrates; Na, sodium; K, potassium; Ca, calcium; Mg, magnesium; P, phosphorus; Cl, chloride

Source: Jenness (1979)[78]

3.2.1. Breastmilk proteins

Apart from their nutritional value, the proteins in breastmilk have an important immune function.[79] Figure 5 gives a graphic representation of the difference in composition between human milk and cow's milk.



WHO 'Infant and Young Child Feeding Counselling', (2021)[80]

Figure 5. Comparison of the quality of proteins in human and cow's milk

Whey protein

- From 60% to 80% of breastmilk consists of whey protein, which contains the following: immunoglobulins that protect against infection; immunostimulants that protect against allergy; and immunosuppressants that dampen inflammation. These proteins are especially favourable for preterm infants who are vulnerable to nosocomial infections.
- Human whey proteins contain lactoferrin, lysozyme and secretory immunoglobulin A (s-IgA) that stimulate the host defence system of the preterm infant. They also contain α-lactalbumin, which promotes more rapid gastric emptying and is more appropriate for preterm infants because it is easily digested.
  - Phosphopeptides support the absorption of calcium and zinc.
  - Lactoferrin acts as a growth factor and bacteriostatic agent and aids the absorption of iron.[24, 79]

Casein protein

- From 20% to 40% of breastmilk protein consists of casein, while the main protein in cow's milk is casein (*see Figure 5*). Casein forms thick, indigestible curds in a baby's stomach.

- Casein is digested into peptide hormones, which oversee the function of the digestive tract.
- Babies who are fed formula milk may develop intolerance to animal milk protein. Signs and symptoms of this protein allergy may include abdominal pain, diarrhoea and skin rashes.[24, 79]

Non-protein nitrogen (breastmilk nitrogen)

- Non-protein nitrogen protects, repairs and improves the growth of the digestive tract.
- Free amino acids form part of non-protein nitrogen, and there are over 20 different amino acids found in breastmilk.
  - The most abundant of these amino acids include taurine (essential amino sulphonic acid for preterm infants), glutamic acid and glutamine. They comprise nearly 50% of total free amino acids.
  - A preterm mother's milk contains a higher concentration of certain free amino acids, including valine and threonine – both essential amino acids – and arginine.
  - Taurine is present in breastmilk as the fourth-most plentiful free amino acid and supports cardiovascular, digestive and nervous system functions. It may play a pertinent role in the configuration and function of retinal photoreceptors.
  - Free glutamic acid is the most plentiful free amino acid in breastmilk. It plays a key role in the metabolism of amino acids and acts as a neurotransmitter in the brain.
  - According to recent research evidence, glutamine has a key role in shielding and protecting the function of the intestinal mucosa and augmenting immune reaction activity.
  - Serine is the second-most plentiful free amino acid and plays a pertinent role in the central nervous system of mammals, functioning as a neurotrophic factor.[81]

3.2.2. Breastmilk carbohydrates

- Carbohydrates in human breastmilk include lactose and oligosaccharides. Preterm infants absorb > 90% of the lactose contained in breastmilk. The small quantities of lactose that are not absorbed produce a softer stool consistency, boost mineral absorption and proliferate beneficial intestinal microorganisms.
- Breastmilk contains high concentrations of oligosaccharides that have many beneficial functions:
  - They have a 'prebiotic' effect, selectively stimulating the colon and influencing the growth and/or activity of a restricted number of bacterial species. In the newborn, oligosaccharides are linked with the occurrence of specific microorganisms.
  - Oligosaccharides contribute to the suppression and inhibition of bacteria, viruses or even parasites. Their structure is similar to the receptors present on the gut

mucosa and they are able to act as decoys to viruses and bacteria that attempt to adhere to these receptors.

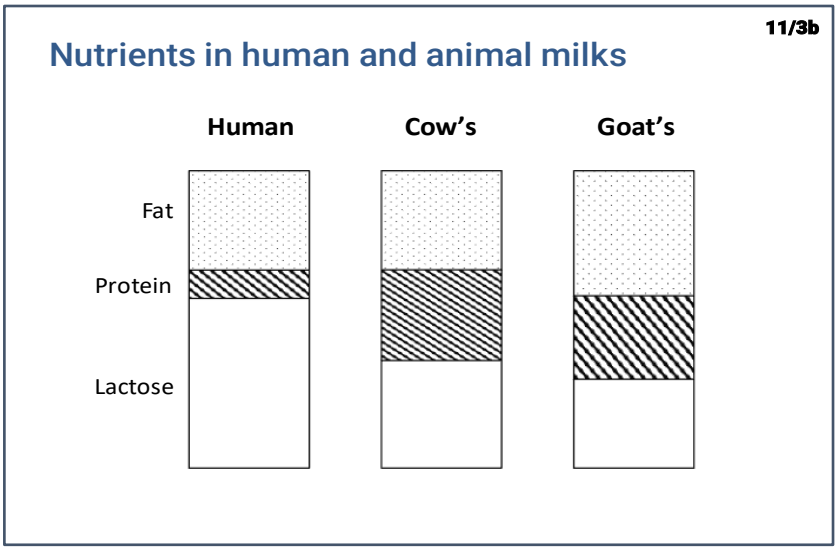
- They are able to modulate certain immune reactions by interfering with selectin-mediated interactions. Selectins are carbohydrate-binding transmembrane proteins (cell adhesion molecules) expressed on platelets. Their role is to mediate the first steps of the recruitment of leukocytes from the bloodstream in a cascade of pathologic inflammatory reactions.
- They are plentiful in sialic acid found in brain gangliosides.
- Through the above actions, oligosaccharides shield and defend the preterm infant against NEC.[24]

3.2.3. Breastmilk lipids

- The lipids in human breastmilk provide important nutritive advantages and provide 50% of the total calories in breastmilk. Preterm infants are also able to absorb a greater quantity of fat due to the pattern and dispersal of fatty acids on the triglyceride molecule and the proximity of bile salt-activated lipase.
- Human breastmilk carries a high ratio of long-chain polyunsaturated fatty acids (LC-PUFA) that are important for brain development, cognizance, vision and growth. They include omega six (ω6), such as arachidonic acid, and omega three (ω3), such as docosahexaenoic (DHA) and eicosapentaenoic acids. They are derived from linoleic and α-linolenic acid (essential fatty acids) and are not found in cow's milk.
- Breastmilk contains more cholesterol than cow's milk, which is a forerunner of steroid hormones and the production of enzymes for digestion. Cholesterol is a key component in cell structure and is also involved in brain development.[24]

3.3. Composition of formula milk

- Formula milks are made from a diverse range of products, containing animal milks, soya bean products and plant oils. Although they have been modified and altered to have a composition 'closer' to human breastmilk, they are nevertheless far from ideal for newborn infants, particularly preterm infants. In order to comprehend the composition of formula milk, we need to recognize the variations between animal and human milk, and how animal milks need to be adjusted to manufacture formula milk.
- Figure 6 compares the nutrients in breastmilk with the nutrients in fresh cow's and goat's milk. All the milks contain fat and lactose, providing energy and protein for growth.



WHO 'Infant and Young Child Feeding Counselling', (2021)[80]

Figure 6. Nutrients in human and animal milks

- Animal milk contains more protein and minerals than human milk. It is challenging for a baby's immature kidneys to excrete the extra waste from the protein and minerals in animal milks.[80]

3.4. Variability of breastmilk composition

The composition of breastmilk fluctuates greatly and alters persistently according to the requirements and circumstances of the infant.[72] Table 4 gives a detailed summary of the different types of human milk.

- Breastmilk composition changes during the sequence of suckling and from one suckling to another.
- It varies from one day to another and during the whole course of lactation.
- It is different for each mother-infant dyad.
- There are remarkable variations in the milk nutrient components during the first few days after birth compared to a week later.
- At birth, colostrum is the first milk produced and contains vast quantities of whey protein, which includes all the protective factors previously reviewed (*see Table 4*). Colostrum is extremely critical for the safeguarding and defence of the newborn infant, particularly the LBW and premature infant. The concentration of whey protein falls to a lower but stable level by day three of life.
- Casein only appears in the milk on the second day of life when the baby is beginning to accept larger volumes of milk.

Table 4. Composition of human breastmilk from birth

Component	Notes
Colostrum	• First yellow coloured milk after delivery that may last for 5-7 days. • Lower quantity (volume) of milk but adequate for a newborn. • Contains more antibodies, immunoglobulins, leucocytes and other anti-infective proteins than mature milk. Colostrum aids in preventing bacterial infections that are dangerous to newborn babies and offers the initial immunization against many of the infections that a baby encounters after delivery. • Has a mild laxative effect that helps to empty the baby's digestive tract of meconium (the first dark stools). Bilirubin is expelled from the gut and this helps to keep jaundice from becoming serious. • Contains many growth factors that stimulate the growth and development of the baby's immature intestine after birth. These factors help to reduce the future development of food allergies and intolerance. • Rich in vitamin A, which helps to reduce the severity of microbial infections. This is another reason why it is essential for preterm babies to receive colostrum for their first few feeds. • Usually ready in the breasts when a baby is born, but may be delayed in preterm births or caesarean sections. Babies should not receive any enteral feeds before they are given colostrum or start breastfeeding. • Artificial feeds given before a baby has received colostrum are likely to cause complications such as infection, intolerance and/or allergy.
Transitional breastmilk	• Produced after 7 to 14 days. • Protein and immunologic concentrations are moderately lower than in colostrum but greater than in mature milk. • Larger quantity (volume) than colostrum. • Colour is whiter than colostrum.
Mature breastmilk	• Produced after transitional milk, usually 2-3 weeks after delivery. • Colour is whiter, relatively thinner and has higher carbohydrate and fat concentration but lower protein and immunologic components than transitional milk. • The milk contains all the nutrients and components that a term infant, needs.
Premature breastmilk	• Produced by a mother who delivers a preterm infant. • Has a higher content of proteins, immunoglobulins, antibodies and electrolytes (Na^+, Cl^-, Mg^{2+}) compared to mature milk. • Premature milk changes to mature milk at 2-3 weeks after delivery and may at that stage not provide all the nutrition that a preterm infant requires for suitable growth.

Component	Notes
All types of human milk consist of foremilk and hindmilk:	
Foremilk	Foremilk is the volume of milk produced by the breasts during the first 10-15 minutes of a feed. It looks thin and watery compared to hindmilk. It is produced in large volumes and supplies plenty of protein, lactose, immunoglobulins and other nutrients. The large volumes of foremilk supply all the water that is needed to quench the baby's thirst. Babies do not need additional water before they are six months old, even in a hot climate. By changing from one breast to the other after only 10 minutes of feeding, the baby will only receive foremilk and very little fat-filled hindmilk. Preterm infants should feed from only the one breast and at the following feeding from the other breast to ensure that they get both foremilk and hindmilk during a session.
Hindmilk	Hindmilk is the richer fat-filled breastmilk that appears after about 10-15 minutes of milk flow from the breast until the breast is drained. Hindmilk looks whiter and creamier than foremilk, because the fat content is higher. This fat provides much of the energy of a feed and satisfies the baby's hunger. This is why it is important to allow the term baby to feed for at least 30 minutes and not to take the baby off a breast too quickly. Preterm infants may not have the endurance to feed for such a long time, and that is why they may need top-up feeds until they are coordinated and strong enough to suckle effectively from the breast.
Na^+, sodium; Cl^-, chloride; Mg^{2+}, magnesium	Adapted from 'WHO Infant and Young Child Feeding Counselling'.[80]

- Lipids are the most fluctuating nutrients in human breastmilk. Their concentration varies during a lactation session, throughout the day between sessions and from mother to mother. The change of fat content within a single feeding session (from foremilk to hindmilk) can be used to benefit the premature infant. If the mother produces surplus breastmilk the baby is given primarily expressed hindmilk. Hindmilk may have a 2- to 3-fold greater fat content than foremilk and can be utilized to deliver considerably more energy-concentrated milk for improved growth.
- There is a considerable reduction in the concentration of protein from colostrum through preterm milk, transitional milk and mature milk. Although concentrations of protein and sodium decline throughout lactation, the nutritional requirements of the premature infant remain higher than those of term infants. Therefore, the waning of nutrient content in breast milk precedes the decline in nutrient requisites of the preterm infant and results in deficient nutrient provision to the infant.
- The mineral content of human milk (e.g., calcium, phosphorus) fluctuates less through a lactation session. However, regardless of enhanced bioavailability, the mineral concentration remains too low with regard to the needs of the premature infant.

- The mother produces types of immunoglobulins in her breastmilk that are specific to the particular bacteria and viruses she encounters in her environment. So, in a mother-infant dyad, the mother's immunoglobulins will provide protection to her infant against bacterial and viral organisms in their combined environment.[72, 80]

3.5. Support of mother's breastmilk supply

It is very important to guarantee optimal lactation and breastmilk supply in a mother who has a preterm or LBW baby. These babies often display poor or no suck efforts on the breast (due to illness, neurological immaturity, weakness, poor musculature or reduced reflexes), which is the most critical reason for a mother's breastmilk output to remain low. Maternal anxiety may also play a role in decreased breastmilk supply. If a baby cannot breastfeed effectively, support the mother's breastmilk production by using an alternative feeding method (*see Section 4*).

- Teach mother to express breastmilk every three to four hours day and night.
- Encourage intermittent or continuous KMC sessions.
- Encourage time for the baby at the breast to practise non-nutritive sucking.
- Reassess readiness of baby to breastfeed daily. (See breastfeeding assessment tool in Annex G.)
- Ensure that the mother's nutritional needs are provided for, that she ingests sufficient fluids and that any medical problems are addressed.
- Counsel and reassure the mother to reduce her anxiety.[82]

3.6. Fortification of breastmilk

Human breastmilk is the perfect food for most infants. While the nutrient concentration and configuration of human breastmilk is ideal for term infants, the protein and mineral content of human milk is inadequate to sustain the requirements of the growing preterm infant as described in Table 4. These insufficiencies are of special concern in the smallest infants (ELBW < 1000 g and VLBW < 1500 g) who have the highest protein and mineral (calcium and phosphate) needs for growth. While TPN will provide additional amino acids, protein intake may be inadequate if unfortified breastmilk consists of > 50% of total daily fluid intake. As the mineral content of TPN is incomplete, preterm infants will accumulate a mineral deficit until fortification of human milk is commenced. Fortification of human milk is advisable in order to provide the extra nutrients required to boost the rate of growth and bone mineralization in the preterm infant. Commercial human milk fortifiers contain primarily a protein and mineral supplement, but may frequently include supplementary calories, electrolytes and vitamins.[83]

A Cochrane systematic review in 2020 found that preterm infants who had been fed fortified breastmilk put on weight and grew in length and head size a little faster while they were in hospital.[84]

3.6.1. When to start with human milk fortification

Introduce fortification when enteral feed volume reaches 100 ml/kg/day. Start with the fortification at a concentration of 1 gram in 50 ml milk (1:50) and if this is tolerated for 48 hours increase the concentration to 1:25.[85]

3.6.2. Which infants should receive fortification?

Although the WHO does not recommend routine multicomponent fortification of mother's milk for all preterm or low-birth-weight (LBW) infants, their recommendation states that it "may be considered for very preterm (< 32 weeks' gestation) or very LBW (< 1.5 kg) infants who are fed mother's own milk or donor human milk".[26] A consensus summary by Kumar *et al.* also states that the addition of a breastmilk fortifier to maternal expressed breastmilk (EBM) should be contemplated in all infants born < 1500 g or less than 32 weeks gestation.[19]

It is common practice to provide fortification to all infants < 34 weeks gestation and/or with a birthweight < 2000 kg. Even infants with birthweights between 2000 g and 2500 g may receive fortification. In locations where fortifiers are expensive or difficult to obtain, only infants with a birthweight < 1500 g should routinely receive fortification. It is possible to fortify EBM by using a milk formula for preterm infants, but it is not the best option for the baby.[86] Fortification should also be considered in infants with a birthweight > 1500 g but < 2000 g, according to the following criteria:

- if volumes of 180-200 ml/kg EBM are unlikely to be tolerated;
- serum urea levels fall < 3.57 mmol/l[87] (after 2 weeks of age);
- weight gain is < 15 g/day on maximum volumes tolerated;
- infants with metabolic bone disease (low phosphate and high alkaline phosphatase levels); and
- intrauterine growth retardation (IUGR) where birthweight for gestational age is < tenth percentile.

Phosphorus supplementation should not be added to fortified milk due to concerns about a possible precipitation reaction. For the same reason, phosphate and iron should never be added to the same EBM feed.[88]

There are three different methods of human milk fortification (HMF):

1. The most common method used by most neonatal units is called standard (STD) fortification, where a fixed amount of fortifier is added to a fixed volume of human milk according to the manufacturers' instructions.
2. Individualized HMF methods:
    a. Adjustable fortification: protein sufficiency is observed by taking serum urea (S-urea) levels twice weekly; cut-off levels of S-urea are 3.57-5.7 mmol/l (blood-urea-nitrogen [BUN] 10-16 mg/dl). If the level is < 3.57 mmol/l, extra protein should be added to the STD fortification by increasing the concentration of the HMF in the breastmilk.
    b. Targeted fortification: macronutrient concentrations in human milk are analysed and, depending on the results, the milk is supplemented with extra protein and/or fat.[85]

3.7. Breastmilk expression, storage and feeding

3.7.1. Expressing breastmilk

- Expressing breastmilk by hand is the best way to extract milk from the breast. Any lactating woman at any time can hand-express her milk and is less likely to transmit infection than when using a breast pump. The skill of how to effectively hand-express breastmilk is explained in the WHO breastfeeding counselling course.[80]
- To teach a mother how to express her own breastmilk, demonstrate the technique to the mother and then allow her to practise it. Do not express the milk for her. For her to establish lactation successfully and feed her small baby, she should commence expressing milk as soon as possible on the first day, preferably within six hours of delivery. She should express as much as she can and as often as the baby would breastfeed. To maintain a good milk supply, expression and/or breastfeeding should take place at least every three hours, day and night. After a period of time, if the mother finds her breastmilk supply declining, she should boost her milk supply by expressing her milk and draining her breasts at every feeding time, day and night, for a few days. The extra milk that


Photo: Elise van Rooyen

is expressed can be labelled and frozen, donated to a breastmilk bank, or discarded if no freezer is available.

- Mothers often acquire their own method of hand expression once they have grasped the essential technique. Some may even express both breasts at the same time, leaning forward over a large bowl and resting now and again to allow the lactiferous sinuses to refill with breastmilk.
- Every mother will find her own expression tempo, which is typically slow and regular. Encourage mothers to express breastmilk their own way, provided it is effective, but ensure that the expression method is not bruising or harming the breasts.
- If a mother has a good milk supply but her small baby has poor weight gain, she can be encouraged to express the foremilk in one container and the hindmilk in a different container. She should feed the baby the hindmilk, which provides extra energy with improved growth.
- If the mother can only express very small volumes at first, give whatever she can produce to her baby and supplement with alternative feeds such as donor breastmilk or formula feeds.[80]

3.7.2. Preparation for manual expression

- Expressing breastmilk takes time, patience and advance planning. Ask the mother to start at least half an hour before the baby's feeding time, regardless of the method used. When possible, use freshly expressed breastmilk for each feed.
- Mother should wash her hands and prepare a container to collect the milk. Wash the container in very hot, soapy water before use.
- Mother should be calm and relaxed and find a comfortable place to express breastmilk.
- The let-down reflex stimulates the secretion of breastmilk by releasing oxytocin that causes the cells around milk ducts to contract and push milk from the breast. The presence of the baby stimulates the let-down reflex in the mother. If baby is physically distant from the mother, she could think about her baby or look at a picture of her baby to stimulate the let-down reflex.
- Other actions that may encourage the let-down reflex are a warm drink, a warm shower or placing a warm towel on the breasts for several minutes before trying to express.
- It is good to eat before starting milk expression, as this will ensure adequate energy and nutrients are available for the production of breastmilk. It is important not to skip meals and to drink at least six glasses of water per day (2-3 litres).
- Find a support person to provide encouragement, such as mother's partner, a friend, relative, a health professional or a counsellor.

- If not used immediately, store breastmilk in the refrigerator immediately after expressing.[80]

3.7.3. Storing expressed breastmilk

- Label expressed milk by name of mother or baby, time, date and place.
- It is safe to store freshly expressed breastmilk at room temperature (< 26°C) for 6-8 hours.
- Store breastmilk in the back of a refrigerator (< 4°C) where it will remain fresh for 2-5 days – do not store in the door of the refrigerator.
- Freshly expressed milk can be stored for much longer in a freezer: in an internal refrigerator-freezer up to 2 weeks; in a refrigerator-freezer with a separate freezer door for up to three months; and in a deep freeze for 6-12 months.[80]

3.7.4. Feeding expressed milk

- Infants can be fed expressed breastmilk by using alternative feeding methods such as gastric tubes, spoons or cups (*see Section 4*).
- The baby can be fed fresh breastmilk without heating it. If the infant does not finish all the fresh breastmilk, the balance can be stored in the refrigerator or freezer for later use.
- Previously refrigerated breastmilk should not be heated but should be allowed to regain room temperature prior to feeding the infant.
- Previously frozen breastmilk should be thawed either in a refrigerator (in which case it can be stored in the refrigerator for up to 24 hours) or at room temperature (in which case it should be used straightaway and any surplus discarded).[80]

3.7.5. Substitutes for mother's own breastmilk

At times, breastmilk production in the mother of the LBW infant may not be adequate, particularly in the early days after delivery.

- Given the significance and benefits of breastmilk to the small infant, the use of expressed donor breastmilk acquired from other lactating women is recommended, if the mother is unable to produce breastmilk for her baby. Preferably, donor breastmilk should be provided in centres where human milk banks are established. A dedicated breastmilk bank ensures that donated milk is safe and healthy.
- Formula milk may be given with correct sterile preparation and hygiene. For infants below 1500 g birthweight, a preterm formula is required. A conditional recommendation of the WHO states: "When mother's own milk and donor human milk are not available, nutrient-enriched preterm formula may be considered for very preterm (< 32 weeks'

gestation) or very low-birth-weight infants" (p 27)[26] The formula milk should be provided under the direction of a paediatrician, nutritionist or dietitian.

- Animal milk: cow's milk is the last choice when all other possibilities have been exhausted. Raw cow's milk is unsuitable and should not be given without dilution.[38]

3.8. Feeding management in the context of HIV and AIDS

Exclusive breastfeeding continues to be the feeding of choice for *all* infants, especially in the case of preterm and LBW infants. Many studies have highlighted the benefits of breastmilk and of the longer duration of breastfeeding in low-income countries. Some of the benefits include the prevention of diseases, such as gastroenteritis and pneumonia, that are associated with high infant morbidity and mortality.

For HIV-exposed infants, exclusive breastfeeding is recommended in the first six months of life, followed by continued breastfeeding with suitable complementary foods for up to at least two years. In many high-income countries, HIV-exposed infants will not be breastfed but will be exclusively fed formula milk to prevent the transfer of HIV while breastfeeding. However, it is well known that the general use of breastmilk substitutes such as tinned formula milk in low- and middle-income settings is associated with considerable increases in morbidity and mortality. Therefore, the WHO advises that all infants should receive exclusive breastfeeding, including those who are HIV-exposed.[89]

3.8.1 Important WHO recommendations on HIV and infant feeding

In 2010, the WHO recommended for the first time the provision of antiretroviral (ARV) drugs for mothers living with HIV to prevent postnatal transmission of HIV through breastfeeding in order to improve the HIV-free survival of HIV-exposed infants. In 2016, the WHO and UNICEF issued updated guidelines on HIV and infant feeding that included two recommendations and two guiding practice statements.[89] They are the following:

Recommendation 1: Duration of breastfeeding by mothers living with HIV

"Mothers living with HIV should breastfeed for at least 12 months and may continue breastfeeding for up to 24 months or beyond (similar to the general population) while being fully supported for ART (antiretroviral therapy) adherence."

"Mothers living with HIV should exclusively breastfeed their infants for the first six months of life, introduce appropriate complementary foods thereafter and continue breastfeeding. Breastfeeding should then only stop once a nutritionally adequate and safe diet without breast milk can be provided." (page 19)

Recommendation 2: Interventions by national health services to support infant feeding practices by mothers living with HIV

"In settings where maternal, newborn and child health services promote and support breastfeeding and ART to increase HIV-free survival among infants born to mothers living with HIV.

"National and local health authorities should actively coordinate and implement services in health facilities and activities in workplaces, communities and homes to protect, promote and support breastfeeding among women living with HIV." (page 26)

Guiding practice statement 1: Advice to mothers living with HIV who practise mixed feeding

"Mothers living with HIV and health-care workers can be reassured that ARV treatment reduces the risk of postnatal HIV transmission in the context of mixed feeding. Although exclusive breastfeeding is recommended, practising mixed feeding is not a reason to stop breastfeeding in the presence of ARV drugs." (page 31)

Guiding practice statement 2: Advice to mothers living with HIV who do not plan to breastfeed for 12 months

"Mothers living with HIV and health-care workers can be reassured that durations of breastfeeding of less than 12 months are better than never initiating breastfeeding at all."

For detailed information on the above recommendations and practice statements, please refer to the updated 2016 guidelines at https://apps.who.int/iris/bitstream/handle/10665/246260/9789241549707-eng.pdf.

Regardless of the feeding choices of mothers living with HIV, health workers have a responsibility to promote safe feeding that takes the individual circumstances of each mother into account. A key message is that any breastfeeding is better than no breastfeeding. Conditions needed to formula-feed safely should always be evaluated using the AFASS concepts (acceptable, feasible, affordable, sustainable and safe) (page 8).[89]

3.8.2 Prevention of mother-to-child transmission

The most common way that babies and young children contract the human immunodeficiency virus is through mother-to-child transmission (MTCT) when the virus is passed from the mother to her unborn baby during pregnancy, through the birth process or when breastfeeding. The 2016 WHO/UNICEF update also recommends lifelong antiretroviral therapy (ART) that includes all pregnant and breastfeeding women living with HIV.[89]

In 2021, the WHO published guidelines that include recommendations on MTCT.[90] Most countries also have their own prevention of mother-to-child transmission (PMTCT) programmes. The most effective way to prevent MTCT is for women to receive lifelong ART, which reduces the risk of HIV transmission to the baby and protects the mother's health during and after pregnancy and during future pregnancies. Most PMTCT programmes require pregnant women to visit antenatal services and undergo HIV testing during pregnancy. Countries should also provide services for safe childbirth practices, for neonatal and infant HIV testing and for postnatal care. Mothers should be advised to breastfeed for at least twelve months.[90]

Annex H contains a case study of the South African PMTCT programme.

4. Alternative methods of feeding

Very premature or ill babies may be unable to suckle directly from the breast at birth. If this is the case, there are different alternative methods to feed expressed breastmilk until the baby is mature or healthy enough to establish breastfeeding. The two major methods that will be reviewed are gastric tube feeding (enteral feeding) and cup feeding (oral feeding). Feeding by spoon or syringe is also considered. Annex B gives detailed guidelines of which method to use when and with which baby.

4.1. Gastric tube feeding

Gastric tube feeding involves feeding milk into the stomach by guiding a tube down the infant's throat and oesophagus into the stomach. The tube can be introduced through the mouth (orogastric) or the nose (nasogastric). It is useful to give small-volume, trophic feeds to babies who are unstable or too unwell to start feeding properly. (See Sections 2.3 and 2.5 for more details on volumes and increments.)

Term neonates are obligate nasal breathers until they are at least two months old and if the nose becomes obstructed, they may develop respiratory complications. Preterm infants are obligate nasal breathers for a longer period than term infants. Orogastric tube feeding is therefore preferred, as blocking one nostril with a nasogastric tube may lead to adverse complications such as increased airway resistance by 30-50%, higher frequency of periodic breathing and central apnoea. Consequently, regular use of nasogastric tubes is not desirable in preterm infants. If only a fairly large tube is obtainable, an orogastric tube should be used to avoid worsening respiratory distress or if the baby is on nCPAP.[80]

4.1.1. Criteria for gastric tube feeding

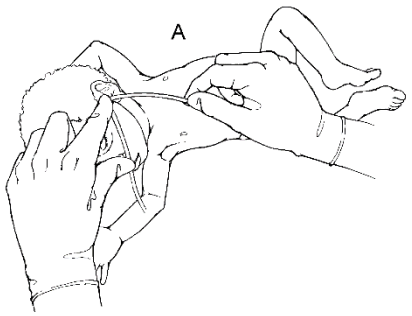
Babies should be considered suitable for gastric tube feeding under the following conditions:

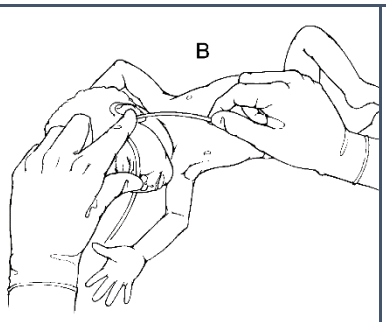
- babies who are too ill or immature to suckle or cup feed – this may include any infant less than 34 weeks gestational age (< 1800 g);
- ELBW and VLBW babies of less than 1200 g;
- babies unable to coordinate suckling, swallowing and breathing; and
- babies who suckle and swallow poorly and do not get enough milk.

4.1.2. Method of inserting a gastric tube

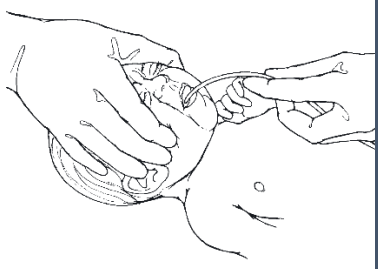
1. Gather the necessary supplies (*see Table 5*).
2. Wash hands and put clean gloves on.

3. Measure the required length of tube:
    - Hold the tube at the tip of the nose or mouth.
    - Extend the tube to the lower tip of the ear lobe and then to the xiphisternum (middle of the chest in the sternal area) (*see Figure 7*).
    - Mark the tube with a pen or piece of tape.
4. Flex the baby's neck slightly and gently insert the tube through the mouth or nostril (*see Figure 7*). It should pass easily and without resistance.
5. If using the nasal route:
    - Direct the tube horizontally to the back of the nose, using a slight twisting action if needed.
    - Try the other nostril if the tube does not slide in easily.
    - If the tube still does not slide in easily use the oral (mouth) route.
    - Never force the tube into the nose if resistance is encountered.
6. Fasten the tube on the cheek with strapping.[82]

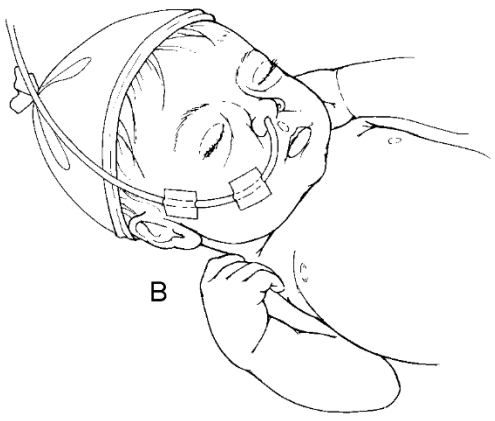




Measuring the gastric tube for oral (A) and nasal (B) routes



Inserting an orogastric tube



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Securing orogastric (A) and nasogastric (B) tubes in place

Source: 'The Gambia KMC Participants' Training Manual'[91]

Figure 7. How to measure and insert a gastric tube for oral and nasal routes

Table 5. Equipment needed for gastric tube insertion

Equipment	Explanation and use
Clean gloves	Infection prevention
Polyethylene feeding tube appropriate for baby's weight	• Weight < 2 kg: use size 5-F tube (nasal) • Weight > 2 kg: use size 6-F tube (nasal) • If tubes are larger, use oral route
Writing pen or piece of tape	For marking the measured length of tube
Syringe	• For pushing air into the stomach • Size: 2 ml, 2.5 ml or 5 ml
Stethoscope	For checking the correct positioning of tube
Cap for gastric tube	To close the tube after feeding
Tape or adhesive strapping	For securing the tube on the cheek

4.1.3. How to check correct positioning of a gastric tube

Assess whether the tube is inside the stomach by listening over the gastric area whilst attaching the syringe to the tube and pushing 1-2 ml of air gently into the gastric tube. A bubbling noise should be heard if the gastric tube is correctly positioned. If this is not heard, the tube is not correctly placed and should be removed and the procedure repeated.[82]

4.1.4. How to tube feed

Feeding with a gastric tube necessitates close observation of the baby. Mothers are often trained to administer feedings via the baby's gastric tube.

- Determine the amount of milk for the feed *(see Annex A, Tables 6-8)*.
- Measure the required volume of expressed milk for the feed.
- Confirm the tube is secured and has not moved from its original position. Check that the mark on the tube is visible at the edge of the nose or mouth.
- Secure the baby upright in the skin-to-skin position. This allows the mother to have both hands free to safely and easily practise gastric tube feeding.
- Have a syringe ready and remove the plunger from the syringe.
- Remove the stopper from the gastric tube and attach the empty syringe tightly to the tube.
- Pinch off the tube below the syringe and pour the milk into the syringe.
- Hold the syringe about 20 cm above the baby; then release the tube to allow the milk to flow by gravity, down the tube into the stomach.
- **NB** NEVER inject the milk into the stomach by using the plunger.

- Repeat the above process until the required volume of expressed milk is delivered to the baby.
- Remove the syringe and recap the gastric tube when finished.
- If the baby spits up or chokes during feeding:
  - Stop the feed and evaluate the baby.
  - Ensure the tube is still correctly situated by rechecking the mark on the tube.
  - Consider slowing the rate of feeding by lowering the tube or reducing the volume of feed if a baby spits up with every feeding.
  - An upright position is very important in these instances.


Photo: Elise van Rooyen

- Each bolus feed should take about 10-20 minutes depending on the required volume of feed.
- When combining gastric tube feedings with cup or breastfeeding, adjust for the volume taken by cup or approximate intake at the breast.
- Both health workers and mothers should know how to feed with a gastric tube. Health workers should first demonstrate the tube feeding steps to a mother and then observe her offering a feed.
- When training mothers how to feed with a gastric tube, feedback and reassurance will help a mother become proficient and self-assured with administering feeds to her baby.
- When a baby is receiving gastric tube feedings, evaluate the baby's readiness to feed by cup every couple of days when baby reaches 30 weeks' gestational age and has a weight of > 1250 g. Early attempts may not result in measurable intake. Use the feeding diary tool when checking readiness for cup feeding (*see Annex G*). Using the somatic-oral stimulation technique, the mother may prepare her baby for breast and cup feeding readiness. See Section 2.10 and Annex C for how to teach the mother the somatic-oral stimulation technique.
- Avoid injecting or running the milk rapidly down the gastric tube since it may result in gastric distension, vomiting, intolerance or aspiration.[82]

4.2. Cup feeding

Cup feeding has been a neonatal feeding option since the middle of the last century.[92] Some high-resource settings use feeding cups in the short term to provide supplemental feeding and to avoid 'nipple confusion', a theory that introduction to artificial nipples hinders the neonate's

ability to breastfeed.[93] The WHO and UNICEF recommend cup feeding in low-resource settings where water quality is poor and electricity unreliable, as cups are easier to clean than bottles.[94] Cup feeding often complements breastfeeding, reduces time using gastric tubes or functions as a long-term feeding solution for those unable to breastfeed.

4.2.1. Benefits of cup feeding

- Cup feeding is a safe and handy technique to feed breastmilk to a preterm and LBW baby.
- It encourages eye contact between mother and baby and it provides involvement of the sensory system compared to tube feeding, as the baby's taste and smell is incorporated.
- The baby has to coordinate lapping, swallowing and breathing and that is why cup feeding is usually introduced when the baby is more mature (> 30 weeks gestation).
- Cup feeding is less stressful than bottle feeding. It permits rest periods from feeding and improves the breathing effort in the infant (better oxygenation) during feeding.
- Newborns can take the amount of milk they want, at their own pace. Research indicates that the preterm infant's heart rate, respirations and oxygen requirements are better maintained within normal parameters during cup feeding in contrast to bottle feeding.
- It takes less effort from the baby to cup feed than to breastfeed. For this reason, babies breastfeed only for a short time before receiving either cup or tube feeds. When a baby is able to finish the calculated feed volume by cup, the baby is switched first from tube to cup, and when the baby is more mature and has good musculature, the switch to exclusive breastfeeding takes place and cup feeding is stopped. Cup feeding is usually continued at home for top-up feeds and stopped when baby weighs > 2500 g or has reached 40 weeks' gestational age.
- A cup is an ordinary type of device that is easily washed and cleaned. There is less chance of contamination compared to bottles.
- The baby is prepared for breastfeeding by exercising the back of the tongue when lapping the milk from the cup. It encourages the baby to stretch the tongue forward over the gums. Tongue action is vital for successful breastfeeding. To extend the tongue is essential for efficient stripping of milk ducts. It also promotes good attachment at the breast. As infants mature, sipping follows lapping.
- Cup feeding stimulates tongue and jaw movement necessary to establish breastfeeding and the production of enzymes and saliva.
- It is an uncomplicated feeding technique that both parents can perform.
- Cup feeding is another method of feeding that allows a newborn to continue receiving

the mother's breastmilk even when separated from the mother.

- Cup feeding is not detrimental to the infant's cardiorespiratory system and oxygen saturation is well maintained.[95-97]

4.2.2. Cup feeding indications

Cup feeding should be introduced as soon as a baby is able to coordinate the suck-swallow-breathing reflex (32 weeks' gestational age).

Cup feeding is particularly useful in the following situations:

- preterm infants who are alert and looking for a feed but who do not have the energy or the muscle power to complete a full breastfeed;
- infants with congenital defects such as cleft lip or palate before undergoing corrective surgery;
- disorders in which infants' sucking competence and coordination may be compromised (e.g. Down's syndrome) or other neurological impairment (e.g. neonatal encephalopathy);
- maternal conditions such as nipple damage or disease requiring surgery that temporarily prevents direct breastfeeding;
- short-term conditions affecting the infant such as drowsiness caused by opiates during labour or excessive jaundice. Physiological jaundice is unlikely to cause drowsiness and poor breastfeeding, but often feeding problems in a small infant may result in the development of jaundice; and
- working mothers can feed their babies expressed milk, using an open cup rather than a bottle. The caretaker of the baby should be taught how to cup feed and the baby should also be introduced to this method of feeding so the baby can become accustomed to it.[95]

4.2.3. Potential risks when feeding by cup

- Cup feeding requires a specific technique and mothers may find it difficult to acquire the skill initially. The small infant is at risk of aspiration pneumonia if the milk is 'poured into' the infant's mouth rather than allowing the infant to 'lap' or 'sip' the milk. For this reason, inexperienced mothers should always be supervised by a health care worker when cup feeding their infants. A case report suggests infant aspiration can transpire with an incorrect feeding technique, but a recent randomized controlled trial with 522 infants described no incidents of apnoea or aspiration.[96, 98, 99]
- Other possible safety hazards that have been described in literature include physiological instability (bradycardia, apnoea, low oxygen saturation),[100] choking and poor weight gain.[101]

- In a systematic review of literature on cup feeding it was found that overall, compared to bottle feeding, infants on cup feeding were inclined to have higher oxygen saturation levels.[92]
- Fewer infants who were cup-fed experienced oxygen desaturation episodes or elevations of heart and respiratory rates compared to bottle-fed infants.[92]
- Collins *et al.* described no undesirable incidents in early premature infants on cup feeding.[102]

- There is also concern that cup feeding is time-consuming or may not provide sufficient intake because of milk spillage.[103]
  - Only one study reported statistically significant lower milk intake with cup feeding.
  - Findings on feeding duration were variable.
  - With regards to spillage, cup feeding was associated with a threefold increase in spillage compared to a bottle. The mean spillage was 25% to 39%.
  - No study found statistically significant differences in newborn weight loss or gain when comparing cup with bottle feeding.[92]

4.2.4. How to cup feed

When cup feeding a baby, always ensure that baby is fully awake, alert and interested in feeding. Never cup feed a sleepy baby.

This is how the WHO describes the process of cup feeding:[104]

- Wrap the baby in a blanket to keep baby in a contained position with the hands in the midline position. Hold the awake baby sitting upright or semi-upright in the mother's lap. Hold baby well-supported in a 'cuddle' against the chest with one of the mother's arms embracing the baby. Small and preterm infants have poor motor control and they need to be well-supported by the mother's body and arms when cup feeding.
- The baby's head should be in a straight line with the rest of the body. It should not be tilted backwards or to the side; otherwise, the infant will have difficulty swallowing properly and may refuse to cup feed or may aspirate the milk.
- Grip a small cup in the opposite hand, half-filled with milk, and hold it slightly tilted to the baby's lips. Tip the cup further so the milk's surface just touches the baby's lips. The cup should rest gently on the baby's lower lip, and the edges of the cup should touch the outer part of the baby's upper lip. The cup should not press the lower lip downwards. Leave the cup in this position while baby laps the milk and also when baby pauses to rest between swallows and is not drinking. Always avoid placing pressure on the lower lip. Continue to tilt the cup enough to keep the milk's surface at the rim of the cup (*see Figure 8*[105]). Take time to burp baby if necessary during the feed.

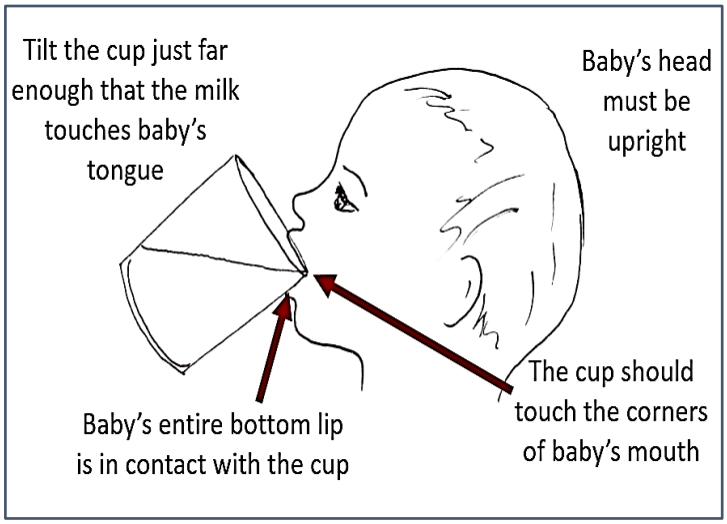


Figure 8. Positioning the cup correctly on the baby's lip

- Babies lap by protruding their tongue into the milk to obtain small boluses. The milk is often held in the mouth for some time before swallowing. The mother may apply firm pressure underneath the baby's chin to encourage and facilitate swallowing.
- When introducing cup feeding for the first time, the baby may spill the milk. That is usually a sign that the baby is not completely ready to feed from a cup or is getting tired. When baby spills or spits up, stop the cup feeding and try again at the following feed.
- Start with small volumes (1-2 ml) when first introducing cup feeding. Babies are mature enough to start with cup feeding between 30 to 34 weeks gestational age (> 1200 g). Some mothers and babies struggle initially to grasp the technique of cup feeding. Be patient and do not increase the volume of cup feeds too quickly.
- Do not pour the milk into the baby's mouth. Keep the cup at the baby's lips, letting the baby take the milk by her/himself. When a baby has had enough, the baby will refuse to take more.
- Any remaining milk that the baby does not finish by cup should be given via tube until the baby manages to finish the full volume of cup feeds at every feed.
- A baby who has not taken much milk may take more next time, or the frequency of the feeds may be increased. For instance, if the volume of the feeds is 30 ml and baby is fed every three hours (8 feeds/24 hours), the volume could be reduced to 24 ml by increasing the number of feeds to 10 feeds in 24 hours. Feeds would be given every two hours during the day from 06:00 until 18:00. Thereafter the infant receives feeds every three hours during the night.


Kangaroo Mother Care video


Kangaroo Mother Care video

- It is important the mother is shown how to cup-feed her baby. She should not be left to feed her baby by cup without proper counselling, training, support and supervision.
- Record how much milk has been taken at each feed.
- Fathers and relatives can cup feed too, if they receive proper training by the health care staff.


https://iycf.advancingnutrition.org/content/cup-feeding-father-cup-feeding-04-covid

4.3. Spoon feeding

Another simple device that is easily available and can be used to dispense feeds to an infant is a spoon. A spoon is sometimes a safe way to initiate this technique of feeding because the mother will be unable to offer too large a volume of feed to her infant, which avoids complications such as aspiration.[80]


https://iycf.advancingnutrition.org/content/cup-feeding-grandmother-cup-feeding-6-9-mo-05a-nigeria

4.4. Syringe feeding

A syringe should not be used for direct feeding. The only time a syringe may be used is to insert a small volume (0.5-2 ml) of colostrum into the cheek of the baby soon after birth or to initiate small oral feeds (1-2 ml) simultaneously with tube feeds or when the infant is practising non-nutritive sucking on the mother's clean little finger. (See also Sections 2.4 and 2.5 for colostrum volume and trophic feed volume.) Usually, a very small syringe (1 ml) is used.

Syringes with larger volumes should never be used as the volume of feed that is injected into the baby's mouth may be too large. The preterm infant has a problem coordinating sucking, swallowing and breathing, and if a large feed bolus is injected down the baby's throat, serious complications may occur, such as respiratory aspiration, apnoea, respiratory collapse and death. Once baby is swallowing volumes greater than 5 ml of expressed breastmilk, syringe feeding should be discontinued and cup feeding should be introduced, each time after the baby has suckled on the breast.[106]

Prior to commencing syringe feeding, a health care worker should ensure the baby is awake, alert and able to feed safely. The mother or person giving the feed should also be well-orientated, alert and able to feed the baby safely.[107]

4.4.1. How to feed a newborn with a syringe

- Wash hands with soap and water to prevent infection.
- Express breastmilk in a sterile container.
- Wrap the baby securely and hold baby in a semi-upright position, supported by the mother's body and arm. The mother should sit in a comfortable, well-supported position. A pillow may be used for extra support of the baby.
- Draw the colostrum or EBM into the 1 ml syringe, press the plunger to remove any air bubbles and set the syringe down where the feeding outlet/end does not make contact with any unsterile surface.
- With the little finger, stimulate baby's lips and encourage baby to open his/her mouth by sweeping the finger from the cheek towards the corner of the baby's mouth. Touching the cheek may encourage the baby to open the mouth and turn the face towards the finger (i.e., stimulation of the rooting reflex).
- Place the little finger inside baby's mouth with the pad of the finger facing upwards to touch the baby's palate. The baby may begin to suck at the finger. Be patient if the sucking movements do not start immediately (i.e., stimulation of the sucking reflex).
- Once baby is sucking on the finger, use the other hand to gradually introduce the syringe's nozzle along the side of the baby's mouth. Do not insert it too deep. The syringe should be between the gums and the cheek or between the side of the baby's tongue and your finger.
- Carefully push the plunger so that the milk runs slowly into the baby's mouth while the baby is sucking on the finger.
- Press the plunger again every time the baby makes sucking movements and swallows the milk. Press no more than 0.2 ml of milk at a time.

- Stop pushing the syringe plunger when the baby stops making the feeding/sucking movements. Restart once the baby begins sucking again. Continue feeding until the baby stops sucking and/or swallowing.[107]

4.4.2. Tips and precautions for safe syringe feeding

- Always use your little finger to open the baby's mouth. Using another finger may cause some babies to gag, which may also happen if the little finger touches the tongue too far towards the back of the tongue.
- The syringe should not hold more than 1 ml of milk.
- Make sure baby is positioned securely before starting the feed. This is particularly important when feeding the baby alone.
- Do not let baby lie flat in mother's lap since it may cause baby to aspirate and choke. Always place baby in a semi-upright position.
- Always use a clean vessel to catch the expressed milk. If frozen milk is used, thaw it before drawing it into the syringe.
- Rinse the syringe with warm water after use. Clean it with soapy water and let it air dry. Thorough washing with soap and water is often sufficient to sterilize certain infant feeding syringes.
- Syringe feeding can be a helpful alternative, especially for newborns who need colostrum. In most cases, the baby may be able to breastfeed eventually.

Annexes

Annex A. Fluid tables for calculating IV fluids and feeds for newborn infants

There are three fluid tables that help with calculating IV and oral feeds for newborn infants. Fluids are calculated daily and the volumes are increased daily at a rate of 30-40 ml/kg/day, until maximum volumes of 150 ml/kg/day for IV fluids and 150-180 ml/kg/day for oral feeds are reached. Term infants usually are on full 150 ml/kg/day feeds by day four of life, and preterm infants by day 5-7 of life.

Some babies may start on only IV fluids and the volume of oral fluids is slowly increased each day. These volumes of fluid requirements for infants (ml/kg body weight/day) are shown in Table 6.[108]

Table 7 provides guidance to calculate fluids and feeds for sick and VLBW babies on IV and gastric or cup feeds. This table was also adapted from the South African *Newborn Care Charts* book.[108]

- Babies should be weighed daily and their feeds should be adjusted according to their weight gain.
- If baby has not regained birthweight, use birthweight to calculate feeds.
- To calculate the volume of a single feed, divide total daily volume by 8. The volume of a single feed can be obtained from Tables 7 and 8.
- Most infants on formula only need 150 ml/kg/day as formula is more calorie-dense than breast milk.
- Feeds of preterm infants with chronic lung disease of prematurity (bronchopulmonary dysplasia/BPD) receiving oxygen or with a haemodynamically significant PDA (diameter > 1.5 mm), should preferably be restricted to 160 ml/kg/day, (8 feeds daily, every three hours).

Infants on tube feeds

If the infant is still on tube feeds consult a speech therapist to evaluate suckling and feeding ability before removing feeding tubes. The speech therapist will give mother stimulation exercises to activate the feeding action (*see Annex C*). If no speech-language therapist is available, the health worker could receive training in the somatic-oral stimulation technique, and demonstrate the stimulation technique to mothers practising KMC. Do not discharge a

baby if breastfeeding has not been established. Make sure the mother is using the correct feeding technique. The baby must be in the KMC position when the mother is tube feeding.

Table 8 provides guidance when feeding babies who are also receiving breastmilk via direct feeding at the breast. The total volume of feeds is always calculated as ml/kg/24 hours. There is a special column giving guidance as to the volume of three-hourly top-up feeds required via cup or tube, depending on age in days and according to the weight of the baby. Top-up feeds are usually larger in volume in the smaller infants and should gradually reduce in volume as the baby gains weight and becomes more mature in ability to suckle on the breast and feed from a cup.

Establish breastfeeding using supplementary cup feeding

The smaller and more immature the baby is, the more the volume of the expressed milk that should be prescribed, sometimes 80%-100% of the calculated milk volume. These infants tire quickly and struggle to suckle large enough volumes of milk for good weight gain. Older and more mature infants may receive less expressed milk – about 50% or even 30% of the calculated milk volume per feed. These infants are stronger and able to suckle better and longer from the breast. The ultimate goal is to get the infant to breastfeed independently by the time baby reaches either 2.5 kg or 40 weeks' gestational age.

Term infants with feeding problems

Term infants with feeding problems may include infants with neonatal encephalopathy (NE), congenital heart defects and syndromes such as Down's syndrome. These infants should also be seen by a speech therapist (where available) for consultation and evaluation of feeding ability on the breast. They will also benefit from the somatic-oral stimulation technique.

It is important that infants with NE should be observed for overstimulation and stress when introducing the somatic-oral stimulation technique. If the baby becomes stressed the intervention should be discontinued immediately. These infants may benefit from a careful non-nutritive sucking (NNS) intervention before breastfeeding or during tube feeding. If they react well to the NNS intervention, one can consider trying the somatic-oral stimulation technique again.

All infants with congenital abnormalities or neurological insults may need large volumes of expressed breastmilk via cup or tube until breastfeeding is successfully established. They may take four to six weeks to establish breastfeeding and they are often hospitalized for long periods of time. If they are also preterm, it may take even longer to establish breastfeeding and/or cup feeding.

Table 6. Fluid requirements for infants (ml/kg body weight/day)

Day of life	< 1000 g			1000–1500 g			> 1500 g		
	Total fluids ml / kg	Suggested IVI fluids ml / kg	Suggested oral fluids ml / kg	Total fluids ml / kg	Suggested IVI fluids ml / kg	Suggested oral fluids ml / kg	Total fluids ml / kg	Suggested IVI fluids ml / kg	Suggested oral fluids ml / kg
1	90	75	Nil / 15*	80	65	Nil / 15*	60	Nil / 30	30 - 60
2	110	85	25	100	60	40	90	Nil / 30	60 -90
3	130	90	40	120	60	60	120	Nil / 30	90 - 120
4	150	80	70	150	60	90	150	Nil	150
5	150	50	100	150	Nil #	120	150	Nil	150-180
6	150	Nil #	130	150	Nil	150	180	Nil	180
7	150	Nil	150	180	Nil	180	180	Nil	
8+	150-180	Nil	150-180						

* Trophic feeds starting with 0.5 or 1 ml feeds via gastric tube

Stop IV fluids if baby is tolerating 120 ml/kg/day of (EBM) enteral feeds

NB to calculate feeds, use birthweight until the baby has regained birthweight and then the daily weight

Who should be kept nil per mouth?

- Any sick baby who is shocked and hemodynamically unstable
- Any baby with a distended abdomen, vomiting and bloody stools
- Any baby with NE, until bowel sounds are present
- Baby with a birthweight < 800 g keep nil per mouth on day one – start trophic feeds the next day
- Babies with birthweight > 800 g – consider trophic feeds on day one if stable
- **NB All the above babies should get colostrum applied to buccal mucosa, even if nil per mouth**

Use Table 6 as a guide to determine how much IV fluid and feeds to give sick and small babies. If a baby is not tolerating the volume of oral feeds, then decrease the oral feeds and increase the IV fluids. Ensure that the total fluid volume is correct for the baby's age and weight. The table gives estimates for babies that need to be nil per mouth. You may prefer to calculate the feeds yourself according to the birthweight, and gradually introduce oral feeds.

No baby should be nil per mouth, for more than 48 hours. If the baby cannot be fed then, consult a paediatrician or neonatologist at your referral hospital.

Table 7. Fluid- and feeding volumes for neonates on IV and gastric tube or cup feeds

TOTAL FLUID VOLUME PER DAY (ml/kg/24-hours)																	
Day of life ⇨	**1**			**2**			**3**			**4**			**5+**			**7+**	
Birthweight categories ⇩	**If nil/ mouth**	**IV**	***Oral***	**If nil/ mouth**	**IV**	***Oral***	**If nil/ mouth**	**IV**	***Oral***	**If nil/ mouth**	**IV**	***Oral***	**If nil/ mouth**	**IV**	***Oral***	**IV**	***Oral (max)***
≤ 1.0 kg	90	**75**	*15*	110	**85**	*25*	130	**90**	*40*	150	**80**	*70*	150	**50**	*100*	**0**	*180*
< 1.5 kg	80	**65**	*15*	100	**60**	*40*	120	**60**	*60*	150	**60**	*90*	150	**0**	*120*	**0**	*180*
≥ 1.5 kg	60	**30**	*30*	90	**30**	*60*	120	**30**	*90*	150	**0**	*120*	150	**0**	*150*	**0**	*180*
≥ 2.5 kg	60	**30**	*30*	90	**30**	*60*	120	**30**	*90*	150	**0**	*120*	150	**0**	*150*	**0**	*150*
FLUID DISTRIBUTION PER DAY: *IV: ml/hour or drops/minute (60 drops/ ml giving set); ***Oral: ml/feed 3-hourly*																	
0.8 kg	3	**3**	*1*	4	**3**	*3*	4	**3**	*4*	5	**3**	*7*	5	**2**	*10*	**0**	*18*
0.9 kg	3	**3**	*2*	4	**3**	*3*	5	**3**	*5*	6	**3**	*8*	6	**2**	*11*	**0**	*20*
1 kg	4	**3**	*2*	5	**4**	*3*	5	**4**	*5*	6	**3**	*9*	6	**2**	*13*	**0**	*23*
1.1 kg	4	**3**	*2*	5	**3**	*6*	6	**3**	*8*	7	**3**	*12*	7	**0**	*17*	**0**	*25*
1.2 kg	4	**3**	*2*	5	**3**	*6*	6	**3**	*9*	8	**3**	*14*	8	**0**	*18*	**0**	*27*
1.3 kg	4	**4**	*2*	5	**3**	*7*	7	**3**	*10*	8	**3**	*15*	8	**0**	*20*	**0**	*29*
1.4 kg	5	**4**	*3*	6	**4**	*7*	7	**4**	*11*	9	**4**	*16*	9	**0**	*21*	**0**	*32*
1.5 kg	4	**2**	*6*	6	**2**	*11*	8	**2**	*17*	9	**0**	*23*	9	**0**	*28*	**0**	*34*
1.6 kg	4	**2**	*6*	6	**2**	*12*	8	**2**	*18*	10	**0**	*24*	10	**0**	*30*	**0**	*36*
1.8 kg	5	**2**	*7*	7	**2**	*14*	9	**2**	*20*	11	**0**	*27*	11	**0**	*34*	**0**	*41*
2 kg	5	**3**	*8*	8	**3**	*15*	10	**3**	*23*	13	**0**	*30*	13	**0**	*38*	**0**	*45*
2.25 kg	6	**3**	*8*	8	**3**	*17*	11	**3**	*25*	14	**0**	*34*	14	**0**	*42*	**0**	*51*
2.5 kg	6	**3**	*9*	9	**3**	*19*	13	**3**	*28*	16	**0**	*38*	16	**0**	*47*	**0**	*56*
2.75 kg	7	**3**	*10*	10	**3**	*21*	14	**3**	*31*	17	**0**	*41*	17	**0**	*52*	**0**	*52*
3 kg	8	**4**	*11*	11	**4**	*23*	15	**4**	*34*	19	**0**	*45*	19	**0**	*56*	**0**	*56*
3.5 kg	9	**4**	*13*	13	**4**	*26*	18	**4**	*39*	22	**0**	*53*	22	**0**	*66*	**0**	*66*
4 kg	10	**5**	*15*	15	**5**	*30*	20	**5**	*45*	25	**0**	*60*	25	**0**	*75*	**0**	*75*
4.5 kg	11	**6**	*17*	17	**6**	*34*	23	**6**	*51*	28	**0**	*68*	28	**0**	*84*	**0**	*84*

Table 8. Volume (ml) of 3-hourly cup or tube feeds for neonates on oral feeds only

One column is for newborns who are not able to feed at the breast (Not BF) and the full calculated single feed volume is given to the baby; another column is for newborns who are also being breastfed (BF), with expressed breastmilk given as top-up feeds. If baby is also feeding directly at the breast, reduce the amount the mother should express at each feeding session, in order to prevent overfeeding. The more mature and larger the weight of the baby, the less top-up expressed breastmilk should be given. Always evaluate how well the baby is breastfeeding when deciding the top-up volume.

Day of life	**1**		**2**		**3**		**4**		**5**		**6**		**7+**	
Newborns up to 2.5 kg														
Fluid volume/day ⇨	**60 ml/kg**		**80 ml/kg**		**100 ml/kg**		**120 ml/kg**		**140 ml/kg**		**160 ml/kg**		**180 ml/kg (max)**	
Birthweight ⇩	Not BF	BF	Not BF	BF	Not BF	BF	Not BF	BF	Not BF	BF	Not BF	BF	Not BF	BF
1.2 kg	9	9	12	12	15	15	18	18	21	21	24	24	27	27
1.3 kg	10	10	13	13	16	16	20	20	23	23	26	26	29	29
1.4 kg	11	11	14	14	18	18	21	21	25	25	28	28	32	30
1.5 kg	11	11	15	15	19	18	23	20	26	25	30	25	34	30
1.6 kg	12	12	16	15	20	18	24	20	28	25	32	25	36	30
1.7 kg	13	13	17	15	21	15	26	20	30	25	34	30	38	30
1.8 kg	14	14	18	15	23	18	27	20	32	25	36	30	41	30
1.9 kg	14	14	19	19	24	19	29	24	33	30	38	30	43	30
2.0 kg	15	15	20	15	25	20	30	25	35	30	40	30	45	30
2.25 kg	17	17	23	20	28	23	34	30	39	30	45	35	51	35
2.5 kg	19	19	25	20	31	25	38	30	44	30	50	30	56	35

Newborns > 2.5 kg								
Fluid volume/day ⇨	**60 ml/kg**		**90 ml/kg**		**120 ml/kg**		**150 ml/kg (max)**	
Birthweight ⇩	Not BF	BF	Not BF	BF	Not BF	BF	Not BF	BF
2.75 kg	21	21	31	19	41	25	52	30
3.0 kg	23	23	34	20	45	25	56	30
3.5 kg	26	26	39	24	53	30	66	30
4.0 kg	30	30	45	27	60	30	75	30
4.5 kg	34	30	51	30	68	30	84	30

Remember these volumes are calculated for a single feed given every three hours (eight per 24 hours)

Give baby expressed breastmilk (EBM) as preference

Babies 1.2-1.5 kg can receive EBM and no IV fluids if they are well and do not have respiratory distress

Adapted from: *Newborn Care Charts: Routine Care at Birth and Management of the Sick and Small Newborn in Hospital* (South Africa)(2014)[108]

Annex B. Which feeding method to use and when?

This is a summary of the information from the main document to explain and assist how and when to start enteral and oral feeds and how to progress from one method of feeding to the other. The guide is divided into different neonatal gestational age and weight groups with different colours to guide the user. The 'Criteria and clinical presentation' column describes the clinical signs and symptoms the baby may present with. The 'recommended feeding methods' provide a guide as to how and when to feed the baby. Explanation of why a specific feeding method is advised is noted in the 'remarks' column.

Table 9. Proposals for when to use different feeding methods in small babies

Criteria and clinical presentation	Recommended feeding methods	Remarks
• **< 28 weeks** • **< 1200 g** • **ELBW and VLBW** **Clinical presentation:**	• Start with IV fluids • Keep nil per mouth if unstable	• Start on 10% dextrose solution (preferably potassium-free fluids) in first 24 hours • After 24 hours give neonatolyte / neolyte maintenance fluid (containing 10% dextrose as well as electrolytes) • Try to reach full enteral feeding volumes and stop the IV fluid as soon as possible
• Many babies are hemodynamically unstable with respiratory distress	• Provide colostrum to buccal mucosa as soon as available even in unstable infants	• Get mother to express colostrum soon after delivery • Providing colostrum as soon as possible is very important for baby's survival
• No or poor suck reflex • Poor latch and attachment	• **If stable:** Allow baby to lick or suckle on the emptied breast once or twice a day	• Suckling on breast is non-nutritive • Do this at the beginning of the feed before breastfeeding
• Poor suck, swallow and breathe coordination	• Insert gastric tube and start enteral feeds even on day one of life	• Preferably an orogastric tube as babies are obligate nose breathers
• Weak and poor muscle power	• Hold baby in KMC position when tube feeding	• KMC improves absorption with secretion of gut hormones and the upright position reduces reflux episodes.
• Does not have the strength to suckle directly from the breast or from a cup	• Start on small trophic feeds • If trophic feeds are well tolerated increase feeding volume with 30 ml/kg/day	• Trophic feeds are small feeds of 10-24 ml/kg/day divided by 8 to provide for 3-hourly bolus feeds for baby

Criteria and clinical presentation	Recommended feeding methods	Remarks
• **28–31 weeks** • **1200–1600 g** • **VLBW and LBW** **Clinical presentation:**	• May insert IV line for IV fluid for first 24-48 hours • Keep nil per mouth if unstable, otherwise start enteral/oral feeds	• Start on 10% dextrose solution (preferably potassium-free fluids) in first 24 hours • After 24 hours give neonatolyte/neolyte maintenance fluid • Subtract enteral feed volume from IV fluid volume • Try to reach full enteral feeding volumes and stop the IV fluid as soon as possible
• Most babies are hemodynamically stable	• Provide colostrum to buccal mucosa as soon as available even in unstable infants	• Get mother to express colostrum soon after delivery • Providing colostrum as soon as possible is very important for baby's survival
• Weak and poor muscle tone	• Allow baby to lick or suckle on the emptied breast with every feed for a few minutes	• Do this before every tube feeding • Most of the breastfeeding is non-nutritive
• Poor strength and suckle, swallow and breathe still not well coordinated	• Insert gastric tube and start with enteral feeds at 30 ml/kg/day	• Preferably an orogastric tube as babies are obligate nose breathers • KMC improves absorption with secretion of gut hormones and the upright position reduces reflux episodes
	• Introduce small-volume cup feeds if weight is > 1400 g or above 32 weeks gestation	• Evaluate whether baby can cope with cup feeding • Teach mother how to hold baby and give cup feeds. • Order of feeds: first, breastfeed for about 10 minutes; then give small amount of milk via cup feed • Complete the feed in the KMC position and feed the rest of the feeding volume via tube feed

Criteria and clinical presentation	Recommended feeding methods	Remarks
• **32-34 weeks** • **1600-2200 g** • **LBW** **Clinical presentation:**	• May insert IV line for IV fluid for first 24-48 hours • Keep nil per mouth if unstable, otherwise start enteral/oral feeds	• Start on 10% dextrose solution (preferably potassium-free fluids) in first 24 hours • After 24 hours give neonatolyte/neolyte maintenance fluid • Subtract enteral feed volume from IV fluid volume • Try to reach full enteral feeding volumes and stop the IV fluid as soon as possible
	• Provide colostrum to buccal mucosa or allow baby to suckle on the breast as soon as possible after birth	• Get mother to express colostrum soon after delivery • Allow baby to suckle immediately after birth if stable
• If a baby has a sucking reflex and is able to swallow but the suckling is of short duration	• Start off with a period of breastfeeding and allow baby to suckle 5-10 minutes on breast	• Start with nutritive feeds • Breastfeed before cup or tube feeding
• If baby sucks poorly on the breast	• Introduce top-up cup feeds	• Mother should express breastmilk • Give cup feeds after breastfeeding session • Provide about 70-80% of feeding volume as top-up feeds via cup
• If baby has poor sucking and swallowing and poor cup feeding with a lot of milk dribbling or spilling from mouth	• Insert gastric tube and start with enteral feeds at 30 ml/kg/day	• Preferably an orogastric tube as babies are obligate nose breathers • Feed in KMC position • KMC improves absorption with secretion of gut hormones and the upright position reduces reflux episodes in the baby
• If suckling action improves	• Try to introduce cup feeding every couple of days • Always start with short period of breastfeeding → then restart with a small volume cup feed → then give the rest of the feeding volume via tube while baby is in KMC position	• Wrap the baby with a cotton blanket when she/he is taken out of the KMC position for breast and cup feeds • Transition gradually from tube feeding to cup feeding by decreasing the tube feeding volume and increasing the cup feeding volume • Volume of top-up feeds should be 60-80% of calculated volume

Criteria and clinical presentation	Recommended feeding methods	Remarks
• **> 34 weeks** • **> 2200 g** **Clinical presentation:** If the sucking reflex is established Signs of readiness for breastfeeding: • Sucking reflex well developed – sucking on hand or fingers • Opens mouth when cheek is touched • Baby moves the tongue and mouth and is interested in suckling	Breastfeed exclusively but consider giving small (10-20 ml) top-up feeds with expressed breastmilk – this helps the mother to establish a good volume of milk and baby will gain weight better and be able to leave hospital sooner.	• Transition gradually from cup feeds to breastfeeding. • It is advisable to continue with expressed breastmilk via a cup until the baby reaches a weight of at least 2500 g or 40 weeks. • Mothers should be advised to continue with small top-up feeds (10-20 ml) following each breastfeeding after discharge. • The expressed, top-up feeds are stopped when the baby has good weight gain or reaches a weight of > 2500 g at follow-up clinic If weight gain is poor, continue top-ups even if weight is more than 2500 g.

ELBW, extremely low birthweight; VLBW, very low birthweight; LBW, low birthweight; IV, intravenous; KMC, kangaroo mother care

Annex C. Somatic-oral stimulation techniques instruction leaflet

Guidelines: Three-Step Somatic-Oral Stimulation Techniques for Successful Breastfeeding

Somatic-oral stimulation techniques were developed by speech-language therapists and have proven beneficial in developing oral feeding skills in babies with feeding problems. The purpose of the three steps is to activate a functional sucking-swallowing and breathing pattern. The mother should do the stimulation techniques so that the baby learns her unique smell, touch and gentle voice. The learning helps with breastfeeding.

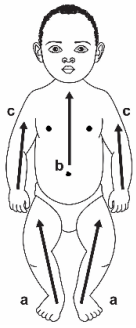
Benefits: It helps to wake baby up and prepare for a feed; It helps baby to move from tube feeding to cup and breastfeeding; Baby calms down, breathes more easily and the heart rate slows down; Baby may gain weight faster and may be discharged sooner.

It is important that stimulation should be done slowly, not rushed or hurried, and gently but firmly. Always wash hands before starting the stimulation (you may wear gloves, but the baby may not like the smell). It is important to keep nails short to prevent injury to the baby's mouth.

Step 1: Somatic Stimulation

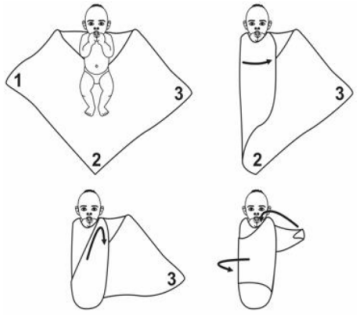
Stroke the following areas 2X in the direction of the mouth. Do not hurry, let the baby be relaxed and calm. Ideally baby should be quiet and alert. Stroke firmly and gently with your hand.

- Hold the baby's foot. Stroke one leg and then the other leg from the foot upwards.
- Stroke from belly button upwards to the chin.
- Hold the baby's hand. Stroke one arm, then the other arm from the hand to upper-arm.



Step 2: Wrapping Baby

- Wrap baby in a thin blanket.
- Place baby's hands in the middle, close to the mouth. Hands close to face enables suckling on the fingers for self-calming.
- Wrapping makes baby feel secure and warm.
- Wrap baby to prepare them for oral stimulation followed by a feed.
- Wrap baby this way when mother goes to the bathroom.
- Keep baby in the KMC position at all other times.

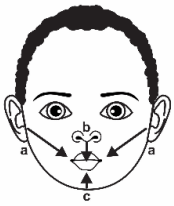


Step 3: Oral Stimulation

Outside Mouth

Activate the muscles of the face and mouth. Stroke 2X towards the mouth:

- Stroke from the one ear to the mouth; from the other ear to the mouth.
- Stroke downwards from the nose to the upper lip.
- Stroke upwards from the chin to the bottom lip.



Inside Mouth

- Slowly put your finger into baby's mouth. Stroke the top and bottom gums 2X. Start from the middle and stroke to the one side, then stroke from the middle to the other side.
- Turn your finger and press against the roof of the mouth.
- Turn your finger and press down on the front part of the baby's tongue. Stroke the tongue 3 to 5 times rhythmically.
- Hold your finger on the baby's tongue and wait. Your baby may start sucking on your finger. It is called non-nutritive sucking.
- Sucking on a finger will improve sucking for breastfeeding. Let your baby suck on your finger as much as possible.

Stress Signs in Baby

Look out for stress signs in the baby and stop stimulation until the baby calms down.

Stop the stroking for a while when the baby shows stress signs like yawning, pushing hands and fingers out (stop sign), covering the face, grimacing, moving arms and legs in all directions, arching backward, crying, sneezing, or moving too much. Also stop when the baby is too tired.

What to do to calm baby: Place baby in the KMC position or wrap in a blanket. Let baby suck your finger or contain baby between your cupped hands.

Important: If baby coughs while feeding, stop feeding immediately and watch their breathing carefully before trying to feed again.

Order of Feeding Process for Mother

- First express the prescribed volume of breastmilk.
- Do the three-step somatic-oral stimulation techniques.
- When breastfeeding or cup feeding, mother should sit in a chair with feet on the floor, holding baby sideways in her arms, with baby's head resting in her bent elbow.
- Keep a small baby wrapped during feeding.
- Baby's head, neck and back should be in a straight line. Baby's body should be flexed.
- Stroke baby's cheek for baby to open the mouth and to latch onto the nipple and areola of the expressed breast.
- Baby should start to suckle when feeling the nipple.
- Initially, the baby will suckle on the expressed breast for non-nutritive suckling. When on full enteral feeds, baby should start feeding from the breast also.
- When baby stops suckling from the breast, mother should start cup feeding in the breastfeeding position and/or tube feeding in the KMC position.

If baby has poor suckling and swallowing

- Stroke baby's tongue 3 to 5 times rhythmically, 1 stroke per second.
- Baby may take time to get ready for suckling. Press gently on the baby's tongue and wait. You will feel how the baby's tongue move and how they start sucking on your finger.
- If you dip your finger in breastmilk you may help your baby to suck.
- Let baby suck your finger for a while. Non-nutritive sucking is very important for a baby to learn breastfeeding.
- Babies with feeding problems may be hypersensitive, clench their gums, or may gag when we touch any part of their tongue. Slowly do the somatic-oral stimulation and let baby suck on your finger for a while. Sucking on your finger will calm your baby. Place baby in the KMC position and continue tube feeding. Wait with breast- and cup feeding until the hypersensitivity reduces.
- Some babies have trouble swallowing. To help your baby swallow, press with your finger under their chin. You will feel the swallow when the tongue moves. It will also help to close the baby's mouth.

Developed by Dr E van Rooyen & Prof. A Kritzinger, Dept of Speech-Language Pathology and Audiology, University of Pretoria, 2019, Revised Oct 2022

Annex D. KMC ward: Routine and clinical care – example guideline

The guidelines below are used at Kalafong Provincial Tertiary Hospital in Pretoria, South Africa. They may have to be adapted for your specific setting and context.

1. Calculation of age of baby

Calculate the age of the baby in days and note it down daily. (When a baby is born between 24:00 (midnight) and 12:00 (noon) it is counted as day one of life. If born after 12:00 it is counted as day 0 of life.)

2. Weight gain

Infants are weighed daily in the KMC unit and weight is written in a KMC weight book. A baby loses weight the first days of life and may take 5–15 days to regain birthweight, depending on the baby's weight and gestational age. Therefore, do not expect weight gain during this early period after birth.

When the infant starts gaining weight, the ideal weight gain is 20 g/day for preterm infants and 30 g/day for term infants. However, babies may have days when they do not gain as much as other days. If weight has jumped or decreased too much, consider reweighing the infant. It is also important to see how the weight gain looks on a growth chart. A daily weight growth chart for preterm infants is available for the first 50 days of life (*see Figures 12 and 13*). Plot weight gain on the growth chart at least three times per week. Unfortunately, term infants' weights can only be plotted once a week as the daily weight growth chart does not cater for term infants. The following are causes and actions to be taken if an infant's growth curve is flattening and does not follow the curve for a period of three or more days:

2.1. Breastfeeding or breastmilk supply problems

To find out whether the mother has any problems, observe and/or question her as follows:

2.1.1. Does mother have enough breastmilk?

Mothers with preterm infants often have a shortage of breastmilk and struggle to produce enough milk for their infants.

2.1.2. Is mother able to express the required amount of breast milk for each feed?

Observe mother's hand expression technique. She may need guidance on how to perform hand expression correctly. This may improve the volume of expressed milk.

- When mother has too little milk it is the custom in some hospitals to prescribe one of the following galactagogues (a drug that promotes lactation in humans):
  - Solian (amisulpride) 100 mg 2x daily for seven days (the most often used drug. It does not affect mother's blood pressure);
  - Eglonyl (sulpiride) 100 mg 3x daily for seven days (do not use in mothers with high blood pressure); or
  - Maxolon (metoclopramide) 10 mg 3x daily for seven days (not very effective).
- Prescribe multivitamins for the mother. (Ask the dietitian to provide the mother with multivitamins.)
- Encourage mother to drink enough fluids, about 2-3 litres per day.
- If mother has so little milk that the baby might dehydrate, consider formula top-up or donor breastmilk. (Donor breastmilk is a scarce resource and is prioritized mainly for premature infants. Only consultants together with the dietitian in charge of the donor milk bank may make the choice to initiate donor breastmilk.)

2.1.3. Does the infant suckle well from the breast?

Does baby latch well and suckle long enough? Very preterm babies may only lick the breast and latch and suckle for a minute or two. More mature and term infants should suckle for about 20 to 30 minutes. According to the time spent on the breast and the quality of the baby's suckling action, the volume of top-up feeds should be decided.

2.1.4. Does the infant complete the expressed breastmilk (EBM) feeds?

If poor feeding technique, especially suckling from breast, or if baby is still receiving tube feeds, refer to speech-language therapist to instruct the mother in the somatic-oral stimulation exercise. Showing mother how to stimulate non-nutritive sucking (NNS) by using her little finger, is also very helpful in improving suckling on breast (*see also Annex C*).

Consider reinsertion of a gastric tube for tube feeding or increase the volume of top-up cup feeds if the baby is not receiving maximum volume feeds already.

2.2. Expressed breastmilk volume

Sometimes very small babies (< 1.2 kg) struggle with the large milk volumes offered per feed when feeding every three hours (8 feeds/day). If this is the case, change to 10 feeds per day by advising the mother to give two-hourly feeds from 06:00 to 18:00 and three-hourly feeds afterwards, during the night. The total daily feed volume should be divided by 10 instead of 8. This is often a practical solution to the problem.

2.3. Cold stress or hypothermia

Poor weight gain can be the result of cold stress or hypothermia. An easy clinical method of checking whether baby is warm enough is by using touch to compare the warmth of the baby's feet with the warmth of the baby's abdomen or the mother's chest skin. If there is a temperature difference between the two areas and the feet are colder, the baby has cold stress and needs immediate warming by being placed in the KMC position. If the coldness of the feet stretches up the baby's legs the baby may have hypothermia, which is serious. The baby should be placed in the KMC position and closely observed for any other complications. A baby with cold stress or hypothermia has poor weight gain. Make sure the mother is practising KMC.

2.4. Fortification of breastmilk

If weight gain remains poor and/or the baby's serum urea falls below 3.57 mmol/l or stays below this level, consider fortifying breastmilk with a human milk fortifier. Monitor serum urea weekly for the response to fortification of breastmilk. Contact the dietitian to arrange this. (Every feed should be fortified with 1 scoop of 1 g powdered fortifier or one sachet of fortifier diluted in a minimum of 25 ml EBM.) Wherever possible, fortification of breastmilk should be provided to all LBW infants less than 2.0 kg birthweight or less than 36 weeks' gestation. It can be considered in babies with higher birthweights with poor weight gain and especially in twin infants.

2.5. Check for acidosis

Very preterm infants often have immature kidney function, which may lead to poor pH control and acidosis. These infants frequently have poor growth due to the acidosis. Check the infant's bicarbonate level on admission to the KMC ward. If the bicarbonate level is < 18 mmol/l, consider retesting and if still < 18 mmol/l, consider giving the baby **oral** sodium bicarbonate 4.2% or 8.5% solution. Start treatment with 1 ml or 0.5 ml with each feed. Check the infant's serum bicarbonate level after 5 days.

2.6. Exclude possible infection

Infections may present with poor weight gain at first, especially urinary tract infection (UTI). If poor weight gain continues in spite of all other issues addressed, exclude infection by doing a full blood count (FBC) and differential count and reticulocytes, C-reactive protein (CRP) and urine microscopy, culture and sensitivity (MCS). Consider starting infant on antibiotics empirically for possible UTI after all investigations have been done.

3. Human milk bank

Below is a description of one way to manage a human milk bank if it is available at your facility.

3.1. Mothers in the KMC unit donate milk to the bank if they have more milk than their infant will use. Only mothers who are HIV-negative can donate breastmilk. When a mother is identified as a breastmilk donor, the following special investigations have to be done: HIV ELISA and hepatitis B serology. The human milk bank staff will ask the clinicians to carry out these special investigations. Provide the staff with the patient's laboratory barcode label, to give them access to the laboratory results.

3.2. Donor breastmilk is occasionally used in the KMC ward if a mother does not have enough milk or if the mother is very ill and cannot supply her own milk to the baby. The donor milk is especially important for preterm infants younger than 14 days of life to prevent the life-threatening complication of NEC.

3.3. Donor breastmilk is a scarce commodity and cannot be used for every baby where the mother is struggling with milk production. Prescribing donor breastmilk can only occur with input from a consultant and/or a dietitian.

4. Urine, stools and vomiting

Ask the mother about the baby's passing of urine, stools and vomiting.

4.1. A baby should have about seven wet nappies a day. If they do not and there is poor weight gain, it could be due to too little breastmilk or baby not finishing cup feeds.

4.2. Stools: a breastfed baby could have seven stools per day or one stool in seven days. Reassure mother if baby skips daily stools. Check the abdomen; if abdomen is distended consider intestinal obstruction or Hirschsprung's disease.

4.3. Babies often spit up milk when bringing up a wind. This is called posseting and is normal for most babies. Vomiting is not normal and should be investigated. If a mother informs you that her baby is vomiting, then first make sure the baby is actually vomiting and not posseting.

- Preterm infants also have a problem with reflux of feeds. This may cause vomiting and the best way to prevent the reflux is to place the baby upright in the KMC position and

for the mother to walk around for a while. If the mother removes the baby from her chest, the baby should be placed on the bed on a cushion, with the head higher than the rest of the body.

- Vomiting may be caused by gastroenteritis. The most common cause of gastroenteritis in neonates is rotavirus infection. This should be excluded by sending special investigations to the laboratory.
- Vomiting may also happen because of intestinal obstruction. On examination, a baby with obstruction will usually have a distended, tender abdomen. If this is the case, an abdominal X-ray should be done.

5. Discharge

Criteria for discharge of a baby is dependent on establishment of breastfeeding, good weight gain (20 g/day in preterm infants and 30 g/day in term infants), regaining of birthweight and a maturity of at least 34 to 36 weeks gestational age.

5.1. An LBW and/or preterm baby should have regained birthweight before discharge and will be considered if birthweight was above 1600 g. The baby should have had good average weight gain of 20 g/day over three days.

5.2. VLBW infants may be discharged when they reach at least 1600 g, if they are mature enough (> 34-36 weeks gestational age) and if they have been off gastric tube feeds for three days.

5.3. ELBW infants who were very premature (< 28 weeks gestation) may be discharged when they are off tube feeds, gaining weight at 20 g/day and have reached a gestational age of 36 weeks.

5.4. Twin infants take longer to establish good weight gain and take longer to be weaned from gastric tube feeds. The mother often struggles with milk supply and taking care of the twins. Therefore, twin infants are usually kept a little longer before discharge to ensure they will thrive after discharge. Discharge weight considerations include a weight above 1650 g - 1700 g for the smaller of the twins; they should both have regained birthweight before discharge and they should have a good daily weight gain (minimum of 20 g/day).

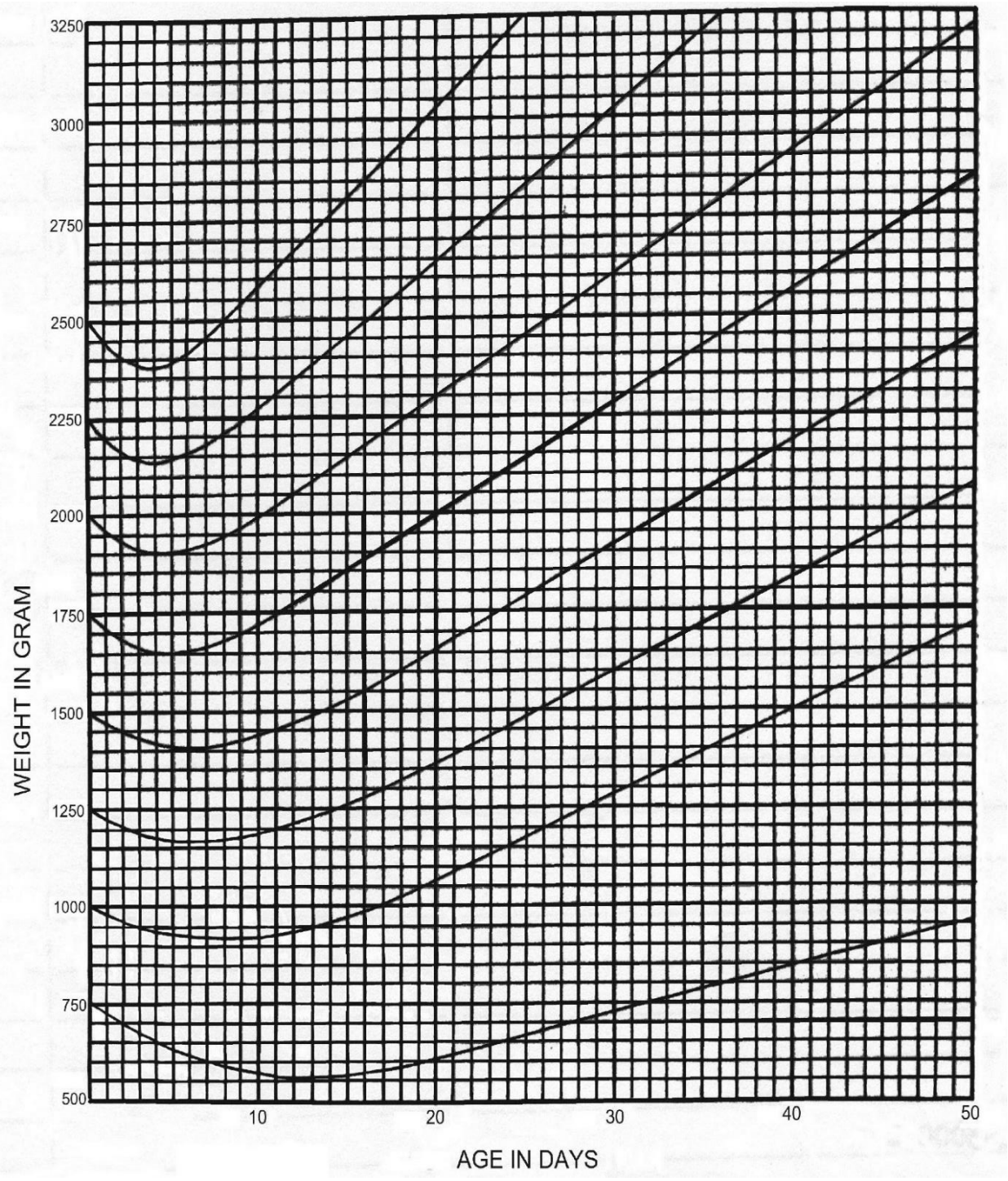
5.5. Mothers with social problems, such as teenage mothers and those with postpartum depression, or drug or alcohol dependence, should only be discharged after consultation with social services or the family.

5.6. Mothers with breastmilk supply problems should only be discharged after the problems have been resolved or addressed.

5.7. Mothers who are HIV-positive:

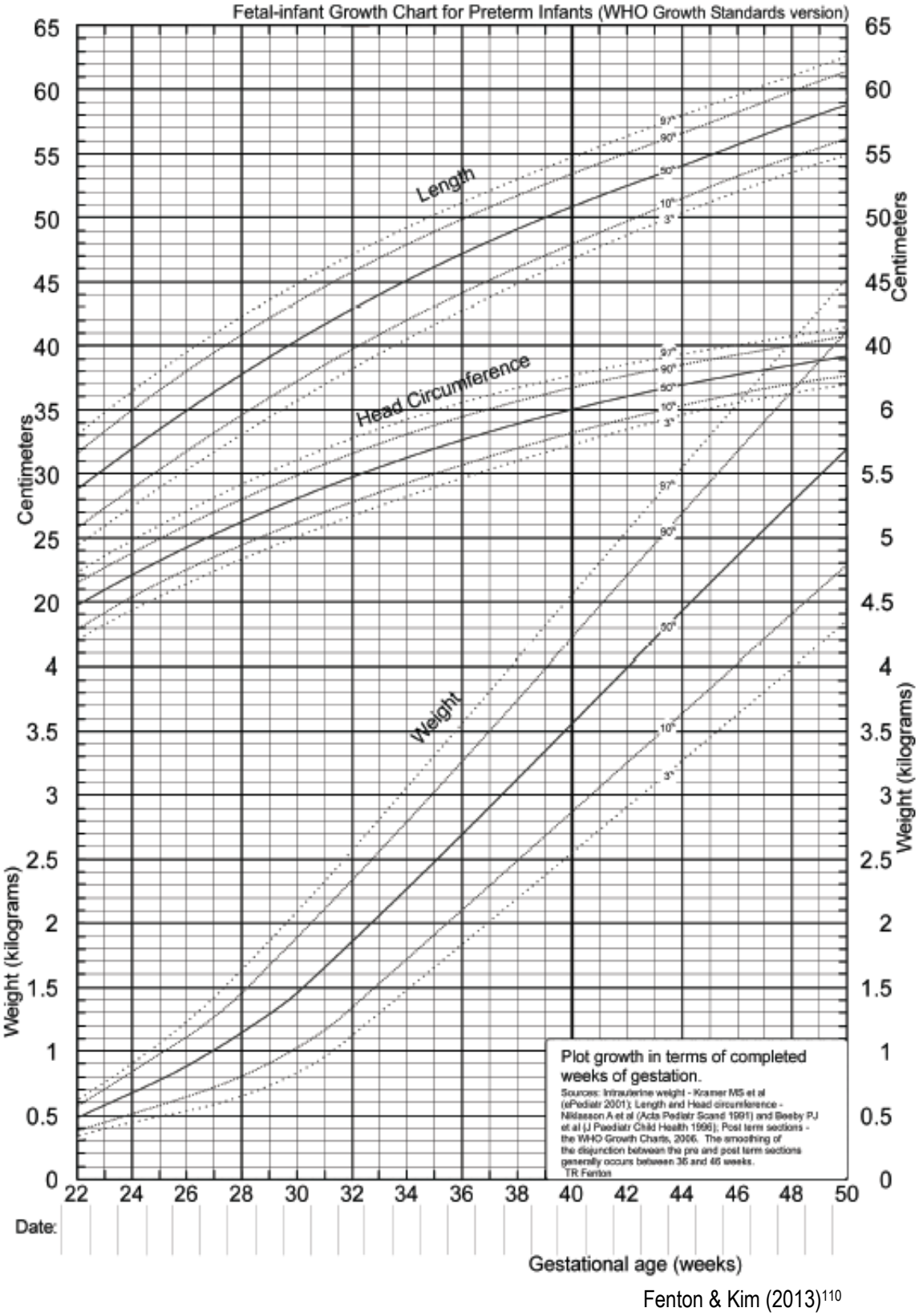
- Make sure the mother has her ARV medication with her and that she is taking the tablets daily.
- Make sure the baby is receiving the appropriate prophylactic therapy.
- Make sure there is a recent maternal viral load (VL) result.
    - If the result is < 1000 copies/ml, the baby is low risk and should be on nevirapine (NVP) for six weeks.
    - If the result is > 1000 copies/ml, the baby is high risk and should be on NVP x 12 weeks and AZT x six weeks.
    - If mother is newly diagnosed or there is no VL or recent VL results, the baby is considered high risk and should also receive NVP x 12 weeks and AZT x six weeks.
- Check whether the baby's birth HIV PCR test is negative.
- Make sure the road-to-health book is completed with the VL results and the baby's birth HIV PCR results.

Annex E. Examples of growth charts for preterm and term newborns



Klaus & Fanaroff (1986)[109]

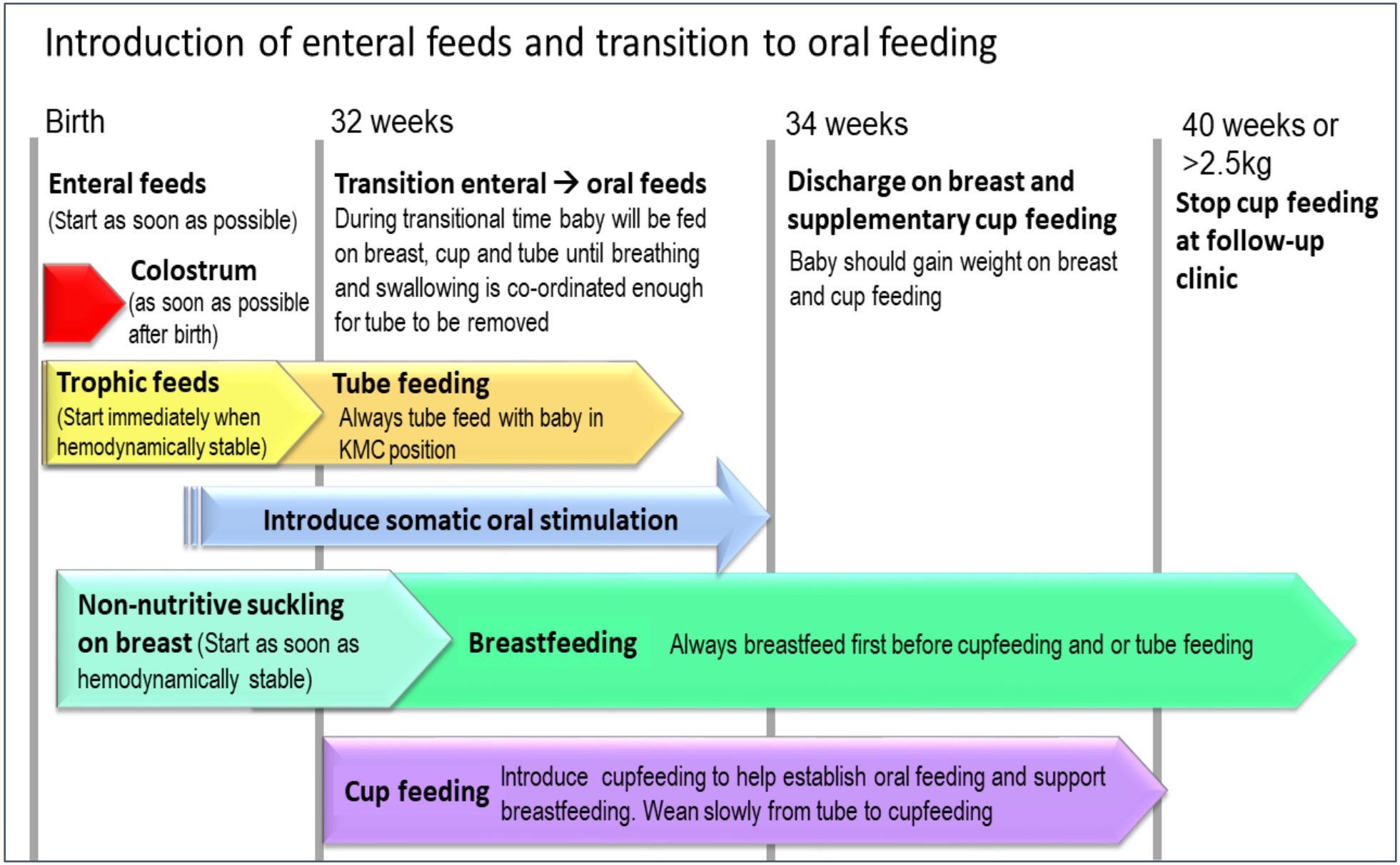
Figure 9. Daily weight chart for preterm infants



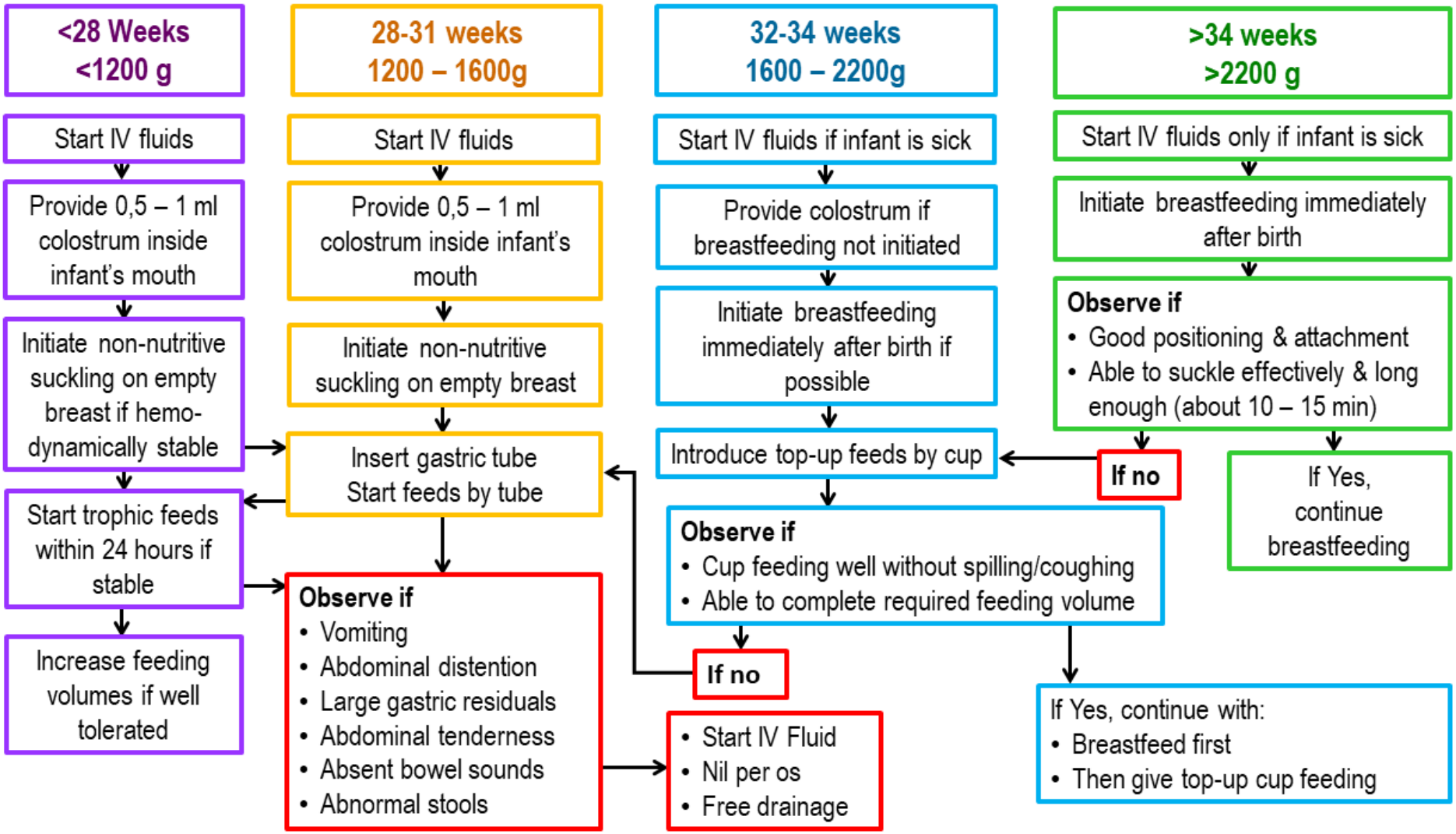
Fenton & Kim (2013)[110]

Figure 10. Growth chart: weight, length and head circumference according to gestational age

Annex F. Feeding job aids

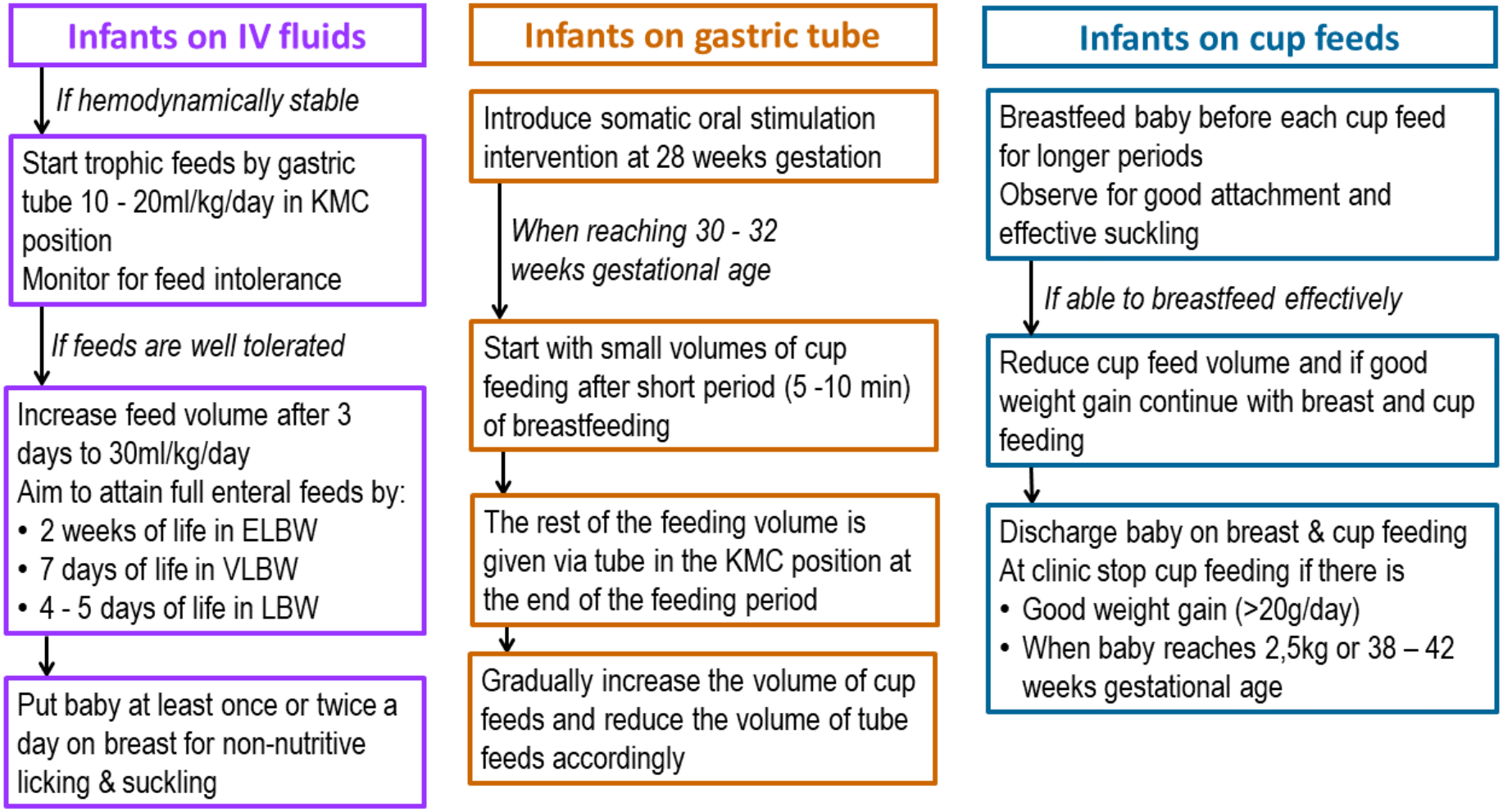


Flow diagram for providing fluids and feeds for preterm and LBW infants



Adapted from the Government of India's 'Feeding Guidelines for LBW Infants', (2014) (p. 22)[38]

Feeding method: transition from tube to cup to exclusive direct breastfeeding



Adapted from the Government of India's ;Feeding Guidelines for LBW Infants', (2014) (p. 22)[38]

Annex G. Feeding readiness assessment tool (feeding diary)

FEEDING DIARY (Includes adapted *Preterm Infant Breastfeeding Behaviour Scale - PIBBS)**

Name: **Reg Number:**

DOB: **Birthweight:** **F / M** **Gest Age:**

Main Problems:

	Therapist							
	Date							
	Age in days							
Behaviour	Weight							
Response to somatic-oral stimulation								
Stressed and crying (stop immediately, place in KMC)								
Floppy, minimal movement								
Active movement in limbs and face								
Non-nutritive sucking noticed								
Better nutritive suckling								
Non-nutritive sucking (on mother's clean pinkie)								
Excessive bite								
No sucking noticed								
Some sucking noticed								
Sucking strong & repetitive; rhythmic 6-8 sucks / swallow								
Tongue cupping around finger								
Breastfeeding								
1. Rooting								
No rooting								
Some rooting								
Obvious rooting								
2. How much breast was inside baby's mouth?								
Only touched nipple								
Part of the nipple								
Whole nipple, not areola								
Nipple and some of the areola								
3. Latched on and stayed fixed to the nipple								
Did not latch on at all								
Latched on, stayed fixed for <1 minute								
Duration in minutes of staying fixed to nipple								
4. Suckling								
No suckling or licking								
Licking and tasting, no suckling								
Single suckles or short bursts								
Repeated short suckling bursts								
Repeated long suckling bursts (>10 suckles)								
Longest suckling burst before pausing. Count suckles								

5. Swallowing							
Swallowing not noticed							
Occasional swallowing noticed							
Repeated swallowing noticed							
6. General behaviour (mark all applicable behaviours)							
6.1 Closed eyes, no body movement							
6.2 Drowsy, eyes open but heavy-lidded. Eyelids fluttered, minimal movement							
6.3 Open eyes, dull or glazed look. Seems to look through rather than at something, minimal movement							
6.4 Eyes wide open, looks tense or afraid, minimal movement							
6.5 Eyes wide open, makes eye contact, looks calm, minimal movement							
6.6 Eyes closed, active movement in limbs and body							
6.7 Open eyes, active movement in limbs and body							
6.8 Crying, fussing audibly							
7. Letdown reflex – Yes / No							
8. Time in minutes baby was held							
9. Breast problems (mark all where applicable)							
Breasts engorged							
Nipples flat or inverted							
Nipples fissured or pain							
Uses nipple shield							
Receives galactagogues							
No problems							
10. Influence of the environment							
Activity and presence of others very disturbing							
Activity and presence of others somewhat disturbing							
Activity not disturbing, enough privacy							
Cup feeding (mark all where applicable)							
Baby positioned correctly (Wrapped, cuddled close to body)							
Approximate amount in ml.							
Spillage							
Open mouth posture, poor lipseal							
Delayed swallow							
Laps up milk, swallows, mouth closes appropriately							
Tube feeding (mark all where applicable)							
Baby tube feeding in KMC position							
Approximate amount in ml.							

Treatment plan

* PIBBS developed by Kerstin Hedberg Nyqvist, Journal of Human Lactation. 1996;12(3):218-219 (Language style slightly adapted)

Compiled by Prof A Kritzinger & Dr E v Rooyen (Kalafong Provincial Tertiary Hospital, 2021)

Annex H. PMTCT guidelines: a case study from South Africa

The South African PMTCT programme has been highly successful in ensuring good outcomes for pregnant women living with HIV and reducing the risk of vertical HIV transmission to their children. The updated PMTCT guideline published in 2019[111] outlines three major strategies for the improvement of the programme:

1. prevention of primary HIV infection and unintended pregnancies in women of childbearing age;
2. improvement of maternal viral suppression rates at delivery and in the post-delivery period through:
    - effective, well-tolerated ARV regimens;
    - strategic use of maternal viral load (VL) monitoring; and
    - linking mothers to post-delivery HIV care and integration of mother-infant health care; and
3. provision of enhanced prophylaxis to infants of mothers with elevated HIV viral loads in the breastfeeding period, while every effort is made to reclaim maternal viral suppression.[111]

Viral load monitoring and management in South Africa

The most critical intervention to prevent vertical transmission is maintaining undetectable VL levels in the mothers through effective ART. In South Africa lifelong ART was implemented in January 2015, regardless of the mother's CD4 count or the severity of clinical disease. Vertical transmission rates within the first two months of life dropped dramatically from 23% in 2003 to 0.7% in 2019. However, in data published in 2016, the cumulative vertical transmission rate by 18 months of age was 4.3%. The largest of these transmissions (> 80%) occurred during the first six months of the breastfeeding period. Monitoring of mother's VL during the breastfeeding period should be rigorously managed.[112]

Breastfeeding, however, continues to be a lifesaving practice in South Africa regardless of maternal HIV status. All evidence revealed that the benefits of breastfeeding outweigh the risks of not breastfeeding.[89, 111, 112]

In South Africa the risk of HIV transmission for the baby at birth is categorized according to the VL result of the mother within the last 12 weeks:

- Low risk = VL < 1000 copies/ml
- High risk =
    - VL ≥ 1000 copies/ml

- No VL result in the last 12 weeks
- Unknown maternal HIV status

All HIV-positive women in South Africa must have a VL test done at the time of delivery. Although this VL result will mostly be unknown when infant prophylaxis is initiated, the laboratory barcode label should be inserted into the postnatal discharge form and the road-to-health book. The results of the delivery VL must be checked at the 3-6-day postnatal clinic visit, and the management of the mother-infant pair adjusted accordingly.[111]

The baby's post-exposure prophylaxis started at birth is based on the risk profile for HIV transmission and the chosen feeding method of the baby. Table 10 gives guidelines for making a decision on the prophylaxis regimen a specific baby should receive.

Table 10. Neonatal HIV post-exposure birth prophylaxis in South Africa

Risk category	Indications	Infant prophylaxis
• Low-risk infant at birth, whether breastfed or exclusively formula-fed	• Maternal VL at delivery < 1000 copies/ml	• Infant NVP at birth and then daily for six weeks
• High-risk infant at birth in the breastfed infant	• Mother not on ART at delivery • Maternal ART < 4 weeks at delivery • Mother on ART with HIV VL > 1000 copies/ml at delivery or prior to 12 weeks • No HIV VL result available at delivery or prior to 12 weeks	• Infant NVP for a minimum of 12 weeks (Infant NVP only discontinued after confirmation of maternal VL being < 1000 copies/ml, and/or until four weeks after cessation of all breastfeeding) AND • Infant AZT twice daily for six weeks
• High-risk infant at birth in the infant exclusively formula-fed from birth	• Mother not on ART at delivery • Maternal ART < 4 weeks at delivery • Mother on ART with HIV VL > 1000 copies/ml at delivery • No HIV VL result available at delivery or prior to 12 weeks	• Infant NVP at birth and then daily for six weeks (provided that avoiding breastfeeding is documented and sustained) AND • Infant AZT twice daily for six weeks

ART, antiretroviral therapy; AZT, zidovudine; NVP, nevirapine; HIV; human immunodeficiency virus; VL, viral load.

Copied from Wessels *et al.* (2020)[112] and 2019 Guidelines SA Department of Health[111]

HIV treatment regime in South Africa

Nevirapine (NVP)

- All exposed infants should receive daily NVP prophylaxis for a minimum of six weeks.
- Give first dose of NVP as soon as possible after birth and no more than one dose per 24 hours.
- Continue with NVP for at least 12 weeks if maternal viral load is high or mother is newly diagnosed at birth.
- Stop daily NVP prophylaxis if birth HIV PCR is positive.
- If mother is not on ART, continue with NVP prophylaxis for duration of breastfeeding and stop one week after last breastfeed.
- If breastfeeding and mother on ART with inadequate viral suppression, continue with daily NVP prophylaxis either until viral load is below 1000 copies per ml or until mother stops breastfeeding.

Dual therapy: NVP and zidovudine (AZT)

- Babies whose mothers have viral loads > 1000 copies/ml or unknown viral loads at delivery or had no VL test for more than 12 weeks are high risk and should receive dual therapy, a combination of NVP for at least 12 weeks and AZT for six weeks.
- Babies of mothers whose HIV status is unknown are also placed on dual therapy.

According to the South African guidelines, the dosages of NVP and AZT are adjusted for preterm and low-birthweight infants. More information is available in the following documents:

- 'Newborn Care Charts: Routine Care at Birth and Management of the Sick and Small Newborn in Hospital', 2014. <www.knowledgehub.org.za/elibrary/newborn-care-charts>[108]
- 'PMTCT Guidelines of the Western Cape Province', amended version, 2015. <www.westerncape.gov.za/sites/www.westerncape.gov.za/files/the_western_cape_consolidated_guidelines_for_hiv_treatment_29032016.pdf>[113]
- 'Guideline for the Prevention of Mother to Child Transmission of Communicable Infections', 2019. <www.knowledgehub.org.za/system/files/elibdownloads/2019-10/PMTCT%20Guideline%2028%20October%20signed.pdf>[111, 112]

Annex I. Case study on the calculation of feeds

Hannah is about 31 weeks into an uncomplicated pregnancy when she feels some pains while doing house work. They do not get better and she realises that she may be in labour. Her husband is not home and she asks her neighbour to help her to get to the hospital.

On admission Hannah is given corticosteroids and treatment to suppress contractions. She is admitted for strict bedrest. The contractions stop, but the next day they resume and her baby boy, Alex is born prematurely 8 hours later. He has a birth weight of 1.200 kg and a gestational age of 31 weeks. He is stable and breathing well on nasal prong oxygen.

Within one hour the nurse expresses colostrum from Hannah's breasts and delivers the colostrum via a small dropper into Alex's cheek.

Alex is now 2 hours old. A drip is inserted and the following fluid requirements are calculated:

- According to Table 6 in Annex A in this document, Alex needs 80 ml/kg/24 hours on the first day of life.
- Alex's condition is stable at 6 hours of life and it is decided that he may start with small trophic feeds of 15 ml/kg/24 hours. Thus the IV fluids will be 80 – 15 = 65 ml/kg.
- The fluid calculations are done as follows:
  - *Intravenous 5% or 10% dextrose solution:*
    1.200 kg X 65 ml = 78 ml in 24 hours or 3.25 ml/hour (rounded to 3 ml/hour)
  - *Trophic feeds volume:*
    1.200 kg X 15 ml = 18 ml in 24 hours or 2.25 ml (rounded to 2 ml) every 3 hours via gastric tube
    Alex receives the enteral feeds (tube feeds) while in the KMC position.

Day 2 of life

Alex accepts the oral feeds well, with no abdominal distention, and the decision is made to increase the oral feeds. Hannah is advised to express her breastmilk.

The total volume of fluids Alex will need on day 2 is 100 ml/kg/day:

- *The IV fluids (5% or 10% dextrose and electrolyte solution) continue as 60 ml/kg/24hours = 3ml/hour*
- *Enteral feed volume:*
  1.200 kg X 40 ml = 48 ml/day ÷ 8 feeds = 6 ml every 3 hours via gastric tube while in the KMC position.

[Note: Instead of calculating the IV fluid and oral feed volumes, one can read them from Table 7 in Annex A. This will save time.]

Day 3 of life

Alex's oxygen saturation is good and he does not require supplemental oxygen anymore. His condition is stable and the enteral feeding is going well. Hannah is encouraged to continue with

KMC for at least one hour after each feed. Alex's weight has dropped to 1.140 kg. [This weight loss is normal as long as it is not more than 7-10% of the baby's birth weight.]

Alex's fluid requirements on day 3 is 120 ml/kg/24hours. [A baby's birth weight is used for calculations; do not use the current weight.] Alex's enteral feeds are increased to 70 ml/kg/day and the IV fluids are reduced to 50 ml/kg/day:

- *IV fluids (dextrose and electrolyte solution):*
  1.200 kg X 60ml = 72 ml ÷ 24 hours = 3 ml/hour
- *Enteral feed volume:*
  1.200 kg X 60 ml = 72 ml/day ÷ 8 feeds = 9 ml every 3 hours via gastric tube in the KMC position

Day 4 of life

Alex is doing well and taking oral feeds well. Hannah is encouraged to let Alex do non-nutritive sucking on her pinkie (little finger, washed and clean) for a short while (1-2 minutes). [Non-nutritive sucking is explained in Section 2.2 of this document.] Then Hannah should place Alex in the KMC position for gastric tube feeding.

Alex's fluid requirement on day 4 is 150 ml/kg/24 hours. The enteral feed volume is increased to 90 ml/kg/day and the IV fluids kept at 60 ml/kg/day:

- *IV fluids (dextrose and electrolyte solution):*
  1.200 kg X 60 ml = 72 ml/24hours = 3 ml/hour
- *Enteral feed volume:*
  1.200 kg X 90 ml = 120 ml/day ÷ 8 feeds = 13.5 ml (rounded to 14ml) every 3 hours via gastric tube in the KMC position

Day 5 of life

Alex has taken feeds well, without any complications. The total enteral feed volume will be adjusted to 120 ml/kg/24 hours on day 5. At enteral feed volume of 120ml/kg/day and above the intravenous fluid can safely be stopped. Thus, Alex's IV drip is now stopped.

Alex's current weight is 1.090 kg. It is normal for all babies to lose between 7-10% of body weight in the first week of life. Alex has lost 110 g, which is a 9.1% loss (calculated as follows: 110 g ÷ 1200 g x 100). [It is normal for a premature baby of this weight to take about 14 days to regain birth weight.]

Hannah is instructed to continue with Alex's non-nutritive sucking on her pinkie and then allow him to suckle on the breast with each feed. After that Alex is placed in the KMC position to receive the gastric tube feeds:

- *Enteral feed volume:*
  1.200kg X 120ml = 144ml/day ÷ 8 feeds = 18 ml every 3 hours

Day 6 of life

Alex's feed volume is increased with 30 ml to 150 ml/kg/day. The calculated volume of breastmilk is:

- *1.200 kg X 150 ml = 180ml ÷ 8 feeds = 22.5 ml (rounded to 23 ml) every 3 hours*

Day 7 of life

The feed volume is adjusted to 180 ml/kg/day. This is usually the maximum feed volume. Further feeding volume adjustments will be made when Alex starts gaining weight above his birth weight.

- *1.200 kg X 180 ml = 216 ÷ 8 feeds = 27 ml every 3 hours*

Day 14 of life

Alex has regained his birth weight. Until now he has received short periods of breastfeeding on the breast and then all calculated feed volumes via the gastric tube. Now is a good time to start weaning him from enteral feeds and introduce oral feeds by giving a small amount of the expressed breastmilk via a cup. To prepare a baby for oral feeding it is good to introduce somatic-oral activation before each feed (*see Annex C*).

Hannah needs training in the technique of cup feeding. As soon as she understands how to hold Alex and offer him the cup, she may start giving him small volumes of expressed breastmilk. The feeding sequence is always as follows:

- First do oral activation or non-nutritive sucking for at least 3 minutes.
- Wrap the baby and place on the breast to breastfeed. Initially the breastfeeding sessions may be very short but should increase in time as a baby gains weight and matures.
- After breastfeeding the baby should start on small amounts of milk via a cup and the rest of the feeding volume is given via the gastric tube while in the KMC position.

[Note: In this growing phase, the feeding volumes per feed can be read from Table 8 in Annex A.]

Day 21 of life

Alex's weight has increased to 1.350 kg. He is currently feeding for about 2 minutes on the breast. The nurse uses Table 8 in Annex A to read off the correct feeding volume. She uses the last column of 180 ml/kg to find the feeding value and chooses the "BF" column because Hannah is breastfeeding Alex. The feeding volume is between 29 and 30 ml. The nurse chooses the higher volume of 30 ml.

Alex is now managing to drink 10 ml milk via cup and the rest of the milk is given by gastric tube. Hannah is advised to try to increase the cup-feed volume with 5 ml every second day and decrease the gastric tube volume with the same amount.

Day 25 of life

Alex now weighs 1.430kg. He is managing 20 ml via cup and 10 ml via gastric tube. He is suckling for about 5 minutes from the breast.

The total volume of a feed is 34 ml. Because Alex is also feeding directly from the breast, the volume of the expressed breastmilk is not increased and stays 30 ml per feed. Any weight gain in Alex will be due to the extra milk obtained through breastfeeding.

Day 30 of life

Alex's weight is 1.540 kg. His cup feeding has improved and he is taking the full volume of 30 ml via the cup. The gastric tube was removed a day ago. Alex is now sucking from the breast for 10 to 15 minutes at each feeding session. The total volume for each feed is about 35 ml, but he is only receiving 30 ml top-up feeds.

Seeing that Alex is growing so well on cup- and breastfeeding, the doctor can consider discharge as soon as he has reached the weight of 1.600 kg [according to Kalafong Hospital guidelines].

On discharge Hannah will continue breastfeeding and will give Alex 30 ml a top-up expressed breastmilk feed at each feeding time after 15 to 20 minutes of breastfeeding. When Hannah brings Alex for follow-up, the decision will be made whether the top-up volume should be reduced or completely stopped, depending on Alex's growth curve and his breastfeeding technique.

Annex J. Postnatal foot length to determine gestational age

There are various methods to determine a baby's gestational age. During pregnancy, last menstrual period (LMP) and ultrasonography before 14 weeks of pregnancy are widely used to estimate the date of delivery. Ultrasonography is not always available in settings with limited resources. At birth Ballard scoring can be used to determine whether a newborn is preterm or not. The Ballard method is complex and requires training and more advanced skills. In the absence of the availability of other methods, a simple method of measuring the foot length of a baby can also give an estimate of a newborn's gestational age. The foot lengths in the table below can be used to calculate the estimated gestational age of a newborn.[114]

Foot-length values for gestational age

Gestational age in weeks	Foot length in mm
<24	<44
24	44.1 – 45.9
25	46 – 48.9
26	49 – 51.9
27	52 – 53.9
28	54 – 55.9
29	56 – 58.9
30	59 – 60.9
31	61 – 63.9
32	64 – 65.9
33	66 – 68.9
34	69 – 70.9
35	71 – 72.9
36	73 – 75.9
37	76 – 77.9
38	78 – 80.9
39	81 – 82.9
40	83 – 84.9
40+	>85
Adapted from Merz data*	

Source: Van Wyk LV, Smith J. Postnatal foot length to determine gestational age: a pilot study. Journal of Tropical Pediatrics. 2016;62(2):144-151. https://doi.org/10.1093/tropej/fmv093

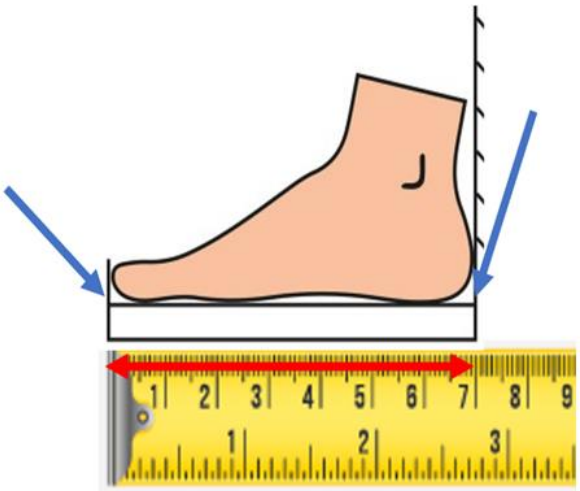
* Merz E, Oberstein A, Wellek S. Age-related reference ranges for fetal foot length. Ultraschall in der Medizin. 2000;21(2):79-85. https://doi.org/10.1055/s-2000-318

Method to measure the foot

Place the baby's foot flat on a piece of paper, draw a line in front of the big toe and at the heel. Take away the foot and measure the distance between the two lines with a measuring tool.

Then read off the gestational age by using the measurement result of the foot length. For example, the foot in the illustration below is 70 mm. Using the foot-length column, find 70 mm and read off the value in the gestational age column. The gestational age of this baby is 34 weeks.

Gestational age	Foot length (mm)
<24	<44
24	44.1–45.9
25	46–48.9
26	49–51.9
27	52–53.9
28	54–55.9
29	56–58.9
30	59–60.9
31	61–63.9
32	64–65.9
33	66–68.9
34	69–70.9
35	71–72.9
36	73–75.9
37	76–77.9
38	78–80.9
39	81–82.9
40	83–4.9
40+	>85



Foot length is 70 mm

Table from Van Wyk and Smith (2016)[114]

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