NUTRITION AND ENTERAL FEEDING ● 1/8

AIMS

- To achieve:
  - growth and nutrient accretion similar to intrauterine rates
  - best possible neurodevelopmental outcome
- To prevent specific nutritional deficiencies

PRINCIPLES

- Early enteral feeds promote normal gastrointestinal structure and function, motility and enzymatic activity
- Delayed nutrition can result in growth restriction with long-term complications of parenteral nutrition, dysbiosis of the intestine, poor organ growth and poorer neurological outcomes
- There is robust evidence that feeding maternal colostrum and breast milk is protective for necrotising enterocolitis (NEC), sepsis and retinopathy when compared to formula milk
- Manage feeding on an individual basis dependent upon gastrointestinal tolerance and availability of breast milk
- This guideline is designed to be used in conjunction with individual clinical assessment processes when decisions are made regarding the initiation and advancement of feeds in preterm infants

NUTRITIONAL REQUIREMENTS

Daily recommended intake of nutrients for stable/growing preterm infants

Nutrient	Term infant	Preterm Infant (Koletzo 2014)	Preterm infant (ESPGHAN 2010)
Energy (kcal/kg)	95–115	110–130	110–135
Protein (g/kg)	2	3.5–4.5	<1 kg: 4.0–4.5 1–1.8 kg: 3.5–4.0
Sodium (mmol/kg)	1.5	3–5	3–5
Potassium (mmol/kg)	3.4	2–5	1.7–3.4
Calcium (mmol/kg)	3.8	3–5	2.5–3.5
Phosphate (mmol/kg)	2.1	2–4.5	2–3
Vitamin A (µg RE/kg)	59	400–1100	400–1000
Vitamin D (units/day)	400	400–1000	800–1000

FEEDING GUIDE

- Commence enteral feeds in preterm infants as close to birth as possible (unless clinically contraindicated)

Buccal colostrum

Aim

- To provide the benefits of colostrum to **all** sick and premature infants who cannot access oral breast feeds
- Place 0.3 mL (0.15 mL per side) colostrum in buccal cavity by syringe/gloved finger at 3-hrly intervals for first 48 hr of life)
  - colostrum is absorbed locally by the buccal mucosa
  - can be administered even to critically-ill, ventilated, fragile infant
- Counsel all mothers anticipating delivery of sick/preterm infant about benefits of colostrum and show SWMN ODN film **Early expressing and benefits of colostrum** available at www.swmnodn.org.uk/media
- Advise mothers to hand express as soon after delivery as possible (ideally within 1 hr)
- Initiate administration of buccal colostrum as soon as colostrum available (ideally within 2 hr of birth)
- Parental involvement in administration recommended. Nursing staff may teach and supervise parents to give colostrum

Patient group

- Preterm infants (born <34 weeks' gestation) admitted to NNU or
- Any infant ≥34 weeks' gestation admitted to NNU and not receiving oral feeds

Contraindicated:

- Any contraindication for receiving mother's own milk e.g. maternal HIV infection
- Oral breastfeeding: will receive colostrum orally as first few feeds after birth

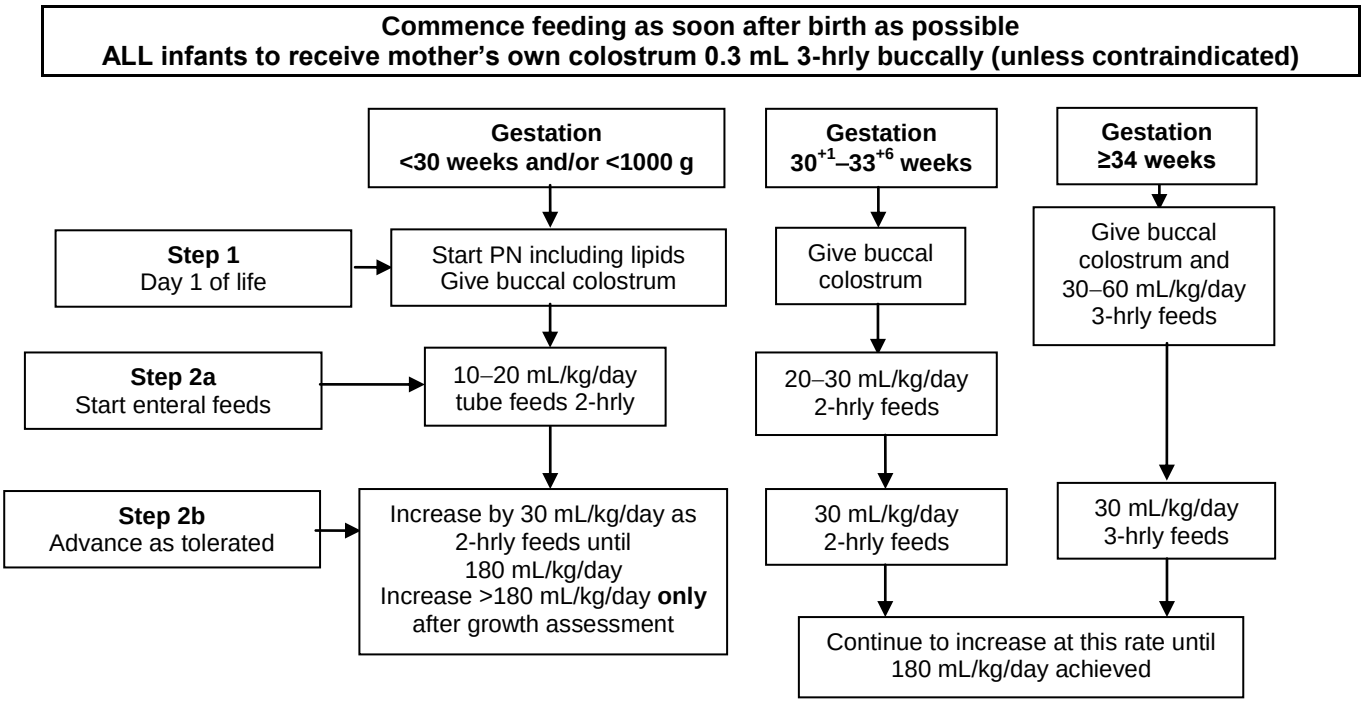
ENTERAL FEEDS

Route of administration

- Infants <34 weeks are not mature enough to co-ordinate sucking, swallowing and breathing to feed effectively and must be tube fed
- use gastric feeding with either naso- or orogastric tube

Initiating and advancing enteral feeds

Make every effort to use mother's fresh expressed colostrum and breast milk



- If mother's expressed breast milk (MEBM) not available within 48 hr of birth, use donor expressed breast milk (DEBM) if criteria met, or preterm formula
- If unable to advance enteral feeds over several days refer to neonatal/paediatric dietitian

Trophic feeds

- Small volumes (10–20 mL/kg/day) of milk given to stimulate the bowel
- Maintain for up to 7 days
- Not intended to contribute to nutrition
- Use in infants where feeds cannot be advanced in order to utilise maternal colostrum and stimulate gut trophic hormones

Which milk to use

MEBM

- Mother's own breast milk remains the ideal milk for term and preterm infants and should be strongly recommended
- Breast milk is more protective against NEC than formula milk
- Wherever possible, use MEBM for initiation of enteral feeds
- If decision to use MEBM made when starting feeds, aim to use only MEBM enterally as available. It may not always be possible to follow feeding schedules until sufficient breast milk is produced
  - record absence of MEBM as 'no mother's milk available' (NMMA)
- If MEBM still insufficient at 48 hr of life, use alternative feeds as tolerated in line with algorithm above

DEBM

- In the absence of mother's own EBM use donor milk, if available, as next milk of choice for infants <30 weeks or <1000 g and/or for the short-term support of any infant on NNU whose mother is seeking to establish breast milk expression
- DEBM is more protective against NEC than formula
- Consent for use must be obtained from parents
- Due to poor nutritional profile of donor milk it is wise to restrict use to establishing feeds only

- Add breast milk fortifier (BMF) when volumes reach ≥150 mL/kg/day and advance to 180 mL/kg/day as tolerated
- Commence gradual introduction of alternative feeds once full volumes achieved (minimum 150 mL/kg/day) and infant aged ≥14 days (see **Slow change to a different type of milk feed**)

BMF

- All preterm infants born <34 weeks fed exclusively on D/MEBM require addition of BMF to meet protein requirements for growth
- Add BMF when D/MEBM volumes reach 150 mL/kg/day
- Increase volume of D/MEBM + BMF to full feeds of 180 mL/kg/day
- Use full strength
  - prepare as per manufacturer's instructions
- When establishing oral breast feeds infants will naturally reduce BMF intake
- Continue BMF until 37 weeks' CGA
- At 37 weeks' CGA:
  - if growth velocity adequate stop BMF
  - if growth insufficient or catch up required continue BMF as fortified breast milk supplements (see **Inadequate growth**)
- If more than half of feed requirement provided by preterm formula, BMF not required unless there is poor growth and intolerance of volume

Composition of mother's own breast milk, donor milk or fortified breast milk/100 mL

	Preterm breast milk	Mature breast milk (>2 wk)	DEBM	Fortified mature breast milk (Nutriprem HMF) (2016 data card)	Fortified mature breast milk (SMA® PRO BMF) (2017 data card)
Energy (kcal)	70	69	66	85	86
Protein (g)	1.8	1.3	0.9	2.6	2.75
Sodium (mmol)	1.3	0.7	Not specified	2.3	2.35
Calcium (mmol)	0.55	0.55	Not specified	2.5	2.75
Phosphorus (mmol)	0.5	0.5	Not specified	1.75	1.9
Vitamin A (µg)	83	57	Not specified	290	438
Vitamin D (µg)	0.18	0.05	Not specified	≥5	≥4
Iron (mg)	0.09	0.07	Not specified	0.07	1.87

Protein supplement (Nutriprem protein supplement)

- Use only under direction of neonatal/paediatric dietitian
- Formulated to provide extra protein to meet requirements of infants <1000 g
- Extensively hydrolysed protein alone – **no** micronutrients or energy
  - 1 g sachet = 0.82 g protein
- Calculate energy and protein intake and compare to requirements before addition of protein supplement
- Check blood urea, if normal range do not add protein supplement discuss with neonatal/paediatric dietitian
- Add to D/MEBM alongside BMF or directly to preterm formula to enhance protein intake
- Monitor blood urea nitrogen twice weekly in all infants on protein supplement
- **Stop** protein supplement when urea level >6 or when infant reaches 1000 g

Preterm milk formula

- Indicated for infants born <34 weeks' gestation **and** <2 kg
- **Nutriprem 1**: formulated to meet the nutrient needs of preterm infants <2 kg where insufficient MEBM to meet requirements

- **Nutriprem 2**: nutrient enriched post-discharge formula (NEPDF) formulated to meet the ongoing enhanced nutrient needs of infants born <34 weeks, once they reach 37 weeks CGA/≥2 kg/at discharge from NNU
- Not all preterm infants require post-discharge formula for extended periods. Infants with normal growth velocity and no requirement for catch-up growth can be discharged on term formula with appropriate vitamin and mineral supplementation
- NEPDF especially useful for infants who have higher nutritional requirements (e.g. CLD on oxygen) or infants who have ongoing poor growth (e.g. have crossed down >2 centiles on growth chart during neonatal stay)
- Volumes >180 mL/kg are not usually necessary and other reasons for poor growth should be sought before further volume increases introduced (see **Inadequate growth**)

Specialised preterm formulas (Hydrolysed Nutriprem 1/SMA® PRO Gold Prem 1)

- **Always** use under direction of paediatric/neonatal dietitian
- Hydrolysed Nutriprem 1 – partially hydrolysed whey, extensively hydrolysed casein protein preterm formula
- SMA® PRO Gold Prem 1 – partially hydrolysed whey protein, MCT containing preterm formula (indicated especially for infants <1000 g)
- These formulas may be suitable for infants who fail to tolerate/progress on standard preterm formula **or**
- have a family history of CMPI (Hydrolysed Nutriprem 1 only) **or**
- require MCT for proven fat malabsorption (SMA® PRO Gold Prem 1 only)

Composition of preterm formula/100 mL

	Nutriprem 1 (2016 data card)	**Hydrolysed Nutriprem 1 (2016 data card)**	**SMA® PRO Gold Prem 1 (2018 online data card)**
Recommended volumes mL/kg/day	150–180	150–180	150
Energy (kcal)	80	80	80
Protein (g)	2.6 (whole protein)	2.6 (partially hydrolysed)	2.9 (partially hydrolysed)
CHO (g)	8.4 (55% lactose)	8.4 (46% lactose)	8.1 (45% lactose)
Fat (g)	3.9 (15% MCT)	4 (15% MCT)	4 (40% MCT)
Sodium (mmol)	3.18	3.6	2.3
Calcium (mmol)	2.4	2.4	2.9
Phosphorus (mmol)	2.0	1.8	2.5
Vitamin A (µg RE)	361	396	370
Vitamin D (µg)	3.1	3.0	3.7

All 'specialised' term formulas

- These formulas do not provide adequate nutrition for preterm infants at standard dilution and will require modification to ensure individual requirements met. Use only where absolutely necessary and always under direction of paediatric/neonatal dietitian

Appropriate Feeds for Preterm and Term Infants

Born At

Preterm and < 1.5kg

MEBM and HMF (aim 180-200ml/kg/d)
NutriPrem 1 (aim 160-180ml/kg/d)

On reaching 2.0kg or at discharge

MEBM (aim min 160-180ml/kg/d) or breastfeeding on demand*

NutriPrem 2 (aim 160-180ml/kg/d)

Preterm and 1.5 - < 2.0kg

MEBM and HMF (aim 180-200ml/kg/d)
NutriPrem 1 (aim 160-180ml/kg/d)

MEBM (aim min 160-180mg/kg/d) or breastfeeding on demand*

Term formula (150-180ml/kg/d)

Any gestation ≥ 2.0kg

MEBM (min 160-180ml/kg/d) or breastfeeding on demand

Term formula (150- 180 ml/Kg/d)

* may also require HMF supplements to achieve adequate growth

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Appropriate maintenance feeds for neonates based on gestational age and/or weight

Gestational age and/or weight	Maintenance feed
≤30 weeks **and/or** <1 kg	• D/MEBM + BMF: aim 180 mL/kg/day • Nutriprem 1: aim 165–180 mL/kg/day
Born between or on reaching 30^{+1}–33^{+6} weeks	• MEBM + BMF: aim 180 mL/kg/day • Nutriprem 1: aim 165–180 mL/kg/day
At 34 weeks **and** <2 kg	• MEBM + BMF: aim 180 mL/kg/day • Nutriprem 1: aim 165–180 mL/kg/day • Introduce oral feeds (see **Progression to oral feeding** guideline) ◦ consider fortified breast milk supplements as breastfeeding increases
At 34 weeks **and** ≥2 kg	• MEBM + BMF: aim 180 mL/kg/day • Nutriprem 2: aim 165–180 mL/kg/day • Introduce oral feeds (see **Progression to oral feeding**) • Allow natural reduction in BMF as breastfeeding increases
Born 34–37 weeks **and** <2 kg	• MEBM: aim 160–180 mL/kg/day or modified responsive breastfeeding + half strength BMF • Nutriprem 2 modified responsive bottle feeding • Discharge on breast milk or term formula
Born ≥37 weeks	• MEBM 180 mL/kg/day via naso-/orogastric tube or modified responsive breastfeeding • Term formula 165–180 mL/kg/day via naso-/orogastric tube or modified responsive bottle feeding
Preterm infants (born <34 weeks) at discharge	• Infants >37 weeks with normal growth velocity and no requirement for catch-up growth: ◦ allow natural reduction in BMF as breastfeeding increases ◦ if insufficient MEBM and growth velocity satisfactory use term formula at discharge • Infants <36^{+6} weeks CGA and/or poor growth velocity or requiring catch-up growth: ◦ use fortified breast milk supplements as oral breastfeeding increases ◦ if insufficient MEBM to meet requirements use Nutriprem 2 on discharge

Change to different type of milk feed

- Slowly change from one type of milk feed to another to ensure infant tolerates change in feed
- **Day 1**: 75% feeds with current milk, 25% with new milk (i.e. 3 old feeds:1 new feed)
- **Day 2**: 50% feeds with current milk, 50% with new milk (i.e. 2 old feeds:2 new feeds)
- **Day 3**: 75% feeds with new milk, 25% with current milk (i.e. 1 old feed:3 new feeds)
- **Day 4**: 100% new milk
- During the slow change it is acceptable to mix the milks together

Do not add human milk fortifier (HMF)/BMF to formula – omit during slow change if feeds being mixed

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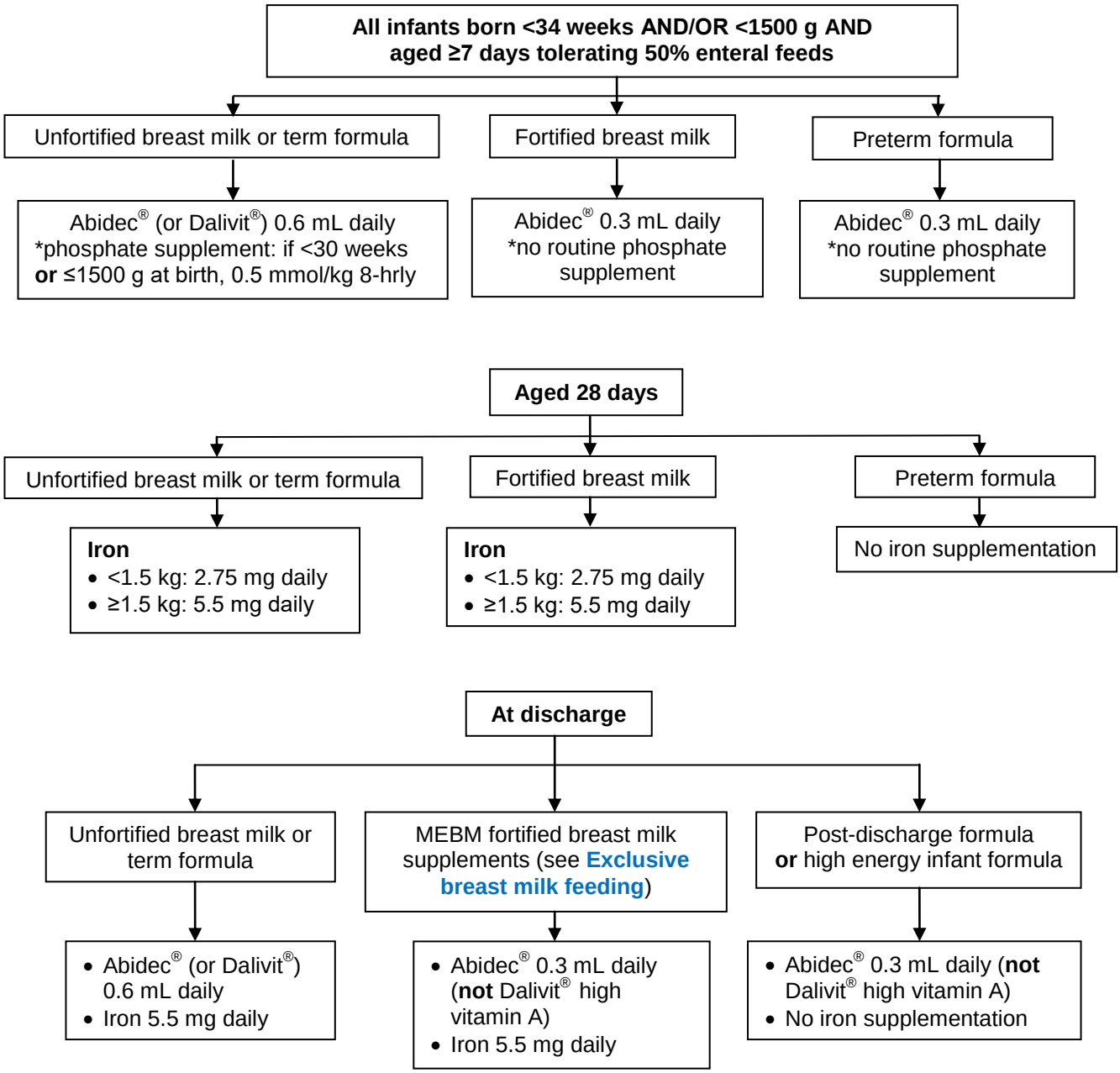
Iron and vitamin supplementation



* Preterm infants fed exclusively on breast milk should receive supplementary phosphorus titrated against normal serum phosphate and ALT levels. If ≤33^{+6} weeks' gestation at birth with PO_4 <1.8 mmol **or** >34 weeks' gestation with PO_4 <1.4 mmol, send paired urine and blood phosphate to measure tubular reabsorption of phosphate (TRP) (see **Metabolic bone disease** guideline)

EVALUATION

Monitoring of feed tolerance, growth and biochemical balance is critical in nutritional management of preterm infants to ensure optimal outcomes

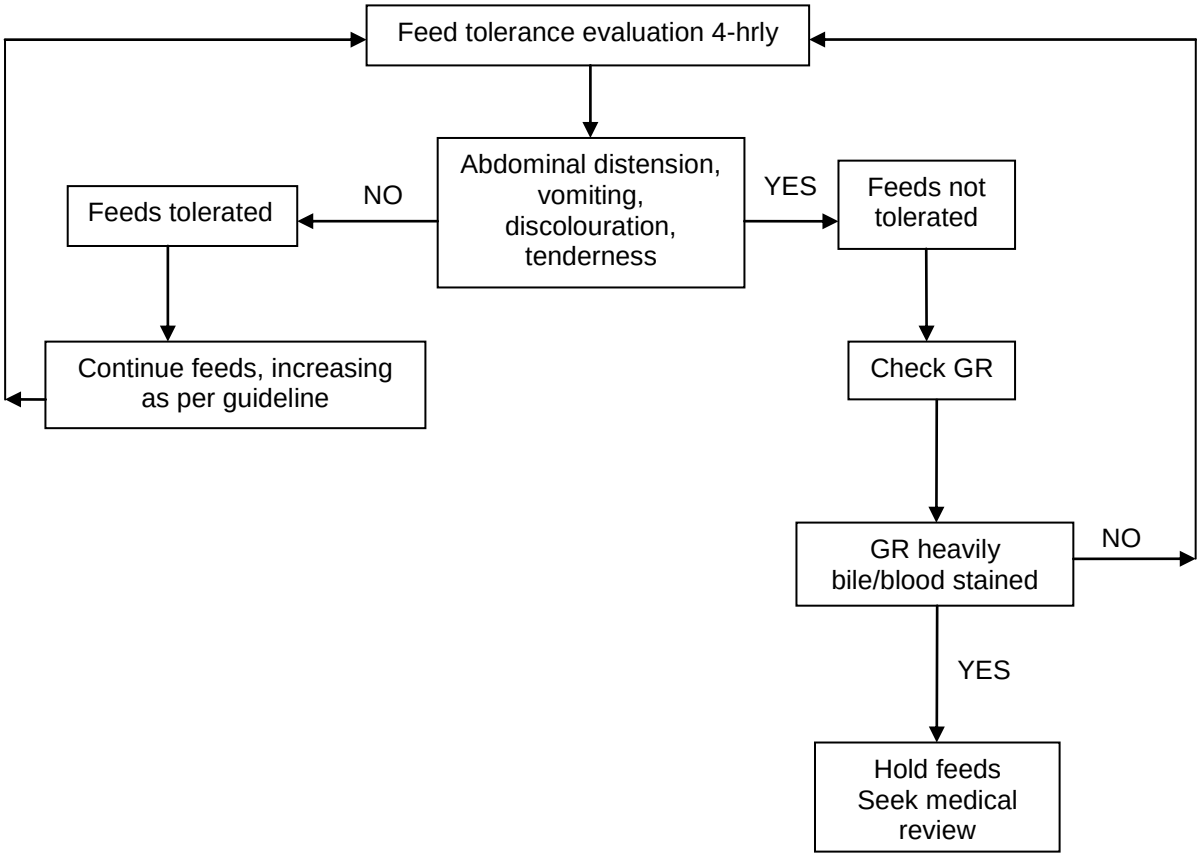
Feed tolerance

- Poor gut motility is common among VLBW/ELBW infants and some will have episodes requiring temporary discontinuation of feeding or delay in advancing feeds
- If failure to progress feeds continues over several days, seek advice early from neonatal/paediatric dietitian

Assessment of gastric residuals (GR)

- Routine aspiration of GR not recommended in preterm infants
- Advance feeds as tolerated after feed tolerance evaluation 4-hrly (see below)

- Do not use GR volumes in isolation when deciding to limit advancement of feeds



Anthropometry

- See **Growth monitoring** guideline

Biochemical monitoring

- Measure plasma urea, electrolytes, calcium, phosphate and albumin weekly in stable preterm infants to monitor nutritional status
- Monitor glucose closely in initial few days

INADEQUATE GROWTH

- Preterm infants with weight gain <16 g/kg/day require further assessment
- Review proportional growth (weight, head, length) on age and gender appropriate growth chart
- Ensure infant **prescribed** recommended nutritional intake
- Ensure infant **receiving** prescribed nutritional intake
- Ensure on maximum advised volume of age/weight appropriate feed – see maintenance feed volume/type charts
- Calculate energy and protein intake per kg/day and compare with ESPGHAN recommended requirements for weight/gestational age
- Check adequate total body sodium by ensuring sodium excretion in urine ≥20 mmol/L (only useful in infants **not** receiving diuretics)
- add extra supplements as necessary
- In infants receiving MEBM use hind milk (see **Breast milk expression** guideline)
- If tolerated, increase feed volumes beyond that recommended
- if receiving MEBM + BMF: ≤220 mL/kg/day
- if receiving preterm formula: ≤200 mL/kg/day
- If infant receiving MEBM + BMF does not tolerate increased volumes, or if insufficient MEBM to increase volumes, replace 25–50% MEBM + BMF with gestational age/weight appropriate formula
- <2 kg preterm formula
- ≥2 kg high energy term formula

- Breastfeeding/MEBM: use BMF as a concentrated solution (known as fortified breast milk supplement, give 1 sachet dissolved in 3 mL MEBM via syringe/teat before 4 breastfeeds, equally spread throughout 24 hr period. Reduce BMF by 1 sachet/day every 2 weeks until 6 weeks post-term or 3.5 kg, whichever soonest, then stop fortified breast milk supplements
- Refer to neonatal/paediatric dietitian for assessment and advice

PROGRESSION TO ORAL FEEDING

Aim

Safe progression to oral feeding (see **Progression to oral feeding in preterm infants** guideline)

Exclusive breast milk feeding

- Encourage modified responsive breast/bottle feeding of MEBM

Exclusive/partial formula feeding

- Encourage modified responsive bottle feeding of post-discharge formula or term formula
- Infants born <34 weeks, prescribe post-discharge preterm formula ≤6 months' CGA (if required)

Department of Health Guidelines state all children aged 6 months–5 yr receive vitamin supplementation containing vitamins A C D unless receiving formula milk >500 mL/day Exclusively breastfed infants should receive vitamin D supplementation from birth