THAMES VALLEY & WESSEX NEONATAL OPERATIONAL DELIVERY NETWORK

WESSEX GUIDELINE FOR NUTRITIONAL CARE OF INFANTS IN THE NEONATAL UNIT	
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Related documents	References 1. Johnson MJ, Pearson F, Emm A, Moyses HE, Leaf AA. Developing a new screening tool for nutritional risk in neonatal intensive care. Acta Paediatr. 2014. 2. Onyeador N, Paul SP, Sandhu BK. Paediatric gastroesophageal reflux clinical practice guidelines. Arch Dis Child Educ Pract Ed. 2014;99(5):190-3. 3. Terrin G, Passariello A, De Curtis M, Manguso F, Salvia G, Lega L, et al. Ranitidine is Associated With Infections, Necrotizing Enterocolitis, and Fatal Outcome in Newborns. Pediatrics. 2011;129(1):e40-e5. 4. Guillet R, Stoll BJ, Cotten CM, Gantz M, McDonald S, Poole WK, et al. Association of H2-blocker therapy and higher incidence of necrotizing enterocolitis in very low birth weight infants. Pediatrics. 2006;117(2):e137-42. 5. Grimshaw KE, Bryant T, Oliver EM, Martin J, Maskell J, Kemp T, et al. Incidence and risk factors for food hypersensitivity in UK infants: results from a birth cohort study. Clinical and translational allergy. 2015;6:1. 6. Vandenplas Y, Koletzko S, Isolauri E, Hill D, Oranje AP,

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Implications of race, equality & other diversity duties for this document	**This guideline must be implemented fairly and without prejudice whether on the grounds of race, gender, sexual orientation or religion.**

Contents

1.0 Aim of Guideline

These guidelines aim to provide both practical and theoretical guidance for the optimal nutrition for all sick and preterm infants.

2.0 Scope of Guidelines

This guideline applies to all Neonatal Units within Wessex Neonatal Operational Delivery Network. This includes the following hospitals.

Wessex		
Dorset County Hospital NHS Foundation Trust	- Dorset	SCU
Hampshire Hospitals NHS Foundation Trust	- Basingstoke	LNU
Hampshire Hospitals NHS Foundation Trust	- Winchester	LNU
Isle of Wight NHS Trust	- St Mary's Hospital	LNU
Poole Hospital NHS Foundation Trust	- Poole Hospital	LCU
Portsmouth Hospitals NHS Trust	- Queen Alexandra Hospital	NICU
Salisbury NHS Foundation Trust	- Salisbury	LNU
University Hospital Southampton NHS Foundation Trust	- Princess Anne Hospital	NICU
Western Sussex Hospitals NHS Foundation Trust	- St Richard's Hospital, Chichester	LNU

3.0 Executive Summary

Good nutrition is important at all stages of life. Babies are born at a time of rapid growth and formation of body tissues and organs, yet immature metabolism means they are unable to cope with either excess or lack of nutrients. Detail in both the quantity and quality of nutrients is critically important.

There is good evidence that mother's breast milk confers many advantages to baby, mother and to the formation of the parental bond. As well as containing just the right nutrients for human development, breast milk contains many factors which promote immune function and enable healthy intestinal development. Breast milk and breast-feeding should be the preferred milk feed and all mothers should be encouraged and supported to breast feed.

Preterm infants and those with congenital abnormalities or metabolic disorders may require nutrient supplements or special feeds, and may require a period of intravenous nutrition until the gut is able to support their needs.

Measuring growth and monitoring biochemical well-being is crucial to optimising nutrition in high risk individuals.

4.0 Definitions

AREDF	Absent or Reversed End Diastolic Flow (in umbilical artery, seen on antenatal scans)
AXR	Abdominal X-Ray
BMF	Breast Milk Fortifier
CPAP	Continuous Positive Airways Pressure
D/C	Discharge
DBM	Donor Breast Milk
DH	Department of Health
ELBW	Extremely Low Birth Weight (birth weight <1000g)
FBC	Full Blood Count
G	grams
IU	International Units
IUGR	Intrauterine Growth Restriction
IV	Intravenous
Kcal	kilocalories
Kg	kilogram
LBW	Low Birth Weight (birth weight <2500g)
LFT	Liver Function Tests
MBM	Maternal Breast Milk
Mg	milligram
Ml	millilitre
Mmol	millimole
NBM	Nil By Mouth
NEC	Necrotising Enterocolitis
NICU	Neonatal Intensive Care Unit
NNU	Neonatal Unit
PBP	Potentially Better Practice
PDA	Patent Ductus Arteriosus
PDF	Post Discharge Formula
PN	Parenteral Nutrition
RCT	Randomised Controlled Trial
SD	Standard Deviation
TAT	Trans-anastamotic Tube
TPN	Total Parenteral Nutrition
U&E	Urea and Electrolytes
VLBW	Very Low Birth Weight (birth weight <1500g)
VON	Vermont Oxford Network

5.0 Details of Procedure to be followed

5.1 Assessment and Monitoring

INITIAL ASSESSMENT

5.1.1 Growth Measurement

All infants should have weight, length and head circumference measured and plotted on the appropriate growth chart at admission. This information, together with other risk factors detailed below, will identify the degree of 'nutritional risk' – i.e. risk of becoming malnourished or developing nutrition and feeding related problems. Infants with multiple risk factors should be classified according to their highest individual risk factor. Infants on CPAP should have their hats removed and their head measured weekly unless they are very unstable. This will guide nutritional care and allow subsequent progress to be monitored.

5.1.2 Risk assessment – identify level of risk for nutrition and / or feeding-related problems

High risk

- Preterm <28 weeks
- ELBW < 1000g
- Severe IUGR (weight < 2nd centile with AREDF) <35 weeks
- Infant establishing feeds after episode of NEC or GI perforation
- Infants with severe congenital GI malformation: e.g. gastroschisis
- Infants with complex congenital heart disease

Moderate risk

- Preterm 28-31^{+6} weeks, otherwise well
- VLBW 1000 – 1500g
- Moderate IUGR (weight < 9th centile and AREDF) <35 weeks
- Baby on inotropes
- Baby on indomethacin/ibuprofen (NB avoid concomitant treatment with steroids)
- Baby >1500g with illness or congenital anomaly which may compromise feeding
- Perinatal hypoxia / ischaemia
- Symptomatic polycythaemia, with PCV $\geq$ 70%

Low risk

- Preterm 32-36^{+6} weeks, otherwise well
- AREDF / IUGR $\geq$35 weeks
- Term Infants >37 weeks

5.1.3 Growth

- Weight should be measured at least twice a week, and plotted on NEWBORN INFANT CLOSE MONITORING WHO growth chart weekly. More frequent weights required for some babies should be plotted on a daily weight chart. See www.rcpch.ac.uk/growthcharts for instructions on plotting.
- Head circumference should be measured and plotted weekly, even if on CPAP or similar.
- Length should be measured and plotted weekly weeks thereafter.
- If a baby is too sick to be weighed and measured so cannot be plotted, growth chart at the day's date.
- Targets for weight – changes in weight in the early days of life usually reflect fluid balance: aim for weight loss of no more than 10% from birth weight. Once baby is stable and growing, aim for gain of 15-20 grams/kg/day.
- Head circumference and length: normally expect increase of 0.75 cm/week.

5.1.4 Biochemistry

First week of PN:

- Full TPN Profile daily (Renal, bone and liver profiles, inorganic phosphate, magnesium on eQuest) this includes U&E's, Calcium, magnesium phosphate and LFTs)
- FBC twice weekly

Second and subsequent week of PN:

- Full TPN Profile and FBC twice weekly if stable (daily if still unstable).
- Triglycerides should be measured weekly (ideally Mondays) when on IV lipid.
- If on PN for longer than 1 month, then Trace elements (Zn, Cu, Se, Mn – use special blood bottle in Dr's Office) and Vitamins (A, D and E) should be measured monthly. Consider measuring Iron status and clotting.
- When on enteral feeds, Infants in the High and Medium risk categories need weekly FBC, U&Es, LFTs and Bone profiles once they are off PN and fully enterally fed. This can be extended to once fortnightly when babies are moved into Special Care.

5.1.5 Screening

- Nutritional screening is important to identify infants at risk if poor growth, and to ensure appropriate feeding pathways are followed. A Neonatal Nutrition Screening form (Appendix 1) should be completed on admission andwhen the baby has been weighed and measured each week on all babies to identify those requiring consultant/neonatal dietician review

5.1.6 Additional Nutrition Review

- 'High-risk' babies, and any others identified by nutritional screening on will have a nutrition review proforma completed with a recommended nutrition plan for the coming week (on reverse of screening tool), which will be discussed with the service consultant before being put into action. The nutritional content of stock PN solutions an commonly used feeds can be found in *Appendix 2.*

5.2 Nutrient Requirements

Nutrient requirement for Term and Preterm infants in the first weeks of life are summarised below. The figures shown below are based on the parenteral requirements for the first week, and the enteral requirements for the subsequent weeks.

Term infants – based on intake in 150 ml/kg breast milk; preterm infants based on recommendations in Koletzko 2014 unless otherwise stated.

There are no specific guidelines for those babies born over 1.5kg and under term weight (2.5 kg) but it can be anticipated that their nutritional needs will be between those of preterm infants and term infants. Nutritional support should therefore aim to deliver nutrient intakes in this area.

It should be noted that these are just recommendations, and some infants may require more of certain nutrients such as Sodium and Potassium as dictated by the results of blood tests.

Nutrient(Unit/kg/day)	Term infant	Preterm VLBW <1500g (enteral)
Energy (kcal)	100	110-130 (85-95IV)
Protein (g)	1.5-2.1	3.5-4.5
Nitrogen (g)	0.24-0.34	0.56-0.72
Sodium (mmol)	1.4	2.4-5.0
Potassium (mmol)	2.0	2.0-5.0
Calcium (mmol)	1.25	3.0-5.0
Phosphate (mmol)	1.3	1.9-4.5
Vitamin D IU*	340	400-1100
Vitamin A IU**	1150	1300-3614
Iron (umol)	17.9	35.7-53.6

*Vitamin D = dose quoted is total daily dose (340 IU = 8.5 mcg Vit D)

**Vitamin A = dose quoted is total daily dose (1150 IU = 350 mcg of Vitamin A retinol equivalent)

5.3 Parenteral Nutrition

5.3.1 Indications for PN

- High or Moderate risk infants as described above
- Infants who are NBM and unlikely to achieve adequate milk intake in the next 5 days. If this is not clear then it is better to be proactive about nutrition and opt to start PN sooner rather than later.
- Infants who are not tolerating feeds such that they cannot take full feed volumes for 5 consecutive days.

5.3.2 Starting PN

- In high and moderate risk infants PN should be started as soon as possible as delay can result in significant and cumulative nutrient deficits.
- Birth weight ≤1500g – start as soon as possible after birth
- Ideally within 6 hours, maximum 24 hours
- Birth weight >1500g – if enteral feeding contra-indicated, start PN by
- 48 hours in 1500-2500g
- 72 hours in 2500-3500g if NBM
- Central line insertion (UVC or peripherally inserted central venous line) should be a priority for high and moderate risk infants
- If feeds are stopped on high or medium risk infant for any reason, re-start PN

5.3.3 Stock PN

- Infants should be started on Stock PN in the first instance as detailed below:
- Babiven – For preterm infants (<37/40 gestation) in the first 2-3 days of life, where additional sodium is not indicated
- Preterm + Sodium PN- For preterm infants (<37/40 gestation) requiring maintenance sodium. **This should be the PN of choice for the majority of preterm infants after the first few days following birth**, as it contains more protein. Note that this bag may still be appropriate if the serum sodium is high due to a relative fluid deficit.
- Term PN – for Term infants (≥37 weeks gestation) at any point after birth.
- **Stock PN comprises an aqueous solution (glucose, amino** acids, electrolytes and trace elements) and a lipid solution (**which contains both fat- and water-soluble vitamins**). For adequate nutrition it is **important that the lipid is always given with the aqueous solution** at all times (except when well advanced on enteral feeds - see below).

5.3.4 Special prescription ('bespoke') PN

- Neither PN alone nor unfortified full breast milk feeds fully meet the nutritional needs of preterm infants, so the period when a preterm infant transitions from PN to milk feeds is when they are at highest risk of poor nutrient intakes.
- Stock PN is designed to give the maximum possible nutrition at 130ml/kg/day. **Therefore, pharmacy can make bespoke PN, which provides more nutrition in a smaller volume, should be used whenever a preterm infant is receiving less than 130ml/kg/day of Stock PN**. This will occur whenever a preterm infant is increasing on enteral feeds, is fluid restricted, or receiving other infusions

- Bespoke PN may also be appropriate where infants have electrolyte requirements than cannot be met with Stock PN

5.3.5 Reducing PN as enteral feeds increase

- **Only once the infant is receiving 180ml/kg/day total fluids should the PN solution be decreased as enteral feeds increase** (unless there is a clinical decision to restrict fluids).
- Once the infant is on 90ml/kg/day enteral feeds, the rate of lipid infusion should be halved, and then stopped when the infant reaches 135ml/kg/day enteral feeds (beware with pharmacy made TPN as this reduction in lipid may have already been done as part of the prescription). Any shortfall in total fluid volume due to the reduction in lipid should be made up by increasing the aqueous PN solution, to allow maximum protein to be delivered to the infant (though do not exceed the maximum prescribed rate). This is important when infants are on Stock PN, but for those on bespoke PN, the reduction in lipid may have already been done/accounted for by the pharmacists when the PN was prescribed so may not be necessary (check with the pharmacists first). **Remember that once the lipid is reduced, vitamin intake will be inadequate until vitamin supplements (Abidec) are started.**

5.3.6 Peripheral PN

- PN should ideally be given via a central line. However, there are occasions in high nutritional risk infants with difficult access where the benefits of giving PN peripherally may outweigh the risks. Such decisions should be made by the Consultant responsible for the patient.

5.3.7 Cautions on PN

SEPSIS - may affect lipid metabolism; measure triglycerides and if >2.8mmol/L consider reducing or stopping IV lipid for 12-24 hours in severely septicaemic baby (remember to restart/increase lipid when sepsis has resolved)

THROMBOCYTOPENIA – high concentration of polyunsaturated fats may impair platelet adhesion: reduce lipid to 1-2 g/kg/day if platelets <50.

CHOLESTATIC JAUNDICE – total and prolonged PN increases the risk, so try to give some enteral feed if at all possible; other risk factors include IUGR, sepsis and short bowel syndrome. SMOF lipid solutions may reduce or reverse cholestasis, and should be considered in high risk babies if on PN for 4 weeks or more. Alternate day lipid may also be indicated in this situation, or if altered liver function - discuss with the pharmacists.

5.4 Nutrition Support for the Preterm Infant

(a) OVERVIEW - GETTING STARTED - EARLY TPN AND TROPHIC MILK FEEDS

HIGH RISK / MEDIUM RISK (see flow charts in appendix 3 for high [A] and medium risk preterm infants [B])

Aim to introduce milk feeds gradually while maintaining calorie and nutrient intake with PN

Before starting or increasing milk ensure baby is clinically stable and abdomen soft. Small gastric residuals can be tolerated if baby well. Passage of meconium and then changing stools is an important indication of gut motility. Glycerine suppositories may help if no stool passed for 24 hours. Ensure mother has lactation support to start expressing (see breastfeeding care pathway)

High risk preterm (<28 weeks; <1000g; severe IUGR/AREDFV <35 weeks)

First 24 hours	Start Babiven PN at 60-90 ml/kg/day via UVC or long line, as soon as possible unless baby very unstable. Give fresh colostrum as mouth care or as trophic feeds (and be sure to note this on the infant's charts and the day's Badger record)
24-72 hours	Continue colostrum as available until sufficient MBM is supplied to start trophic feeds as MBM 1 ml/kg 2-4 hourly. If at 48 hours there is no MBM as mother is

	unable or unwilling to provide MBM, then DBM can be used- see choice of milk chart
48-72 hours	Change to Stock Preterm + Sodium PN. Increase milk by 10-20 ml/kg/day as tolerated (see table); Aim to decrease PN flow rates with feeds only once baby on total fluids of 180ml/kg/day. Commence Abidec 0.6ml once daily once tolerating 60ml/kg/day enteral feed to provide additional vitamin A.

Moderate risk preterm (28-31^{+6} weeks; 1000g <1500g; mod IUGR/AREDFV < 35 weeks)

First 24 hours	Start Babiven at 60-90 ml/kg/day via UVC or long line as soon as possible; if no central access consider peripheral PN
24-72 hours	Start colostrum/milk 1 ml/kg 2 hourly ('see choice of milk' chart)
48-72 hours	Change to Stock Preterm + Sodium PN Aim to decrease PN flow rates with feeds only once baby on total fluids of 180ml/kg/day Increase milk by 20-30 ml/kg/day according to clinical condition and tolerance. Commence Abidec 0.6ml once daily once tolerating 60ml/kg/day enteral feed to provide additional vitamin A.

Low risk

First 24 hours	Commence milk feeds 30-60 ml/kg/day, supplemented by IV fluids if necessary
Beyond 72 hours	Increase milk feeds by 30 ml/kg/day as tolerated

Choice of milk

Mother's breast milk (MBM) is almost always the feed of first choice, unless contraindicated by maternal illness, drugs or maternal reasons. If no MBM is available pasteurised donor breast milk (DBM) may be used for high risk babies (documented parental consent required) in accordance with the DBM guideline. Preterm formula (Nutriprem 1) is indicated for infants with birth weight <1800 grams; Post discharge formula (Nutriprem 2) is indicated for preterm infants either as sole diet or in addition to breast-feeding from around 36 weeks (or discharge) up to 6 months corrected age (*see Flow Chart D*)

Nutritional supplementation

BREAST MILK FORTIFIER (BMF, see high risk and moderate risk flow charts A and B)

'Multi-component' fortifier provides additional calories (carbohydrate), hydrolysed protein (cows' milk based), minerals and vitamins in a powder which is added to MBM. It should be routine for babies with birth weight <1500g to receive fortifier once they have tolerated 100 mls/kg/day of MBM for 24 hours, unless significant gut or renal compromise. In general, give ½ strength for 24-48 hours and then increase to full strength (2.2g sachet to 50 mls MBM). If there are concerns that the baby will have problems with GI upset with breast milk fortifier, options include continuing parenteral nutrition or using nutriprem protein supplement. This should be discussed with the neonatal dietician or nutrition team. Babies can be discharged home with breast milk fortifier boluses (1 sachet in 5-10mls EBM given via cup 4-6 x daily with a breast feed) to support weight gain until around 44 weeks CGA. This should be done under dietetic supervision.

Infants who are fed with a mixture of fortified breast milk and preterm formula do nt need fortifier to be added if they are on 50% or greater preterm formula (assuming they are on 180ml/kg/day)

MUM PLANNING TO FORMULA FEED

- Babies <34 weeks gestation, with birthweight <1.8kg can be considered for discharge on Post-Discharge Formula (PDF) – 'Nutriprem 2'. This should be continued until 3 to 6 months corrected age.
- ELBW and VLBW babies who have been on Nutriprem 1 should be changed to PDF at approximately 36 weeks corrected age, or taking most feeds by bottle. For those with very

poor growth, continuing with Nutriprem 1 formula to 40 weeks corrected age may be appropriate.

- Babies discharged on PDF should have **Abidec 0.6 ml, but not Sytron**.
- If changing to term formula, prescribe Abidec 1 ml (continue until at least one year post term) and Sytron1ml (continue until 6 month post term)

SOLIDS

Can be introduced at 5-8 months chronological age, depending on developmental stage and degree of prematurity

VITAMINS AND IRON

Breast milk provides insufficient vitamins (particularly vitamin A and D) and iron for preterm infants. Preterm infants have low levels of fat soluble vitamins, particularly A and D.

- Preterm infants <35 weeks should therefore be commenced on Abidec 0.6ml once daily once tolerating 60ml/kg/day enteral feed (different types or amounts of vitamin supplements may be recommended by the nutrition team in special circumstances).
- All preterm infants <35 weeks should then be switched to Abidec 1ml OD once intravenous lipid is stopped or on reaching full feeds, whichever is sooner, in order to ensure adequate vitamin D provision (unless they are on preterm formula, in which case 0.6ml OD will suffice).
- Sytron (iron) should be started according to NNU guideline, from day 28, with preterm infants on breast milk, fortifier or term formula receiving 1ml OD, and infants on preterm formula not requiring iron supplements

Nutrition at discharge

It is important to start discharge-planning well in advance. Breast-feeding at discharge is the preferred goal for all infants. However for preterm infants nutritional supplementation will be required. For those not being breast fed advice has to be given on choice of formula, so for all infants a pre-discharge nutrition assessment should be made and plan documented using the nutrition discharge planning sheet (Appendix 3). For high risk infants this will normally be completed by the nutrition team in the 2 weeks prior to discharge.

5.5 Management of Common Gut and Feeding Problems

a. **Gastric aspirates / residuals** – preterm infants have immature gut motility, and aspirates/residuals and small vomits are not uncommon. Large volume aspirates or dark green bile stained aspirates, particularly in association with abdominal distension and / or tenderness are a cause for concern. However small milky / yellow aspirates up to 2-3 mls are frequently normal. They can be replaced, and feeds continued.

b. **Abdominal distension** – this is another common feature in preterm infants, due to poor gut motility. It tends to be more common in babies on CPAP, with high volumes of air flowing into the upper airway and oesophagus. Tenderness, or systemic symptoms and signs such as apnoea, tachycardia or temperature instability should raise concern. If baby is otherwise well, a small glycerine suppository may help to stimulate peristalsis, and enable feeds to be continued.

c. **Suspected NEC** – classical features are blood and mucous in stools, bile stained aspirates and abdominal tenderness. Systemic signs such as tachycardia and hypotension occur in severe NEC. X-ray might show intramural gas (‘pneumatosis coli’), dilated loops of bowel, free air, or a ‘gas-less’ bowel. In suspected NEC feeds should be stopped, and urgent attention paid to supporting ventilation, circulation and fluid balance

d. **Suspected GOR** – GOR is a normal physiological process, and mild milk reflux is very common in newborn babies, including those born preterm and is usually self-limiting. Recent guidance by Onyeador et al suggests that Gastroesophageal reflux (GOR) is a normal physiological phenomenon. It is common and manifests as effortless vomiting with no discomfort. It does not affect growth and development. GOR disease (GORD) exists when GOR results in troublesome symptoms including poor weight gain. It needs to be distinguished from vomiting due to non-GORD disorders such as pyloric stenosis, metabolic causes, infections, and so on. Significant weight loss or faltering of growth in any age group is a red flag and should prompt further evaluation. PPIs are the most effective pharmacological therapy currently available for children with GORD. However, current guidance recommends:

- Avoiding the empirical trialling of acid suppression therapy as a diagnostic test for GORD in infants and young children
- Avoiding treating paediatric patients with GORD with prokinetic medications.
- Ideally the use of antacids, alginates (e.g. Gaviscon) and sucralfate should be avoided(2).
- Use of ranitidine has been associated with increased risk of NEC and infection in VLBW infants, and so should not be used in this population. The mechanism for this association is felt to be related to the raised gastric pH caused by ranitidine and so on this basis omeprazole should also be avoided(3, 4).

Therefore, GOR should be managed conservatively with positioning of the head end raised at 30°, thickening of feeds and parental education and reassurance should suffice in most cases of GOR(2). Breast feeding should be continued where possible, though formula fed infants may benefit from a change in feed of GOR is felt to be related to CMPA (see below).

e. **Suspected Cow's Milk Protein Allergy (CMPA)** – Incidence of CPMA in infants is estimated is 2.4% for IgE mediated and 1.7% for non-IgE mediated (5). CMPA can occur in young infants either breast fed or formula fed. Symptoms may include severe regurgitation, vomiting, constipation, peri-anal rash and macroscopic blood in stools, with the latter being most significant (as the others can occur normally in infants) and suggestive of a need to try a cow's milk free feed. Whilst microscopic haematuria is associated with CMPA, it is less sensitive. Note that **urine dipsticks should not be used to test for microscopic blood in stools** (faecal occult blood, FOB) as they are subject to high levels of false positives. An approved bedside test for faecal blood should be used if this is required. Non-intestinal features may include skin rash – atopic eczema, and colic.
If CMPA is thought to be the cause of symptoms, it is recommended that cow's milk protein be excluded from diet:

- If breast feeding, mother should exclude both cows' milk and egg products from her diet for two weeks, while continuing to breast feed.
- Formula fed term infants should be tried on amino acid formula.
- Preterm infants so hydrolysed Nutriprem 1 should be used in preterm infants in the first instance, moving to amino acid formula only if symptoms persist and are felt to be due to CMPA, as amino acid formula is nutritionally inadequate for these patients.

If improvement is seen, national guidance is that a staged reintroduction should be carried out after 2-4 weeks in order to formally make the diagnosis of CMPA. However, in high risk or nutritionally compromised infants, the need for and timing of this can be done on an outpatient basis. If no improvement is seen on definite exclusion diet, CMPA is unlikely. If exclusion diet is difficult to maintain, a trial of amino-acid formula may be appropriate for breast fed infants. See review by Vandenplas et al.(6)

Note that any infant on a non-standard formula should have a paediatric dietician involved in their management.

5.6

5.7 Nutritional Management of Cardiac Infants Should this section be deleted for the Network guidelines???

Congenital Heart Disease (CHD) – nutritional requirements

Growth failure in CHD is likely to be multi-factorial arising from low levels of growth hormone and other growth factors, undefined genetic polymorphisms, insufficient nutrition support, feeding difficulties including gastro-oesophageal reflux disease, vocal cord palsy and feeding aversions (14-16).

1. **Nutritional requirements;** pre-surgical requirements are estimated at being 10% higher than otherwise healthy infants. The amount of energy a term infant requires is dependent on the type of cardiac lesion and ranges 110 – 130kcal/kg day, but occasionally up to 150kcal/kg is required to support growth. Although additional calories and protein are often prescribed it is common for infants not to achieve feeding targets either due to feeding difficulties or fluid restrictions leading to growth failure. Post-surgery catch up growth may be required. To achieved 10g/kg per day 128kcal/kg and 2.8g/ kg of protein is required until weight/ length gain goals are met (17). It is important to ensure micronutrient and electrolytes are given in sufficient amounts to support lean body mass acquisition and growth (18) and as such vitamin supplementation should be given to all CHD infants. Medication particularly diuretics reduces total body stores, particularly sodium, affecting growth and as such supplementation may be required (16, 19).
2. **Breast milk is best;** where possible breast milk should be used. It is usual for most infants with heart failure to be on some fluid restriction and combination feeding of fortified breast milk or energy/nutrient dense formula feeds may help promote growth (19, 20). Where there are feeding issues, such as reflux, a ready to feed extensively hydrolysed protein/energy/nutrient dense feed may be better tolerated.
3. **Methods of feed administration;** where infants are not able to breast feed or finish bottles easily the following can be tried;
    - Offer smaller oral feeds more frequently i.e. 2 – 3 hourly
    - Put the remainder of an oral feed via an nasogastric tube (NGT) – always try to give some feed orally to maintain oral feeding skills
    - Provide an overnight feed via an enteral feeding pump and small day time boluses orally
    - If weight gain remains poor then give feeds continuously over 20 – 22 hours via an enteral feeding pump, if vomiting is an issue then consider feeding via a nasojejunal tube (19).

6.0 Roles and Responsibilities

BREAST-FEEDING AND LACTATION SUPPORT

- **All Staff**: awareness of Local Trust Policy and NNU Guidelines
- **NNU Lactation Support Team/lead**:: expert guidance for mothers breast-feeding and/or expressing milk in NNU

PARENTERAL NUTRITION

- **All Staff**: awareness of need for PN in high risk infants
- **Nursing Staff**: awareness of location of 'stock' PN in NNU and knowledge and skills for PN administration appropriate to nursing skill level
- **Medical Staff**: awareness of PN supplies available and how to prescribe; awareness of potential complications of PN and how to avoid
- **Pharmacists**:: expertise in detailed composition of PN solutions and provision of PN in different situations on NNU

ENTERAL NUTRITION

- **All Staff**: support for mothers in informed choice of feeding, recognising that breast milk is the preferred feed for all infants, particularly those born preterm
- **All Staff**: awareness of choices for enteral nutrition: maternal breast milk / breast-feeding; donor breast milk / milk bank; standard infant formula; formulas for preterm infants; special formulas for infants with specific gut or feeding problems
- **Neonatal Dietitian**: expert knowledge of composition of breast milk and alternatives and guidance on making appropriate choices
- **Surgical Team**: expert knowledge on potential feeding challenges in infants with congenital or acquired abnormalities of the gut, particularly following surgery

FEEDING DIFFICULTIES

- **All Staff**: awareness of common feeding difficulties of preterm infants and those with neurological complications
- **Speech and Language Therapist**: expert knowledge of structure and function of upper gastro- intestinal tract and how to optimise feeding potential of vulnerable babies

GROWTH MONITORING

- **All Staff**: Awareness of importance of making accurate and regular measurements and plotting them on appropriate charts to monitor growth
- **Nursing Staff**: Weigh babies at intervals as indicated by clinical condition (ideally three times per week) and head circumference and length weekly.
- **Medical and Nursing Staff**: Plot growth measurements on appropriate chart weekly (provided competent to do so)

SPECIAL CASES

- **Neonatal Nutrition Team**: Will review high risk medical, surgical or complex patients on weekly nutrition ward round

7.0

8.0 Implementation

Information for all staff on induction and regular updates as necessary

9.0 Process for Monitoring Compliance/Effectiveness

Key aspects of the procedural document that will be monitored:

What aspects of compliance with the document will be monitored	What will be reviewed to evidence this	How and how often will this be done	Detail sample size (if applicable)	Who will co-ordinate and report findings	Which group or report will receive findings
Compliance with guideline, including feed management and growth measuring and plotting	Audit	3 yearly Spot audit of all inpatients	Spot audit of all inpatients	Nutrition Lead Consultant	Neonatal Unit Staff

Version Control:

Version	Date	Details	Author(s)	Comments
1 DRAFT	Dec '16	Work began on transposing from a UHS Guideline to a Network format.		
2	Oct 2017	Draft New Network Final	Dr Mark Johnson, Locum Consultant Neonatologist Dr Freya Pearson, Consultant Neonatologist Mr Nigel Hall, Associate Professor of Paediatric Surgery	Ratified 19 Oct 2017
Review Date:	**May 2020**			

Forms:

Affix Patient Label Here

Neonatal Nutritional Screening Tool

To be completed on admission and weekly (every Monday)

Date: _____

Gestation at birth: **Birth Weight:**

1. Assess Growth

Current Weight:		Current Centile:		Birth Centile:	
Current OFC:		Current Centile:		Birth Centile:	
Current Length:		Current Centile:		Birth Centile:	

2. Determine Risk Category

		Tick
HIGH RISK	*Any one of:*	
	• Preterm <28 weeks at birth	
	• Extremely Low Birth Weight < 1000g	
	• Infant establishing feeds after episode of NEC or GI perforation	
	• Infants with severe congenital GI malformation e.g. gastroschisis	
	• Infants with severe congenital heart disease	
MODERATE RISK	*Any one of:*	
	• Preterm 28-31^{+6} weeks, otherwise well	
	• IUGR (weight < 9^{th} centile) and AREDFV <35 weeks	
	• Very Low Birth Weight 1000 - 1500g	
	• Illness or congenital anomaly which may compromise feeding	
LOW RISK	*Any one of:*	
	• Preterm 32-36^{+6} weeks, otherwise well	
	• IUGR (weight < 9^{th} centile) and AREDFV >35 weeks	
	• Well Term Infant ≥37 weeks	

3. Determine the need for nutrition team review

The nutrition team should review any infant meeting the following criteria:

	Tick
• High Risk Infants according to criteria above	
• Not regained birth weight by 2 weeks of age	
• >15% weight loss at any time	
• Weight gain <10g/kg/day from 2 weeks of age onwards	
• NEC or GI surgery at any time	

Name of person completing assessment: _____ Signature: _____

If completing admission assessment, please file in the baby's nursing folder, next to the nutrition flow charts

If completing a weekly asessment, please place this form in the nutrition screening box if infant needs nutrition team review, otherwise file in notes

Nutrition Team Review and Weekly Nutrition Plan

Date: _____ Staff Present:

Day: _____

Gestation at Birth: _____

Corrected Gestation: _____

Current Clinical Issues:

Fluid Intake

Total Prescribed Fluids: ml/kg/day

Enteral Feed Type: Parenteral Feed Type:

Nutrient Intake

Recommended nutrient intakes:		*kcal/kg/day*	*g/kg/day Protein*
Enteral Feed Provides:			
Milk Feeds:	ml/kg/day	kcal/kg/day	g/kg/day Protein
Parenteral Feed Provides:			
Aqueous PN:	ml/kg/day	kcal/kg/day	g/kg/day Protein
Lipid:	ml/kg/day	kcal/kg/day	
Total Intake:	ml/kg/day	kcal/kg/day	g/kg/day Protein
			g/kg/day Lipid

Comments on intake:

Bloods

Hb:	Sodium:	Calcium (corr):	ALT:
CRP:	Potassium:	Albumin:	Magnesium:
Triglycerides:	Urea:	Bili:	Phosphate:
Other_____:	Creatinine:	ALP:	

Assessment and Recommendations

Nutrition Plan for the week

Plan for Parenteral Nutrition:	
Plan for Enteral Nutrition:	

Days PN Bloods due if stable (circle): Tues Weds Thurs Fri Sat Sun Mon

Day Triglycerides due (circle): Tues Weds Thurs Fri Sat Sun Mon

Trace elements this week?: Y/N

Nutrition Discharge Plan

Date: _____ Staff Present during planning:

Day: _____

Gestation at Birth: _____

Corrected Gestation: _____

Current Nutritonal Issues:

Current Intake:

Total Feed Volume: ml/kg/day

Feed Type: ml/kg/day

Nutrient Intake Provided by Feed kcal/kg/day g/kg/day Protein

Current Supplments (includig iron and Vitamins):

Comments on intake:

Relevant Blood results:

Current Growth

Weight: Centile: **Head Circ:** Centile: **Length:** Centile:

Comments on growth:

Assessment and Recommendations:

Nutrition Plan for discharge:

Need for Home team follow up: Y/N

Instructions for Home team:

Need for Dietetic Follow up? Y/N

Timing of Dietetic Follow up: _____

Nutritional content of common feeds and stock PN

Nutrient Content of Commonly Used Products per 100ml

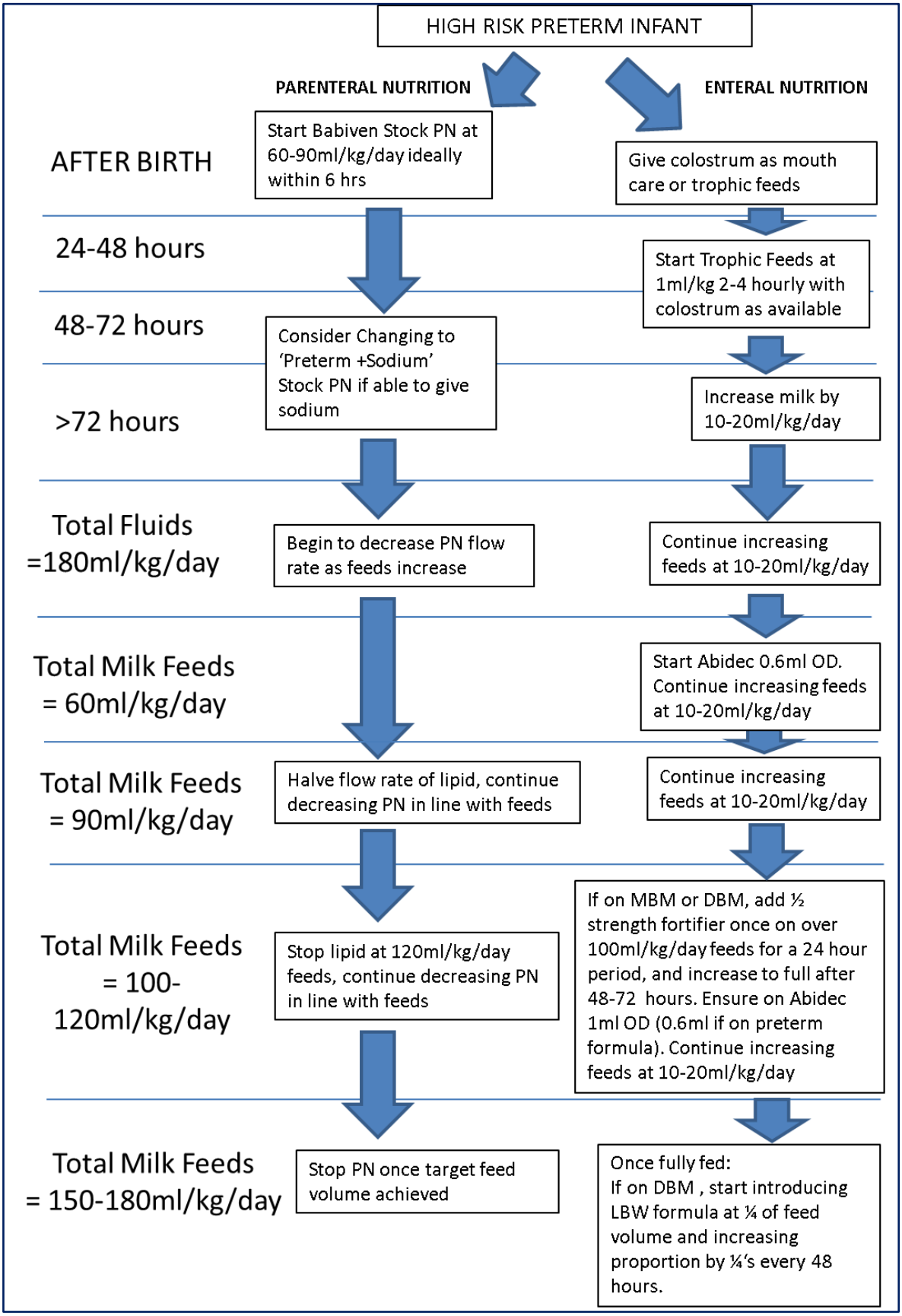
Typical Values are used and are correct at 06/08/2015

***Based on Cow and Gate Nutriprem Breast Milk Fortifier**

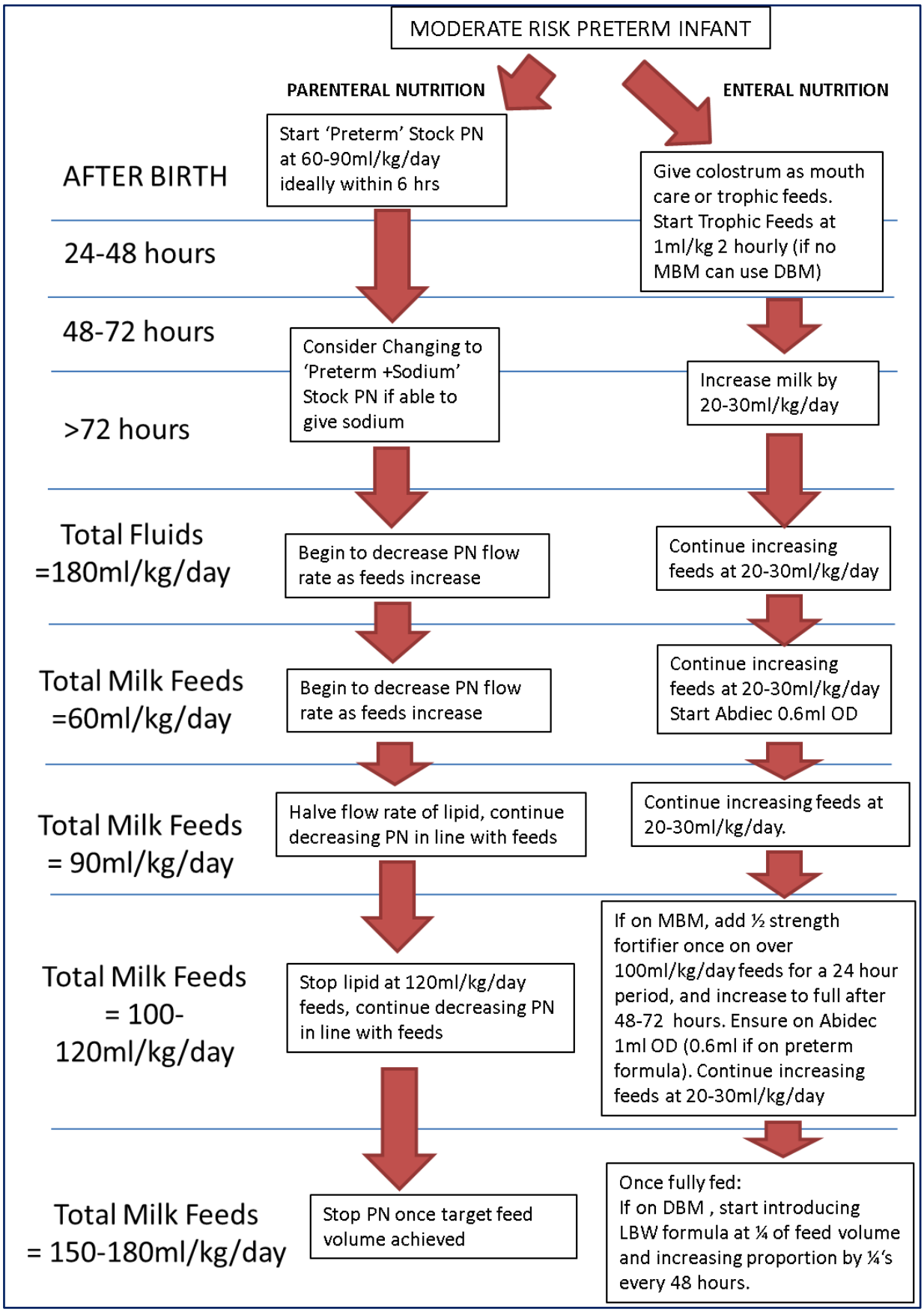
Fluid Name / Nutrient	Babiven Stock PN	Preterm + Sodium Stock PN	Term Stock PN	Stock Lipid	Dextrose 10%	MBM/DBM	MBM with Full Fortifier*	Neocate LCP	Peptijunior	LBW Formula (Aptamil Preterm)	Post D/C Formula (Nutriprem 2)	Term formula	Infantrini
Energy (kcal)	651.0	59.8	70.2	166.7	40.0	69.0	85.0	71.0	66.0	80.0	75.0	66.0	100.0
Protein (g)	2.6	2.8	2.5	0	0.0	1.3	2.5	2.0	1.8	2.6	2.0	1.3	2.6
Carbohydrate (g)	10	11.0	13.5	0	0.0	7.2	10.0	8.1	6.8	8.4	7.4	7.3	10.3
Fat (g)	0	0	0	16.7	0.0	4.1	4.1	3.5	3.5	3.9	4.0	3.5	5.4
Sodium(mmol)	0.0	4.3	2.8	0.1	0.0	0.7	2.2	0.8	0.9	3.0	1.2	0.7	1.1
Potassium (mmol)	1.0	1.7	1.9	0	0.0	1.5	2.1	1.6	1.7	2.1	2.0	1.6	2.4
Calcium(mmol)	1.0	1.0	0.9	0	0.0	0.8	2.5	1.2	1.2	2.3	2.2	1.2	2.0
Phosphorous (mmol)	1.0	2.2	0.9	1.5	0.0	0.5	1.7	1.1	0.9	2.0	1.5	0.9	1.3
Iron (umol)	0.0	0.0	0.0	0.0	0.0	1.3	1.3	18.8	13.8	25.1	17.9	9.5	21.5
Vitamin A (IU)	0.0	0.0	0.0	3910.0	0.0	213.0	985.6	264.0	173.2	599.4	269.7	183.2	333.0
Vitamin D (IU)	0.0	0.0	0.0	680.0	0.0	0.0	200.0	51.0	52.0	120.0	68.0	48.0	68.0
Volume (ml/kg) required to reach recommended protein intake (ELBW infants)	152	125	140	Contains no protein	Contains no protein	292	152	195	211	146	190	292	146

Flow Charts

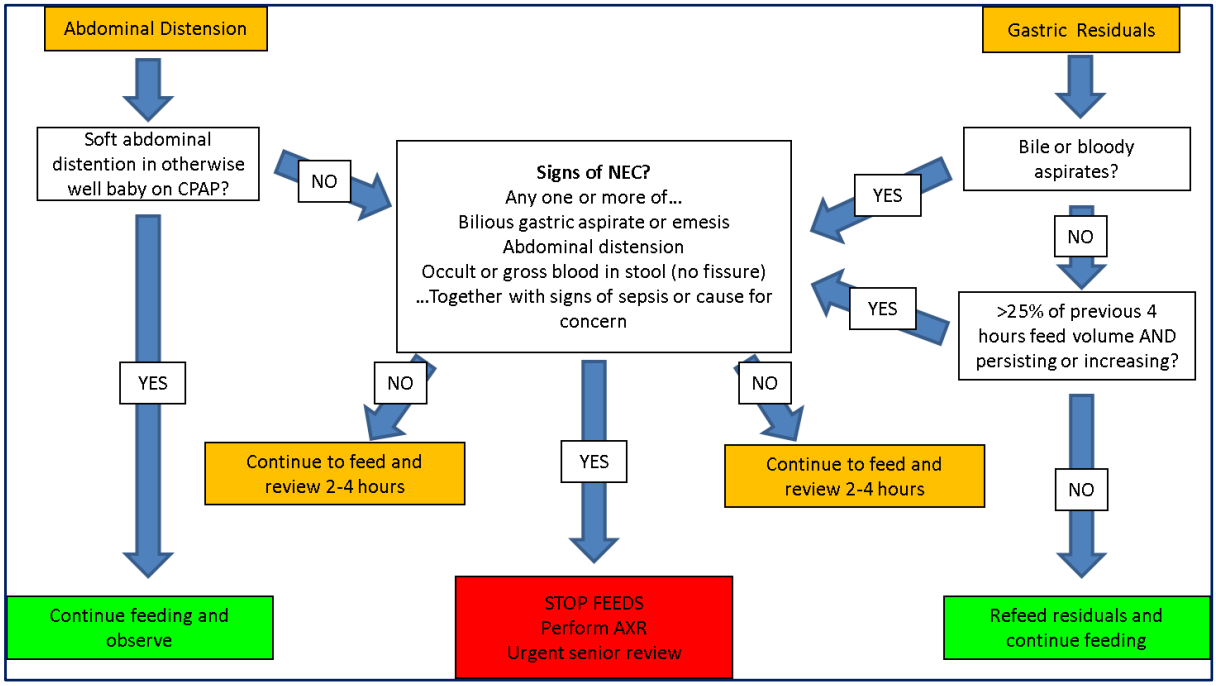
a. Managing parenteral nutrition and feeds – High risk infants



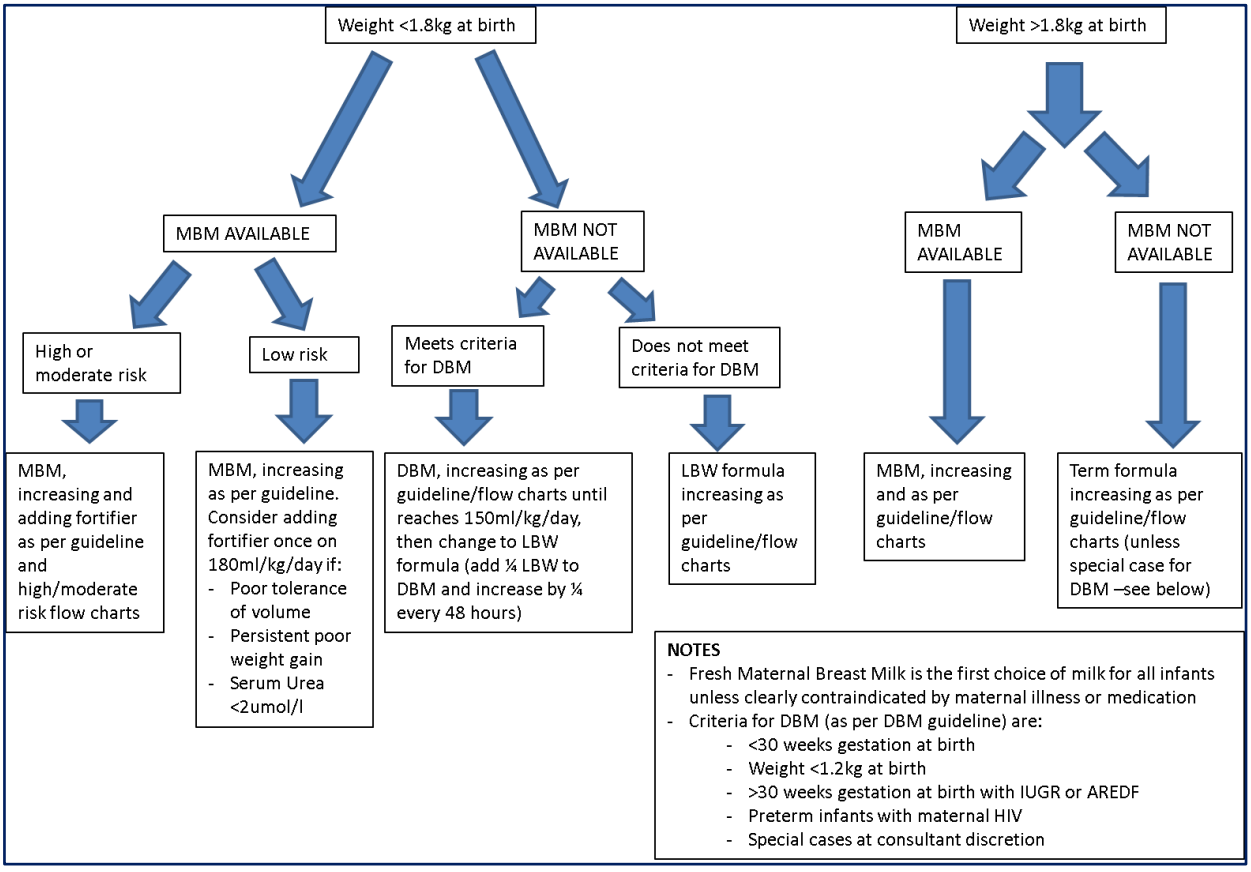
b. Managing parenteral nutrition and feeds – Moderate risk infants



c. Management of gastric residuals



d. Preterm infant – choice of milk



Preterm Infant Feed Volume Tables

a. Starting and Increasing Feeds

i) High Risk Infants (based on increases of 10-20ml/kg/day)

Weight (kg)	Start at (hourly)	Start at (2 hourly)	Increase hourly feed volume by:*	Increase 2 hourly feed volume by:
less than 0.6	N/A	0.5	0.25ml every 24 hours	0.5ml every 24 hours
0.6-0.9	0.5	1	0.5ml every 24 hours	1ml every 24 hours
0.9-1.2	0.75	1.5	0.5ml every 12 hours	1ml every 12 hours
1.2-1.5	1	2	0.5ml every 8 hours	1ml every 8 hours
1.5-1.8	1.25	2.5	0.5ml every 6 hours	1ml every 6 hours
1.8-2	1.5	3	1ml every 12 hours	2ml every 12 hours

ii) **Moderate Risk Infants (based on increases on 20-30ml/kg/day)**

Weight (kg)	Start at (hourly)	Start at (2 hourly)	Increase hourly feed volume by:*	Increase 2 hourly feed volume by:
1.0-1.2	1	2	0.5ml every 6 hours	1ml every 6 hours
1.2-1.6	1.5	3	1ml every 12 hours	2ml every 12 hours
1.6-2.0	2	4	1ml every 8 hours	2ml every 8 hours
2-2.4	2.5	5	1ml every 6 hours	2ml every 6 hours
2.4 and above	3	6	1.5ml every 8 hours	3ml every 8 hours

***Note that this refers to the actual feed <u>volume</u> based on 1 hourly feeds. Therefore if baby is 2 hourly fed then multiply the amount on this table by 2 to give the increase on the feed volume, if on 3 hourly feeds multiply by 3 and so on.**