# MCN for Neonatology

# West of Scotland

# Neonatal Guideline


# Enteral Feeding of Preterm Babies

## Contents

## Introduction

This guideline describes enteral feeding practices for babies born at ≤34 week's gestational age (GA) and / or ≤1800 grams birth weight. It should be used in conjunction with local Parenteral Nutrition (PN) guidance.

It advocates for consistency of approach across neonatal units and networks. These recommendations must always be used in combination with individualised clinical assessment and are **NOT** applicable to:

1. Babies with congenital anomalies of the gastrointestinal (GI) tract
2. Babies commencing enteral feeding after GI surgery
3. Babies commencing enteral feeding after an episode of medically managed necrotising enterocolitis (NEC)

This guideline is applicable to all healthcare professionals caring for preterm babies in Scottish neonatal units.

## Background

With improved survival increased emphasis is now placed on ensuring the highest quality outcomes for babies born prematurely. Early nutrition plays an important role in achieving optimised short and longer term health, and the aims of nutritional management are to:

1. Achieve an adequate standard of short and longer term growth
2. Meet the increased nutritional requirements of the preterm baby
3. Avoid feeding-related morbidities, especially NEC
4. Optimise longer term health outcomes such as neurodevelopmental attainment

A consistent approach to enteral feeding is advocated because data from multiple observational studies suggest that the use of a standardised feeding guideline positively impacts a number of clinical outcomes including[1-5]:

- Reduced time taken to achieve full milk feeding
- Shortened time on PN
- Shortened length of hospital stay
- Reduced NEC rates
- Improved growth and neurodevelopmental attainment

There is good evidence that both consistency of practice and growth outcomes are improved with a multi-disciplinary team (MDT) approach to nutritional care; weekly nutrition specific ward rounds including neonatologists, dieticians, pharmacists and nursing staff are advocated by centres with excellent growth outcomes e.g. Southampton[6].

The recognised benefits of MDT working are reflected in national recommendations for the optimal provision of neonatal care e.g. British Association for Perinatal Medicine (2022) *Service and Quality Standards for Provision of Neonatal Care in the UK* (https://www.bapm.org/resources/service-and-quality-standards-for-provision-of-neonatal-care-in-the-uk).

## What is adequate growth for a preterm baby?

It is generally accepted that there are two phases of postnatal growth; loss of extra cellular fluid (ECF) and therefore weight in the first few days after delivery (first phase), followed by growth after commencing early and optimal nutrition (second phase).

Early weight loss due to ECF contraction is inevitable, therefore on average a baby will generally be lower than birth centile, but when ECF contraction is complete they should grow parallel to a centile. Early fluid / weight loss can be mitigated by the appropriate and early use of PN, with figures for acceptable day seven weight loss including <5% of birth weight or <0.5 standard deviation score (SDS) lower than birth weight. If a stable baby continues to grow along their day seven centile this would usually be viewed as adequate.

There may be times when it is not possible to meet a baby's nutritional requirements e.g. if they are fluid restricted for medical reasons. In addition critically unwell babies won't grow in the first few days of their illness, and these factors have to be taken into considerations when reviewing overall growth trajectory **S**ee *Appendix 1* for a more detailed description of how to assess a baby who is failing to achieve adequate growth.

Enabling a small amount of catch up growth after illness is generally viewed as desirable, although there is very little data on the impact of this on longer term outcomes.

## Growth monitoring in the neonatal unit

Growth monitoring is a key component to assessing nutritional status. Anthropometric measurements should include weight, head circumference (OFC) and length because no one measurement in isolation is sufficient to fully evaluate proportional body growth. All measurements should be plotted regularly on an appropriate growth chart.

### Weight

All babies should be weighed at birth with a note taken of any oedema or other fluid collection (e.g. hydrothorax) present. Thereafter weight should be measured as clinically / developmentally appropriate every two days for the purpose of growth monitoring and feed / fluid calculations. Birth weight should be used for these calculations until it has been regained. Daily weights may be requested when closer assessment of fluid balance is indicated. For babies unable to be weighed an estimated weight should be calculated at least weekly using their anticipated weight trajectory on their growth chart.
**An increase of 15–20 grams/kg/day is ideal to follow a centile line.**

### Head circumference (OFC)

OFC should be measured on the day of birth and weekly thereafter.
**An increase of 0.9 cm/week is ideal to follow a centile line.**

### Length

Linear growth is a good indicator of true body growth and is associated with lean tissue mass. Length should be measured once stabilised after birth and weekly thereafter, along with OFC.
**An increase of 1.4 cm/week is ideal to follow a centile line.**

## Nutritional requirements of a preterm baby

Preterm delivery results in reduced nutrient stores at birth and increased postnatal nutrient requirements, creating a risk of accumulating nutritional deficits and postnatal growth failure. Early, adequate nutrition is essential to mitigate this risk and optimise outcomes.

The European Society for Paediatric Gastroenterology Hepatology and Nutrition's (ESPGHAN) position paper on enteral nutrition in preterm infants provides an expert consensus approach to feeding in this population (2022 Enteral Nutrition in Preterm Infants: ESPGHAN Position Paper | ESPGHAN)[7]. ESPGHAN acknowledge that whilst many of their recommendations are based on high quality evidence significant gaps remain and there is a need for further research, especially into longer term functional outcomes.

### Table 1. Recommendations for fluid, macro and micronutrient intake

| | Term baby | Preterm baby (ESPGHAN 2022) |
|---|---|---|
| Fluid volume | 150 ml/kg | 150-180 ml/kg |
| Energy | 96-120 kcal/kg | 115-140 kcal/kg; may increase up to 140-160 kcal/kg if growth faltering despite optimal protein / other nutrient intakes |
| Protein | 2.1-2.6 grams/kg | 3.5-4 grams/kg; may increase up to 4.5 grams/kg if growth faltering despite optimal energy / other nutrient intakes |
| Sodium | 1.9 mmol/kg | 3-5 mmol/kg; may increase up to 8 mmol/kg in babies receiving high energy and protein intakes, or with large sodium losses |
| Potassium | 4.2 mmol/kg | 2.3-4.6 mmol/kg |
| Calcium | 13.1 mmol/day | 3-5 mmol/kg |
| Phosphate | 13.1 mmol/day | 2.2-3.7 mmol/kg |
| Iron | 1.7 mg/day | 2-3 mg/kg |
| Vitamin A | 1166 IU/day | 1133-3300 IU/kg |
| Vitamin D | 340 IU/day | 400-700 IU/kg (max dose of 1000 IU) |

## Feeding the preterm baby

### When to start milk

The early introduction of milk enhances gut maturation, motility and hormone release, as well as shortening the time to full milk feeding and discharge[8]. It does not increase the risk of feeding-related morbidities, in particular NEC[8]. We recommend that stable babies of any gestation with no other contraindications should receive maternal colostrum as close to birth as possible**.** To facilitate this it is important that neonatal units have policies and processes in place to support maternal breast milk expression in labour ward.

### Benefits of buccal colostrum

Oropharyngeal or buccal administration of freshly expressed colostrum

- Promotes the absorption of maternal antibodies and anti-inflammatory substances which can protect against disease and infection[9]
- Provides bactericidal, antiviral, anti-inflammatory and immunomodulatory protection[10]
- Provides a positive oral experience
- Supports early sensory development of taste and smell

### Practicalities of buccal colostrum administration

- Commence as soon as possible after birth, always use colostrum in the order it was expressed
- Insert the tip of colostrum syringe into the buccal pouch (do not use a swab as colostrum will be absorbed)
- Give a maximum of 0.15mls in each side
- Use a gloved finger to gently massage the colostrum in, observing baby for signs of stress

### Minimal enteral feeds

Minimal enteral feeds (MEF), also known as trophic feeds are defined as nutritionally insignificant, small volumes of milk (typically 12–24 mL/kg/day) administered without advancing for a period of 3–7 days. There is **NO** clear benefit of MEF with delayed advancement compared to initiating small volumes as soon as possible after birth and advancing as clinically tolerated[11, 12].

### Rate of feed advancement

Meta-analysis and systematic review demonstrate that faster feed progression (generally defined as 30-40 mL/kg/day) versus slower (15-25 mL/kg/day) reduces the time to full enteral feeds, without increasing the incidence of NEC or all-cause mortality[13, 14]. Included in these analyses is the large ***S***peed of ***I***ncreasing milk ***F***eeds ***T***rial (*SIFT*) which compared daily increments of 18mL/kg/day with 30 mL/kg/day. It is worth noting that the median enrolment age of four days in *SIFT* may not adequately inform the relative safety of these increments at an earlier age, in addition the actual daily increment was slower than targeted in both arms of the study[15].

An accepted approach to advancing feeds is to assess each baby's risk of developing feeding-related morbidities (see the colour coded boxes in Figure 1 below), and to use this to inform a standardised rate of increment (see *Appendix 2*). Any approach to feed advancement must be underpinned by regular assessment of feed tolerance

Figure 1. Assessment of a baby's risk of developing feeding-related morbidities

**Highest risk babies**

- <28 weeks gestational age or birth weight <1000 grams
- Small for gestational age (<2nd percentile) especially if associated with absent or reversed end diastolic flow
- Perinatal hypoxic-ischaemic insult with evidence of end organ injury
- Hypotensive / unstable ventilated babies
- Additional risk factors for gut hypoperfusion e.g. haemodynamically significant ductus arteriosus, co-existing congenital heart disease

Introduce buccal colostrum as soon as possible after birth
Start minimal enteral feeds @ 12-24 mL/kg/day as 2 hourly boluses as soon possible thereafter
Advance feeds once tolerated after 24 hours old @ 30 mL/kg/day (see *Appendix 1*)
Continue to monitor feed tolerance regularly with cares

**Moderate risk babies**

- 28 to $31^{+6}$ weeks gestational age without additional risk factors

Introduce buccal colostrum as soon as possible after birth
Start minimal enteral feeds @ 24 mL/kg/day as 2 hourly boluses as soon possible thereafter
Advance feeds as tolerated @ 30-40 mL/kg/day (see *Appendix 1*)
Continue to monitor feed tolerance regularly with cares

**Standard risk babies**

- ≥32 weeks gestational age without additional risk factors

Introduce buccal colostrum as soon as possible after birth
Start full enteral feeds @ 60-90 mL/kg/day as 2 to 3 hourly boluses as soon possible thereafter
Advance feeds as tolerated @ 30-40 mL/kg/day (see *Appendix 1*)
Continue to monitor feed tolerance regularly with cares

## Method and frequency of feeding

### Bolus versus continuous

Current evidence does not support the firm recommendation of one particular method over another, however published data indicate that[16-19]:

- Bolus feeds promote the cyclical release of GI tract hormones which stimulate gut maturity and motility
- Babies fed continuously take slightly longer to achieve full feeds compared to those bolus fed
- Growth may be compromised by continuous feeding as human milk fat adheres to the tubing and nutrients may be lost
- There is no significant difference in somatic growth and incidence of NEC between continuous and bolus feeding

In general **we recommend starting with two hourly bolus feeds in most babies[20].** One hourly volumes or continuous feeds may be considered if feed tolerance is problematic. Progression to three hourly volumes should occur when tolerance permits.

### Nasogastric versus orogastric tubes

Nasogastric (NG) and orogastric (OG) feeding tubes are both used in practice. NG tubes may increase nasal airway resistance especially in the smallest babies[21], which can theoretically have an impact on their work of breathing[22, 23]. However systematic reviews show no consistent effects on feed tolerance or frequency of desaturation / bradycardia / apnoea[24]. OG tubes may be more prone to vagal stimulation which can provoke bradycardia due to tube movements in the hypopharynx[25]. Adverse effect of both NG and OG tube placement have been described (misplacement, laryngeal perforation). They must be inserted, and their position checked in line with local guidance.

## When to stop parenteral nutrition and remove vascular access

The majority of babies' <32 weeks GA receive both parenteral and enteral nutrition, with a transitional period in between which is influenced by local feeding practice[26, 27]. This transition phase is a critical time period for poor growth, although early progressive parenteral and enteral nutrition strategies, such as earlier fortification may lead to reductions in the cumulative energy and protein deficits that occur during the first weeks of life[28-31].

Administration of PN requires venous access and a balance needs to be struck between optimised nutritional intake and the infection risk associated with indwelling vascular access. NICE recommend consideration of stopping PN within 24 hours of[32]:

- Babies <28 weeks GA tolerating milk volumes of 140 to 150 mL/kg/day
- Babies ≥28 weeks GA tolerating milk volumes of 120 to 140 mL/kg/day

Following discontinuation of PN, babies should then continue to increment milk volumes at the same rate until they reach around 165 mL/kg/day.

## Assessing feed tolerance

### Gastric residual volumes / aspirates

The residual volume (RV) aspirated from the stomach prior to a feed is one factors used to assess feed tolerance. However gastric emptying can be influenced by a number of variables including positioning of the baby and the type of milk feed, with maternal expressed breast milk (MEBM) emptied almost twice as fast as formula[33-35]. For these reasons RV alone should not be used to determine whether milk feeding is stopped.

Evidence from relatively small studies suggests that routine monitoring of RV increases the risk of feeds being stopped and slows the time taken to reach full milk volumes, without having any impact on adverse outcomes such as NEC[36, 37]. Currently routine measurement of RV in a stable preterm baby is not recommended and existing practice in many neonatal units is to simply obtain a small volume of gastric aspirate to ensure the correct position of a gastric tube prior to each use. This approach is being evaluated further in the neoGASTRIC trial (neoGASTRIC | NPEU (ox.ac.uk); a multi-centre study comparing no routine measurement of RV with routine (up to six hourly) measurement. The primary outcome is time to full feeds and secondary outcome is NEC.

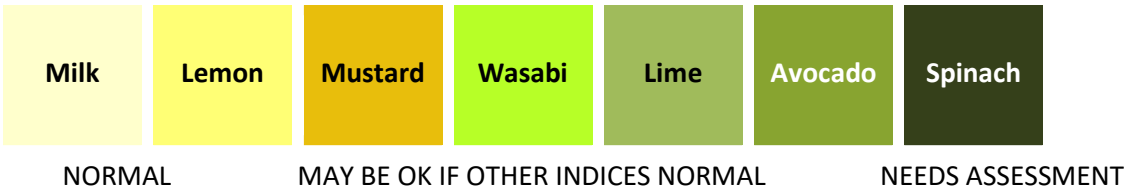
If RV are measured there is no consensus on whether to re-feed or discard the aspirate. If re-feeding is practiced the following should apply:

- RV consist of undigested milk
- RV are present during low volume / trophic feeding
- There are no clinical concerns – see below

### Colour of gastric residual volumes

The colour of gastric RV can vary significantly and it is good practice to visualise these and compare them to a standardised chart (see Figure 1 below) if concerns are raised.

### Figure 1. Indicative chart for assessing the colour of gastric residual volumes / aspirates




### Signs of feed intolerance

The definition of feed intolerance includes not only the volume and colour of gastric RV, but also assessment for some or all of the following:

1. Any concern that gastric residual volumes resemble or smell like faeces (so called faeculent aspirates)
2. Vomiting
3. Abdominal distension / visible bowel loops / discolouration / tenderness
4. Presence of abnormal or bloody stool

5. Clinical instability e.g. apnoea, temperature instability, tachycardia
6. Blood results e.g. metabolic acidosis, rising inflammatory markers
7. Abdominal x-ray

Dependent on these findings an informed decision to continue milk feeding, reduce milk volumes and review, or stop milk feeding can be made.

## Differing milks and their indications for use

### Maternal expressed breast milk / mother's own milk

Maternal expressed breast milk (MEBM), also known as mother's own milk (MOM) is the optimal feed for preterm babies. It confers many short and longer term health benefits which are described in more detail in the recently updated World Health Organisation (WHO) recommendations for the care of preterm and low birth weight babies[38] (https://reliefweb.int/report/world/who-recommendations-care-preterm-or-low-birth-weight-infant).

### Donor human milk

In the absence of sufficient MEBM donor human milk (DHM) is recommended in preference to infant formula (IF) for babies <32 weeks GA and / or <1500 grams[38, 39, 40]. High quality evidence of benefit from DHM is limited, but a consistent finding when compared to IF is that DHM reduces the incidence of preterm NEC[41, 42].

It is important to acknowledge that DHM is fundamentally different to MEBM. DHM undergoes multiple processes e.g. freezing, transportation and pasteurisation prior to being fed, which have an impact on the biochemical, immunological and nutritional composition when compared to fresh and frozen MEBM. Parents should always be counselled of the differences between MEBM and DHM, highlighting that optimal outcomes are based on MEBM, and that DHM is ideally a bridge to achieving this. Ongoing maternal lactation support should always be provided in conjunction with DHM use, and parental consent for use must be obtained. Further information on DHM, the existing evidence base and ongoing uncertainties is available in the updated British Association of Perinatal Medicine Framework for Practice on Donor Human Milk Use in Neonates[39] (The Use of Donor Human Milk in Neonates | British Association of Perinatal Medicine (bapm.org) )

Ideally DHM is replaced by MEBM once maternal lactation is established, but in the continued absence of sufficient MEBM the options include continuing with DHM beyond the highest risk window for NEC i.e. >34 weeks corrected GA or grading over to a preterm formula (PTF). If DHM is continued fortification should be considered as per MEBM (see below).

There is insufficient evidence to make specific recommendations about either duration of DHM use or routine fortification of DHM. However it is important than neonatal units and networks work collaboratively to produce and adhere to guidelines that ensure DHM use is consistent. See the BAPM recommendations below[39].

BAPM recommendations for donor human milk use

- DHM may be considered in babies born at <32 weeks gestation and/or <1500 grams to establish enteral feeding when mother's own milk (MOM) is unavailable or insufficient to meet their baby's requirements.
- Parents must provide informed consent for the use of DHM; as part of the consent process they should be counselled regarding the differences between both DHM and infant formula when compared to MOM, including benefits, risks and ongoing uncertainties.
- DHM use must be supported by adequate lactation support and appropriate staff training.
- There is insufficient evidence to make specific recommendations about duration of DHM use, fortification of DHM and use of DHM in moderate/late preterm and term babies.
- Neonatal units and networks must work collaboratively to produce guidelines that ensure DHM use is consistent.

## Multicomponent breast milk fortification

The benefits of MEBM have been described above, however human milk alone (maternal and / or donor) at volumes of ≤200 ml/kg does not have the nutrient density, particularly of protein, calcium and phosphorus to meet the increased nutritional requirements of a preterm baby[43]. For this reason supplementation with a multicomponent breast milk fortifier (BMF) is recommended. It should be noted that although most studies of BMF show slightly greater weight, length and head growth, and no demonstrable increase in NEC there is no consistent data showing improvements in longer term developmental outcomes[44].

## Which babies should receive breast milk fortification?

There is insufficient evidence to make specific recommendation on which subgroups of preterm babies may benefit most from BMF and **we therefore recommend that fortification should be considered in all babies born ≤32 weeks GA or ≤34 weeks GA with a birthweight of ≤1800 grams.**

Fortification may not be required if ≥50% of the feed requirement is provided by preterm formula, although it can be considered if there is poor growth and suboptimal tolerance of volume. **BMF should never be added as a supplement to preterm formula.**

## When should breast milk fortification be started?

The optimal time to start BMF is not clear and practice varies across the UK. Early fortification seems to be as safe as delayed fortification and it may reduce accrued nutrient deficiencies, positively influencing bone metabolism[45]. ESPGHAN suggest starting BMF when enteral intakes reach 40–100 mL/kg/day[7] however this is considerably earlier than most neonatal units in Scotland have traditionally introduced fortification.

**We recommend a move towards earlier consideration of fortification once milk volumes ≥120 mL/kg/day have been tolerated for at least 24 hours.** This will help to mitigate the recognised reduction in nutritional intake and associated growth failure when PN stops[28-31].

## Which breast milk fortifier?

Currently bovine based, multi-nutrient BMF are recommended for routine clinical practice. The following are both produced in powder form and packaged into sachets:

- Nutriprem BMF (Cow & Gate) - contains extensively hydrolysed protein, carbohydrate, vitamins and minerals. Halal & Kosher certified
- SMA BMF (Nestle) – contains partially hydrolysed protein, carbohydrate, vitamins and minerals, including iron. Halal certified

Human milk derived BMF are now commercially available either as concentrated liquids or lyophilized powders which make an exclusive human milk diet possible. They are expensive when compared to bovine based fortifiers and to date systematic reviews do not show clear benefit of their use over current practice of using a bovine based fortifier, and they are not routinely recommended at this time[46].

## When should BMF be stopped and when should post discharge fortification be considered?

Traditionally BMF have been stopped before discharge once breastfeeding is established. However there is evidence that babies who have not reached term benefit from continued milk fortification to ensure that their intake of critical nutrients (especially protein and minerals) is maintained[47]. This combined with the introduction of home nasogastric feeding policies to facilitate earlier discharge mean that continuation of BMF at home is becoming established into practice.

**We recommend that post discharge fortification is considered in the following babies:**

- **Those <37 weeks CGA and / or ≤1800 grams, especially if there has been inpatient growth faltering and growth parameters have dropped >2 centiles from birth**
- **When breast feeding is still being established**

Fortification is generally not required beyond 6 weeks CGA and if growth remained suboptimal at this stage medical review and dietetic referral should be considered. A guideline to provide greater clarify on the practice is currently being written.

## Preterm formula

Preterm formula (PTF) have been designed to meet the increased nutrient requirements of preterm babies and to support adequate growth. They are not recommended for growth restricted term babies and are only available in hospital settings.

**PTF are recommended when MEBM and / or DHM are unavailable in babies born <34 weeks GA and are used until babies reach 2000 grams and / or 37 weeks CGA.**

- **If using SMA Gold Prem 1, volumes should be maintained at 150 mL/kg/day to avoid excessive protein intake**
- **If using Cow & Gate Nutriprem 1, volumes can be increased up to 165 mL/kg/day as indicated by weight gain and volume tolerance**

SMA Gold Prem 1 is partially hydrolysed. Cow & Gate Hydrolysed Nutriprem is extensively hydrolysed however the benefit of hydrolysed milk use in neonatal settings is yet to be substantiated[48].

## Nutrient enriched post discharge formula

**Nutrient enriched post discharge formulae (NEPDF) can be considered when a preterm baby reaches >37 weeks CGA and / or >2000 grams if:**

- **Growth has been poor i.e. growth parameters have dropped >2 centiles from birth and catch-up growth is required**
- **There are associated co-morbidities, such as BPD which result in a higher nutrient requirement**

It should be noted that meta-analyses of NEPDF have not shown any consistent improvements in longer term growth outcomes[49] and a decision to use it should be discussed within the MDT on a case by case basis. **The majority of preterm babies with normal growth velocity do not require NEPDF.**

There are two NEPDF available in the UK; Nutriprem 2 and SMA Gold Prem 2. Both are available on prescription and should be added to discharge prescription request. Once introduced they are continued until adequate catch-up growth has been achieved or until 6 months CGA.

## Term formula

In the absence of MEBM, term formula are indicated for late preterm babies 34-37 weeks GA with normal growth velocity and no requirements for catch-up growth.

## Specialised term formula

Specialised term formulae are not designed to meet the requirements for preterm babies and will require modification to ensure individual requirements are met. These should only be used where absolutely necessary and under the direction of a specialist neonatal dietitian.

These are not available as ready to feed preparations, and if reconstituted out with a specialist milk kitchen they need to be prepared in accordance with the Department of Health guidelines[50, 51].

## Nutritional supplements – vitamins & minerals

Babies born prematurely have lower stores of fat soluble vitamins, and potentially higher requirements for all vitamins and minerals than those born at term. High quality evidence to guide supplementation is lacking which has led to variation in practice. **Please see local monographs for current unit policies.**

## Probiotics

Evidence from randomised controlled trials and meta-analysis suggest that administration of probiotics to preterm babies reduces their risk of severe NEC and death[53, 54]. A variety of probiotic preparations have been studied and although preparations using combinations of organisms appear to confer the greatest benefit there is still uncertainty about which is the optimal preparation[55].

Probiotics are not licensed as medicines, rather they are characterised as a food product and regulated in a similar way to breast-milk fortifier. The two most commonly used preparations in the UK are[56]:

- **Labinic (Biofloratech Ltd, UK)** which contains *Lactobacillus acidophilus, Bifidobacterium infantis* and *Bifidobacterium bifidum.* This is a liquid preparation and the dose is 5 drops (0.2ml) daily. The cost is 64p per dose
- **ProPrems (Neobiomics AB, Sweden)** which contains *Bifidobacterium infantis Bifidobacterium lactis* and *Streptococcus thermophiles*. This is a powder preparation and the dose is one sachet (0.5g) mixed into 1-3ml of milk or sterile water daily. The cost is £5.90 per dose

## Practicalities of introducing probiotics into clinical practice

- Although not licensed as a medicine in the UK, it is important to ensure appropriate delivery, dosage and governance when introducing probiotics onto the neonatal unit
- They should be prescribed on the neonatal drug prescription chart and administered after checking by two nurses in the same way as for a medicine
- An appropriate information leaflet should be available for families
- Sepsis with probiotic organisms has been described and the local microbiology team should be made aware if probiotics are introduced into practice. These organisms are sensitive to standard antibiotics and grow on conventional culture media

## Criteria for use

- Start probiotics in babies <32 weeks GA or <1500 grams within 48 hours of commencing enteral feeds
- Continue probiotics until 34 weeks CGA
- Withhold daily dose in babies who are seriously unwell / septic due to the potential risk of translocation of probiotic bacteria in this situation
- Withhold daily dose in babies who are nil by mouth for a suspected gastrointestinal surgical diagnosis

## Appendix 1. Guide to the assessment of a baby with poor weight gain

Multiple factors contribute to nutrient deficits and poor weight gain in a preterm baby including:

- Late / inadequate nutrient provision e.g. delayed introduction of parenteral nutrition or breast milk fortifier
- Multiple interruptions to intravenous or enteral nutrition e.g. around blood transfusions
- Periods of poor milk tolerance
- Fluid restriction for medical reasons
- Medical co-morbidities

Routine growth monitoring enables the early identification and management of growth faltering. This should include:

- Regular measurement of developmentally appropriate anthropometry (weight, OFC and length), with accurate plotting and interpretation of results
- Interpretation of biochemical markers including plasma urea, electrolytes, calcium, phosphate, alkaline phosphatase and albumin, and urinary sodium

This information can be used to inform a detailed nutritional assessment and develop management strategies. Factors that should be taken into consideration include:

- Optimised protein to energy intake to ensure that protein is utilised for growth and not as a source of energy
- Appropriate feed volumes to achieve recommended nutritional intake
- Assessment of total body sodium stores to exclude sodium depletion; this requires assessment of urinary sodium as well as serum sodium (low urinary levels suggest inadequate total body stores)
- Treatment of anaemia / sepsis
- Recognition of the impact of medication e.g. steroids can delay length growth for 3-4 weeks after cessation of therapy
- Recognition of high energy requirements secondary to co morbidities
- Low serum urea as an indicator of protein insufficiency
- Organic causes of growth failure

## Appendix 2. Guide to rate of feed advancement

The tables below provide a guide to the frequency and volume of feed increments

### Table 1. Two hourly feeding regimen

| Weight (grams) | 30 mL/kg/day increments High risk | | | 40 mL/kg/day increments Moderate risk | | |
|---|---|---|---|---|---|---|
| | Increase (mL/day) | Frequency of increment | | Increase (mL/day) | Frequency of increment | |
| | | 1mL/feed every | 2mL/feed every | | 1ml/feed every | 2ml/feed every |
| ≤500 | 15mL/day | 20 hour | | | | |
| 600 | 18mL/day | 16 hour | | | | |
| 700 | 21mL/day | 14 hour | | | | |
| 800 | 24mL/day | 12 hour | | | | |
| 900 | 27mL/day | 11 hour | | | | |
| 1000 | 30mL/day | 10 hour | | 40mL/day | 8 hour | |
| 1100 | 33mL/day | 10 hour | | 44mL/day | 8 hour | |
| 1200 | 36mL/day | 8 hour | | 48mL/day | 6 hour | 12 hour |
| 1300 | 39mL/day | 8 hour | | 52mL/day | 6 hour | 12 hour |
| 1400 | 42mL/day | 8 hour | | 56mL/day | | 10 hour |
| 1500 | 45mL/day | 6 hour | 12 hour | 60mL/day | | 10 hour |
| 1600 | 48mL/day | 6 hour | 12 hour | 64mL/day | | 8 hour |
| 1700 | 51mL/day | 6 hour | 12 hour | 68mL/day | | 8 hour |
| 1800 | 54mL/day | | 10 hour | 72mL/day | | 8 hour |
| 1900 | 57mL/day | | 10 hour | 76mL/day | | 8 hour |
| ≥2000 | 60mL/day | | 10 hour | 80mL/day | | 8 hour |

### Table 2. One hourly feeding regimen

| Weight (grams) | 30 mL/kg/day increments High risk | | | 40 mL/kg/day increments Moderate risk | | |
|---|---|---|---|---|---|---|
| | Increase (mL/day) | Frequency of increment | | Increase (mL/day) | Frequency of increment | |
| | | 0.5mL/feed every | 1mL/feed every | | 0.5mL/feed every | 1mL/feed every |
| ≤500 | 15mL/day | 19 hour | | | | |
| 600 | 18mL/day | 16 hour | | | | |
| 700 | 21mL/day | 14 hour | | | | |
| 800 | 24mL/day | 12 hour | | | | |
| 900 | 27mL/day | 11 hour | | | | |
| 1000 | 30mL/day | 10 hour | | 40mL/day | 7 hour | |
| 1100 | 33mL/day | 9 hour | | 44mL/day | 7 hour | |
| 1200 | 36mL/day | 8 hour | | 48mL/day | 6 hour | 12 hour |
| 1300 | 39mL/day | 7 hour | | 52mL/day | 6 hour | 12 hour |
| 1400 | 42mL/day | 7 hour | | 56mL/day | | 10 hour |
| 1500 | 45mL/day | 6 hour | 12 hour | 60mL/day | | 10 hour |
| 1600 | 48mL/day | 6 hour | 12 hour | 64mL/day | | 8 hour |
| 1700 | 51mL/day | 6 hour | 12 hour | 68mL/day | | 8 hour |
| 1800 | 54mL/day | | 10 hour | 72mL/day | | 8 hour |
| 1900 | 57mL/day | | 10 hour | 76mL/day | | 8 hour |
| ≥2000 | 60mL/day | | 10 hour | 80mL/day | | 8 hour |

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