Worcestershire Acute Hospitals NHS Trust

Neonatal Parenteral Nutrition Guideline

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

Parenteral Nutrition (PN) is an important aspect of care for babies who are unable to meet their nutritional requirements through enteral feeding. This document has been widely based on the West Midlands Neonatal Operational Delivery Network Parenteral Nutrition Guideline (October 2023) and adopted for local use at Worcestershire Acute Hospitals NHS Trust.

This guideline is for use by the following staff groups:

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This is the most current document and should be used until a revised version is in place

Worcestershire Acute Hospitals NHS Trust

Key amendments to this guideline

Date	Amendment	Approved by
July 2019	Document approved	Paediatric QI Meeting
Oct 19	Alteration to lipid filtering on manufacturers advice	Dr Kamalarajan CD
Oct 19	European medicine agency advice on light protection added	Dr Kamalarajan CD
Oct 19	Removal of SMOF lipid details as not used at WRH	Dr Kamalarajan CD
July 20	PM12 not to be used peripherally	Dr Kamalarajan CD
Oct 20	Reinforce that in a baby who was on enteral feeds TPM can start full Vamin & Lipid	Dr West CD
November 2022	Document approved for 3 years with no amendments	Dr Gregory/ Neonatal Guidelines Review Meeting
March 2024	Full document review	Paediatric Governance Meeting/Medicines Safety Committee

Table of Contents

1. Definitions

PN	Parenteral Nutrition
WMNODN	West Midlands Neonatal Operational Delivery Network
UVC	Umbilical Venous Catheter
Preterm neonate	Babies born <37+0 weeks gestation
Term neonate	Babies born ≥37+0 weeks gestation
SMOF	Soya, Medium chain, Olive oil, Fish oil intravenous lipid blend
PNALD	Parenteral nutrition associated liver disease
MEBM	Maternal expressed breast milk
DEBM	Donor expressed breast milk

2. Introduction

Early post-natal growth failure on the neonatal unit is associated with longer term growth failure and/or neurological deficit. Parenteral nutrition (PN) is an important component of neonatal care where gastrointestinal immaturity or disease prevents nutritional requirements being met by the enteral route. Once the decision is made that PN is required, it should be started as soon as possible to reduce the risk of nutritional deficit developing, especially in preterm infants.

The European Society of Paediatric Hepatology Gastroenterology and Nutrition (ESPGHAN) and the National Institute for Health and Clinical Excellence (NICE) provide recommendations on the nutritional requirements of preterm infants and aim to describe best practice for neonatal PN.[1,2,3] The British Association of Perinatal Medicine (BAPM) published 'The Provision of Parenteral Nutrition within Neonatal Services A Framework for Practice' in April 2016 also with the aim of describing best practice for the provision of neonatal PN.[4] Additionally in 2022 NICE published a quality standard on PN in neonates which describes high-priority areas for quality improvement in the delivery of neonatal PN. The quality standard provides recommendations on the use of standardised PN bags, light protection, ensuring parents and carers of babies receiving neonatal PN have regular opportunities to discuss their baby's nutritional care and ensuring healthcare professionals have access to a specialist nutritional multidisciplinary team to ensure a safe and effective service.[5]

Standardised neonatal PN formulations maximise nutrient delivery and in line with BAPM and NICE recommendations using standardised bags enables the early delivery of neonatal PN, because it can be readily available on neonatal units and easily accessed. Using standardised bags improves consistency in nutritional care, reduces variation in practice and minimises the risk of errors in prescribing and compounding. PN formulations and administration should be based on nationally agreed evidence-based guidelines, recognising that the evidence base for neonatal PN can be limited, many of the recommendations are based on expert opinion and expert evaluation of limited evidence.[4,5] These guidelines and frameworks form the basis of this document and should be used in conjunction with clinical judgement.

3. Indications for starting neonatal PN

- For preterm babies born before 31+0 weeks, start PN.
- For preterm babies born at or after 31+0 weeks, start PN if sufficient progress is not made with enteral feeding in the first 72 hours after birth.
- Start PN for preterm and term babies who are unlikely to establish sufficient enteral feeding, for example, babies with a congenital gut disorder or a critical illness such as sepsis.
- For babies of concern (including IUGR/SGA babies) born after 31+0 weeks, a dietitian and/or nutrition review should be sought prior to starting PN.

Indications for starting neonatal PN if enteral feeds are stopped:

For preterm babies on enteral feeds, start PN if:

- Enteral feeds have to be stopped and it is unlikely they will be restarted within 48 hours

OR

- Enteral feeds have been stopped for more than 24 hours and there is unlikely to be sufficient progress with enteral feeding within a further 48 hours.

For term babies on enteral feeds, start PN if:

- enteral feeds have to be stopped and it is unlikely they will be restarted within 72 hours

OR

- enteral feeds have been stopped for more than 48 hours and there is unlikely to be sufficient progress with enteral feeding within a further 48 hours.

Any baby who fails to make sufficient progress with enteral feeds will need review and advice from unit Nutrition Team or Neonatal Dietitian to ensure an individualised nutrition plan is in place to meet nutritional needs.

4. Timing of starting neonatal PN

When a preterm or term baby meets the indications for PN, start it as soon as possible, and within 8 hours at the latest.

5. PN Constituents & Preparations

WMNODN Neonatal PN is made up of two phases which run as simultaneous, separate continuous infusions: the aqueous phase (otherwise known as Vamin) and the Lipid phase.

The use of visually distinct light covers, different syringe pumps and administration sets for the two components is recommended to reduce the risk of administration errors, as highlighted in the 2017 patient safety alert into neonatal PN.[6]

Please note WMNODN formulated PN bags and lipid syringes are unlicensed preparations, therefore recording batch numbers of all products is essential (please see Administration section).

a. Aqueous phase

There are four types of standardised aqueous bags specifically formulated by WMNODN to provide adequate nutrition when infused at the maximum prescription rate. The range of standardised aqueous bags stocked differ in glucose concentration, protein, acetate and electrolyte content.

All bags contain carbohydrate (glucose), and protein as Vaminolact®, which provides nitrogen as a mixture of amino acids, based on the profile of breast milk. Maintenance bags also contain electrolytes, phosphate and chloride.
Trace elements (*Peditrace*®) which contain copper, fluoride, iodide, manganese, selenium, and zinc are also included in all bags to ensure recommended micronutrient intakes are met.

If you are in any doubt which is the most suitable choice of aqueous bag, please either discuss with the unit Nutrition Team, Nutrition Lead, Neonatal Pharmacist or Neonatal Dietitian, if available. Further discussion with the multidisciplinary team may be required for babies with complex disorders associated with fluid and electrolyte imbalance, liver or renal failure.

Aqueous Preparations:

The 4 WMNODN formulations of aqueous PN bags available are:

- Start up with Peditrace
- Preterm maintenance 12 with Peditrace
- Preterm maintenance 15 with Peditrace
- Term baby with Peditrace

WMNODN Start Up with Peditrace (270ml bag)

Starting rate	Day 1: Prescribe 78mL/kg/day Start up with Peditrace + 10mL/kg/day from Intralipid 20% bag = Total fluid requirement of 88mL/kg/day *Note: Tertiary units use lipid syringes with added vitamins when starting PN and this has different rate – see bottom of page 10.*
Maximum rate	**A maximum of 100mls/kg/day** of Start Up Vamin can be used if clinical decision to continue Start Up Vamin for >24hours.
Glucose Content	10%
Protein Content	3.4g
Other significant	Electrolyte free **except for magnesium** (0.2mmol/100ml) Trace elements included from 2023 in WMNODN Start-up formulation. ****Can be administered via central or peripheral line****
Indication for use	• WMNODN Start up with Peditrace is sodium free as giving sodium is usually avoided until physiological postnatal diuresis occurs. • Use as initial infusion fluid for up to 24 hours of life. • Can be given peripherally if central access is temporarily unavailable. • Can also be given by either route if electrolyte free PN is required. **This will **not** provide adequate nutrition and should be used for the shortest duration possible and separate infusions of electrolytes may be required**

If PN is initiated after a baby has previously tolerated enteral feeds they do not require a Start Up bag and should commence on the appropriate maintenance bag if central access is available. They can start at maximum volume/rate of lipid.

If suspected fluid overload, consultant review to consider start PN at 60mL/kg/day

WMNODN Preterm 12 with Peditrace (400ml bag)

To prescribe:	**100mls/kg/day** **This is the maximum rate.**
Glucose Content	12%
Protein Content	3.5g
Other significant	Contains acetate (1.38mmol/100ml) Peditrace dose limited by stability, 100ml/kg/day provides 0.8ml/kg/day Peditrace ****Administer by central line only****
Indication for use	• To be given to preterm babies following Start-up PN. Given for at least 48 hours, or until glucose tolerance is established (defined locally as blood glucose ≤12mmol/L. If >12mmol/L, please refer for consultant review and decision). • Prolonged use may be required in infants with glucose intolerance or acidosis (contains acetate). **Please note this does not provide adequate nutrition for long term growth.**

WMNODN Preterm 15 with Peditrace (440ml bag)

To prescribe:	**110mls/kg/day** **This is the maximum rate.**
Glucose Content	13.6%
Protein Content	3.5g
Other significant	Contains more chloride than Preterm 12 bag and no acetate: increased risk of metabolic acidosis **Administer by central line only**
Indication for use	• To be used when glucose tolerance established as the standard maintenance PN for preterm neonates. **WMNODN Preterm 15 with Peditrace **will** provide adequate nutrition to meet recommendations for growth when infused with adequate lipid doses. **

WMNODN Term baby with Peditrace (600ml bag)

Maximum rate	**100mls**/kg/day
Glucose Content	15%
Protein Content	3.06g
Other significant	Reduced Calcium compared with preterm bags (1.48mmol/100ml) **Administer by central line only**
Indications for use	• For preterm infants weighing ≥2.5kg and/or infants with corrected gestational age ≥37 weeks. **WMNODN Term baby with Peditrace will provide adequate nutrition to meet recommendations for growth when infused with adequate lipid doses. **

b. Lipid phase

There are two different lipid preparations available: Intralipid 20% and SMOFlipid®, each derived from different sources of fat.

Intralipid 20% is derived from soya beans and is primarily made up of omega-6 polyunsaturated fatty acids, which are crucial for neurological development, but can induce hepatocyte damage over time due to considerable inflammatory properties. It is thought that it is these properties of the lipid that contribute to parenteral nutrition associated liver disease (PNALD). Plant-based lipid emulsions may also have a direct effect on the development of PNALD due to a high phytosterol content.[7]

SMOFlipid® is a blend of soybean oil, medium chain triglycerides, olive oil and fish oils. Fish oil contains primarily omega-3 polyunsaturated fatty acids, which are anti-inflammatory and potentially hepatoprotective, and no phytosterols. SMOFlipid® has been shown to be safe to use in preterm infants, but currently there is no evidence to suggest any benefits of its routine use over Intralipid 20% in non-cholestatic infants (direct bilirubin <50 µmol/L).

There is a recent study showing that the use of SMOFlipid® improves the liver function tests in those with cholestasis but does not prevent the development of PNALD. Use varies across the WMNODN but SMOFlipid® should be considered in babies with a direct bilirubin >50 µmol/L and rising trend.[8,9]

As an integral part of PN, lipid emulsions provide an energy-dense source of calories that help reduce glucose load and contribute to the supply of essential fatty acids, thus preventing essential fatty-acid deficiency. Maximum infusion rates provide sufficient lipid energy to optimise growth, provide essential fatty acids and minimise the risk of hyperglycaemia.[3]

Lipid Preparations:

Regardless of preparation (bag or syringe), all lipid products syringe may be infused for a maximum of 24 hours.

Intralipid 20% bags

This is commercially available in 100mL bags with a 24 month manufacturer expiry. When infusing an intralipid bag, this should be directly from the bag via a volumetric pump; intralipid 20% should never be withdrawn from the bag into a syringe at ward level.

This lipid preparation is used most frequently at WRH and is routinely stocked on the ward at room temperature.

Intralipid 20% syringes

Intralipid 50mL syringes formulated for WMNODN contain intralipid 20% with added fat-soluble and water-soluble vitamins. They are produced by a Manufacturing Specials unit (Monday to Friday only) on a case-by-case basis and must be stored in the fridge. Although these syringes are nutritionally preferred over Intralipid bags, they only have a 7-day expiry from the date of manufacture. We have therefore decided as a unit not to routinely keep these stocked at WRH due to unpredictability of babies requiring PN which may lead to excess waste and financial losses. If syringes are deemed to be appropriate, they will be ordered by a neonatal-trained pharmacist.

SMOFlipid®

SMOFlipid® syringes formulated for WMNODN contain SMOFlipid® with added fat-soluble and water-soluble vitamins. These syringes also have a 7-day expiry from the date of manufacture. To prevent wastage, in the event of excess stock, SMOFlipid® syringes may be prescribed for any baby requiring lipid. This is very rarely used at WRH.

Prescribing Lipid Preparations

The amount of lipid to be prescribed is increased each day that PN is given. This is demonstrated in the table below.

	Fat grams/kg/day	**Intralipid bag** (no added vitamins)	**Intralipid syringe** (inc. vitamins)	**SMOFlipid® Syringe** (inc. vitamins)
1st Day of PN	2g	10mL/kg/day	12mL/kg/day	12mL/kg/day
2nd Day of PN	3g	15mL/kg/day	18mL/kg/day	18mL/kg/day
3rd Day of PN and thereafter	3.4g	17mL/kg/day	20mL/kg/day	20mL/kg/day

Please note the slight difference in dose when prescribing an Intralipid 20% bag or Intralipid / SMOFlipid® syringe due to added vitamin component in the syringes.

This will affect the total daily fluid volume and cause a very small deficit of 2-5mL/kg/day but was this volume was deemed 'nutritionally insignificant' during the development of this guideline.

6. Mode of Delivery

PN should ideally be administered via a central venous catheter (for example, UVC, long line, percutaneous long line or surgically inserted central venous catheter); peripheral venous catheters should be avoided due to risk of extravasation injuries.

Peripheral administration of PN

- It is recommended that all PN is run **centrally.**
- In the absence of central access WMNODN Start Up bag and Intralipid/SMOF may be run peripherally, for example on day of birth or when central access is temporarily unavailable in a baby already established on PN.
    - WMNODN Start up formulation consists of nitrogen, glucose, magnesium and peditrace only. When used in babies already established on PN where central access is temporarily unavailable it should be used for the shortest duration possible and close monitoring of electrolytes will be required, separate infusions of electrolytes may be needed (usually sodium as a minimum is required.) **This will not provide adequate nutrition**
- Running lipid peripherally in addition to the aqueous component may prolong the life of the peripheral cannula.

Central administration of PN

- Central access should be sought as soon as possible
- All PN should be administered centrally via a UVC, percutaneous long line or surgically inserted central venous catheter in view of the osmolarity, high concentration of glucose and calcium.
- Due to the increasing reports of PN extravasation when administered via a UVC, prolonged infusion via a UVC is not recommended. There is little evidence around the optimum dwell duration of UVC's in neonates. Two single centered studies suggested that use of UVC's for greater than 7 days is associated with an increased risk of central line associated bloodstream infection compared with use less than 7 days. In line with BAPM guidance on UVC's, the need for continued use should be reviewed daily.[9]
- There must be vigilance towards infection in infants on PN particularly in those with central venous access (low threshold for infection screen). Catheter-related blood stream infection remains the most common complication related to central venous access therefore meticulous attention to sterility of the line that is used for PN delivery is vital.

Please note, there have been fatalities due to intralipid being administered too quickly. It is rarely necessary to run lipid at a rate more than 1.5 mL/hr in any baby on our NNU. Always question lipid prescribed at more than 1.5 mL/hr.

7. Protection from light

- Protect the bags, syringes and infusion sets of both aqueous and lipid PN solutions from light.
- In line with European Medicines Agency and the Medicines and Healthcare products Regulatory Agency guidance, NICE and ESPGHAN both recommend that lipid and aqueous PN solutions should be protected from light.
- Use of light-exposed PN products containing amino acids and/or lipids, particularly PN with vitamins and/or trace elements, may lead to severe adverse effects in premature neonates. This is because exposure of such solutions to light causes formation of peroxides and other degradation products.
- Light protection also helps to prevent light induced vitamin degradation.[11]

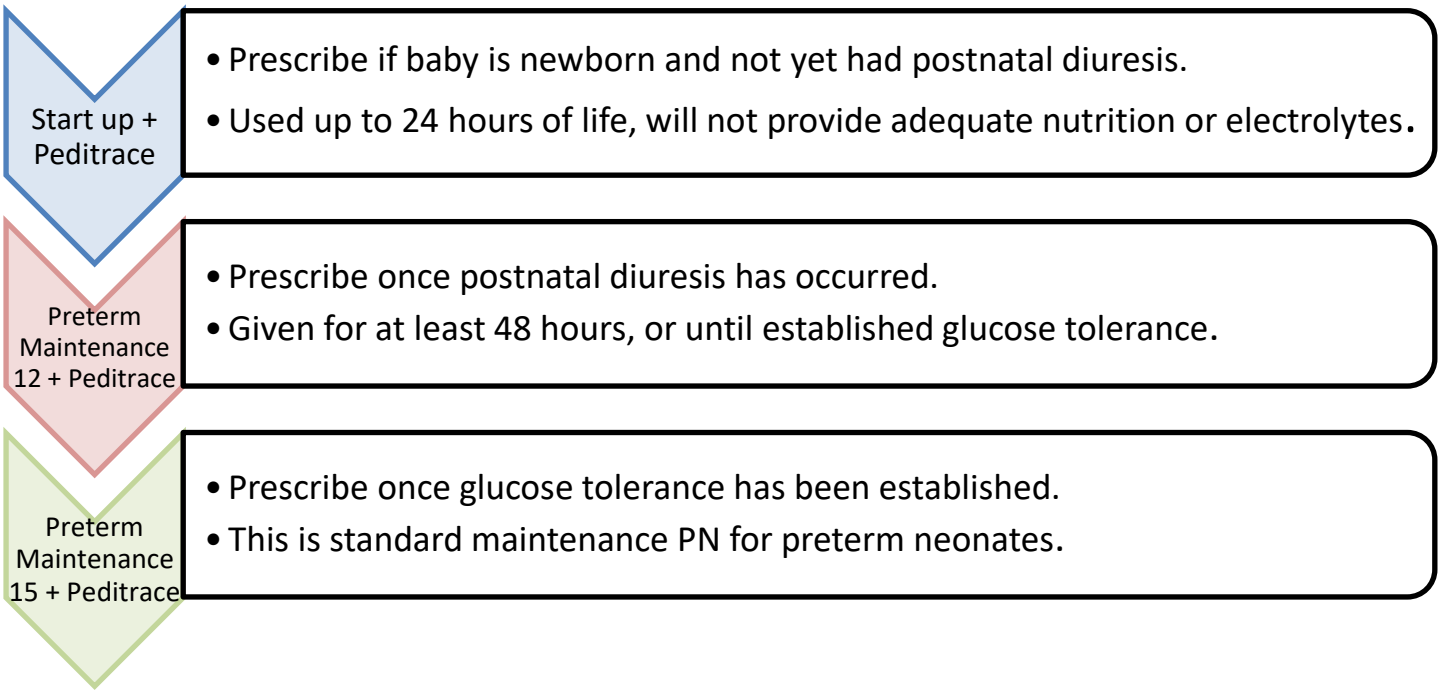
8. Prescribing

- All PN should be prescribed on an intravenous fluid chart or dedicated prescription chart or within an electronic prescribing system where available.
- PN should be prescribed based on birth weight in the first week of life. Thereafter it should be prescribed on the greatest recent weight (birth weight or current weight) as long as there is no significant oedema.
    - If baby too unstable to be weighed for >5 consecutive days, and incubator does not have inbuilt scales:
        - Calculate weight-for-age from appropriate growth chart, use as working weight (assuming baby is following their previous centile line) to ensure adequate fluids, enteral and PN administered.
        - Reinstate routine weighing once baby stable.[12]

If PN is being commenced after a baby has previously tolerated enteral feeds they do not require a startup bag and should commence on the appropriate aqueous maintenance bag. They can start at maximum volume of lipid.
Maintenance PN (aqueous bag + lipid) delivered at maximum rate will provide 120–130 mL/kg/day (dependent on aqueous bag), which may not provide adequate fluid, particularly in the first week of life. It may be necessary to provide extra fluid, which can be given alongside the parenteral nutrition as clinically necessary.

What PN preparation should be prescribed?

Vamin



For Term babies, they will require 'Term baby + Peditrace'. This is seldom used in our unit thus not stocked routinely, please contact the neonatal pharmacist to obtain supply from manufacturer. Turnaround time is approximately 72 hours (Can only be ordered on Weekdays).

Lipids

Most babies in our unit will be advancing enteral feeds during days 1 to 5 up to 100ml/kg/day at which point, Human Milk Fortifier (HMF) and Abidec can be started as per Network Enteral Feeding Guidelines.

Due to 48-72-hour turnaround time for lipid syringes, by the time they arrive on the unit, baby is likely about to start enteral vitamins.

1. Prescribe Intralipid 20% bags on Days 1-5 as per above table.
2. **Nutrition review to take place at Day 5 to decide whether to order in Lipid syringes.**
   - If baby is at or close to 100mL/kg/day: prescribe HMF + Abidec, no need to order lipid syringes.
   - If baby is slow to tolerate feeds or unlikely to reach 100mL/kg/day by Day 5-7: decision to prescribe HMF + Abidec early (40-100mL/kg/day as per ESPGHAN) or order in lipid syringes to arrive by Day 7 at the latest.

9. Administration

- Any prescribed medications/fluids should be administered following the Aseptic Non-Touch Technique Policy and as per local medicine administration guidelines.
- Aqueous PN bags should not run for longer than 48 hours and **must** be infused via a 0.2micron filter.
- Lipid bags and syringes should not run for longer than 24 hours and should be infused over 24 hours. It is advised that lipid emulsions should also be infused via a 1.2micron filter, refer to local unit policy.
- The PN giving set and filters must be changed every 48 and 24 hours respectively for aqueous and lipid solutions.
- Access to the line should be minimised and ideally PN should always be infused via a dedicated lumen although this is not always possible in neonates due to difficulties in venous access.
- In exceptional circumstances where the baby has a single lumen line but requires additional infusions/ drugs and obtaining additional access is impossible check compatibility. If in any doubt, assume that they are not compatible and contact pharmacy to confirm compatibility.
- **Note that calcium, magnesium and phosphate containing fluids must never be administered simultaneously with PN.**

Checks prior to administration

Prior to administering any infusion of PN, two registered practitioners should independently ensure that:

- The prescription is legal and clinically correct.
- The type of aqueous bag and lipid obtained are the same as that prescribed
- The product will not expire for at least 24 hours (note if vamin expiry <48 hours then bag will need replacing sooner than usual).
- The PN has reached room temperature. (During warming small gas bubbles form, which then dissipate when the bags reach room temperature. Whilst they are reportedly not large enough to cause any harm to the patient, they may set off pump alarms. In addition, patients may get cold shock from infusion of chilled fluid).
- The calculated infusion rates are correct and do not exceed the maximum allowed.
- The batch number for both the aqueous bag and lipid syringe/bag are documented in the baby's paperwork as per unit policy.
- An independent log (separate to the baby's notes) is made of the product/ batch number to be administered to baby and retained for a minimum of 5 years.
- A dedicated lumen of a central line is available and designated for PN (see mode of delivery).
- PN infusions are administered via a rate controlled syringe/volumetric pump. Smart pumps should be used if available.
- The administration tubing must be traced to the point of origin in the body at the initiation of the infusion and at each shift change. The LIPID is white and is always at a LOWER rate than the aqueous, which is clear. LIPID should always be placed in a LOWER pump than the aqueous solution. Remember LIPID, LOWER.[13]

Refer to appendix 2 for WRH Local Nursing Procedure for Safe Administration of Neonatal PN.

10. Weaning

- Enteral feeds should be commenced as soon as possible and increased as per WMNODN Enteral Feeding Guideline.
- Do not wean PN until total fluid requirement is reached; this is between 150ml/kg/day and 165mL/kg/day depending on type of enteral feed (unless fluid restricted).
- 165ml/kg/day will be the target for babies receiving fortified EBM /DEBM and Nutriprem 1
- Refer to WMNODN enteral feeding guideline for advice on enteral feeds and rates of advancement.
- Once this volume is reached the aqueous and lipid components of the PN should be weaned **in proportion** to ensure the ratio of calorie provision by fat and carbohydrate remains appropriate.
- The lipid component should be weaned as per below regardless if it is in a bag or syringe.

For every 1mL increase in enteral feeds (as per SIFT), decrease PN as below	
Preterm 12 + Peditrace regime	
Vamin	↓ by 0.83mL
Lipid	↓ by 0.17mL
Preterm 15 + Peditrace regime	
Vamin	↓ by 0.85mL
Lipid	↓ by 0.15mL

See example on page 16 for calculating PN infusion rates.

On the rare occasion that term baby maintenance is required then this should be reduced as follows:
Vamin by 0.83ml/hr and Lipid by 0.17ml/hr.

Example calculation 1:

1600g baby on Preterm Maintenance 15 + IntraLipid 20% bag and increasing enteral feeds of preterm formula
Step 1: Calculate required volume of PN to maintain adequate fluid intake

Total fluid requirement = 165ml/kg/day
= 165ml x 1.6kg = 264ml/day
→ Hourly fluid requirement = **11ml/hr**

Preterm formula = 8mL every 2 hours
→ Hourly enteral nutrition = **4mL/hr**

Volume remaining for PN (ml/hr)= total fluids (ml/hr) – enteral nutrition (ml/hr)
= 11 – 4 = **7ml/hr**

Step 2: Calculate proportion of PN volume to give as lipid and aqueous phase

***Note different proportions depending on type of Maintenance bag (12 or 15: see previous page)**

Rate of Preterm maintenance 15 with peditrace (mL/hr) = Volume remaining for PN/hr x 0.85 Rate of lipid (mL/hr) = Volume remaining for PN/hr x 0.15

→ Preterm maintenance *15 rate = 7 x 0.85 = **5.95mL/hr**

→ Lipid rate= 7 x 0.15 = **1.05ml/hr**

End check:
Enteral nutrition (mL/hr) + Preterm maintenance 15 rate (mL/hr) + lipid rate (mL/hr) = Total hourly fluid requirement

4ml/hr + 5.95ml/hr + 1.05ml/hr = 11ml/hr

11. Monitoring

The monitoring suggested below is purely for evaluating PN and additional monitoring according to the clinical condition of the baby may be required.

Biochemical Monitoring	Frequency		Additional considerations
	Initiation of PN, increasing PN or acutely ill infant	Stable infant on maintenance PN	
Blood glucose	1-2 hours after first starting PN and each change of PN bag	1 to 2 hours after each change of PN bag (usually every 24 or 48 hours).	Measure blood glucose more frequently if: • The preterm or term baby has previously had hypoglycaemia or hyperglycaemia • The dosage of IV glucose has been changed • There are clinical reasons for concern
Blood pH	Daily	Twice weekly	Measure blood pH more frequently if: • Previous levels out of normal range • There are clinical reasons for concern
U&E	Daily	Twice weekly	Measure more frequently if: • Previous levels out of normal range • There are clinical reasons for concern
Calcium & phosphate	Daily	Twice weekly	Measure more frequently if: • Previous levels out of normal range • There are clinical reasons for concern
Magnesium	Daily	Twice weekly	Measure more frequently if: • Previous levels out of normal range • There are clinical reasons for concern
Liver function including split bilirubin/bone profile	Weekly	Weekly	Measure more frequently if: • Previous levels out of normal range • There are clinical reasons for concern
Triglycerides	*Not routinely checked	*Not routinely checked	Measure serum triglycerides more frequently, but not more than once a day, if: • the level is elevated • the preterm or term baby is at risk of hypertriglyceridaemia, for example, if the baby is critically ill or has a lipaemic blood sample.

Nutrition bloods if on PN >28 days	At 28days	Every 4 weeks	These include: • Fat soluble vitamins A D E • Zinc • Copper • Manganese • Selenium • B12 and folate • Iron
Other Monitoring			
Line checks	At each handover	At each handover	
Infusion rates and proportions if weaning PN	At each handover	At each handover	
Fluid input/output	At each handover	At each handover	
Weight	Daily	At least three times weekly	Ideally weight should be measured daily during the initiation of PN, but this is not always practically possible as babies receiving PN are frequently not clinically stable.
Length	Weekly	Weekly	
Head circumference	Weekly	Weekly	

Nutrition bloods should not be performed if there is any evidence of infection as the levels of some of the serum nutrient levels will be adversely affected. Copper levels are elevated in the presence of infection, and vitamin A, zinc and selenium are lowered.

* It is recommended in ESPGHAN and NICE guidelines to measure triglycerides to ensure lipid tolerance daily while the lipid volume is being increased, and then weekly. This is often not practical in extremely preterm babies in view of the volume of blood required.
Triglycerides should be measured weekly in babies who require more than 4 weeks of PN. Lipid intolerance is more likely to occur in extremely preterm babies, may occur during episodes of sepsis and may cause severe unexplained thrombocytopaenia. Triglycerides should be measured when sepsis is suspected and in cases of unexplained thrombocytopaenia in babies receiving PN. At present, serum triglyceride concentrations < 3.0 mmol/L are generally considered acceptable. [15] If the sample is noted to be lipaemic, stop the lipids and recheck the triglyceride level after 4 hours. The lipid should be cleared in this time frame. If the level is >3mmol/L when triglycerides are repeated after this 4 hour period, consider reducing lipid infusion in discussion with the Nutrition Team or Neonatal Dietitian.[16]

12. Ordering of PN

Ordering of all Vamin bags and lipid syringes is maintained by pharmacy team. Intralipid 20% bags for ward stock can be ordered by neonatal nursing staff via the usual ward requisition procedure. Contact the neonatal pharmacist (or on-call pharmacist out of hours) for advice.

13. Storage

All aqueous (Vamin) bags and lipid syringes should be refrigerated immediately after delivery. Aqueous bags and the lipid syringes should be refrigerated between 2 – 8°C. The temperature of the fridge should be checked daily and documented according to local policy. Intact Intralipid 20% bags can be stored at room temperature.

Appendix 1: Aqueous bag Compositions

Composition (ml)	Start up + peditrace		Preterm maintenance 12 + peditrace	Preterm maintenance 15 + peditrace	Term baby + peditrace
Per volume ml/kg	**90**	**100**	**100**	**110**	**100**
Nitrogen (g)	0.49	0.54	0.56	0.56	0.49
Protein(g)	3.06	3.40	3.5	3.5	3.06
Glucose (g)	9	10	12	15	15
Non-nitrogen calories (Kcal)	36	40	48	60	60
Total calories (Kcal)	46.67	54.07	62.5	74.5	72.67
Sodium (mmol)	0	0	4.98	4.98	4.93
Potassium (mmol)	0	0	2	2.5	2.5
Calcium (mmol)	0	0	1.97	1.97	1.48
Magnesium (mmol)	0.18	0.2	0.2	0.2	0.2
Phosphate (mmol)	0	0	2	2	2
Acetate (mmol)	0	0	1.38	0	0
Chloride (mmol)	0	0	1.6	3.48	3.43
Zinc (micromol)	3.45	3.83	3.07	3.83	3.83
Selenium (nanomol)	22.77	25.3	20.24	25.3	25.3
Copper (micromol)	0.28	0.31	0.25	0.32	0.32
Manganese (nmol)	16.38	18.2	14.56	18.2	18.2
Fluoride (micromol)	2.7	3	2.4	3	3
Iodide (nmol)	7.09	7.88	6.30	7.88	7.88

Monitoring

Page/ Section of Key Document	Key control:	Checks to be carried out to confirm compliance with the Policy:	How often the check will be carried out:	Responsible for carrying out the check:	Results of check reported to: *(Responsible for also ensuring actions are developed to address any areas of non-compliance)*	Frequency of reporting:
	WHAT?	**HOW?**	**WHEN?**	**WHO?**	**WHERE?**	**WHEN?**
Page 12-14	To ensure the PN is prescribed and administered safely and will not exceed maximum administration rate.	Daily review of prescriptions from clinical staff, two trained nursing staff as per MedPolSOP22. All errors and incidents will be reported on Datix for investigation.	Daily review of prescription on ward round, nursing checks at handover (twice daily), any change in intravenous pump administration rates performed by two members of staff should identify any errors.	Clinicians responsible for prescribing and administering on neonatal ward including doctors, nurses and pharmacists.	Errors will be reported to Datix as per Medicines Policy. These errors will be investigated and reported to the Directorate, Division and at Medicines Safety Committee.	Will be dependent on frequency of errors, if and when they occur.
Page 19	To ensure PN is stored correctly within the stated temperature range.	Daily fridge temperature audit. Pharmacy checks which include fridge audit. Safe and Secure Handling Audit.	Fridge checks – daily General pharmacy audit– monthly Safe and Secure Handling audit – annually.	Nursing staff and pharmacy staff.	To store refrigerated items correctly as per MedPolSOP29.	Fridge temperature monitoring checked daily.

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Contribution List

Contribution List

This key document has been circulated to the following individuals for consultation;

Designation
All consultant paediatricians at Worcestershire Acute Hospitals NHS Trust
Keith Hinton (Clinical Team Lead Pharmacist)
Lara Greenway (Matron, Neonatal Services)
Anya Wright (Ward Manager, Neonatal Services)
Faye Anderson (Clinical Educator, Neonatal Services)
Beth Goodwin (Lead Clinical Educator, Neonatal Services)
All nursing staff on neonatal unit, WRH.

This key document has been circulated to the chair(s) of the following committee's / groups for comments;

Committee
Neonatal Development Group
Paediatric Governance
Medicines Safety Committee

Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and included as an appendix to key document when submitted to the appropriate committee for consideration and approval.

Please complete assessment form on next page

Herefordshire & Worcestershire STP - Equality Impact Assessment (EIA) Form
Please read EIA guidelines when completing this form

Section 1 - Name of Organisation (please tick)

Herefordshire & Worcestershire STP		Herefordshire Council		Herefordshire CCG	
Worcestershire Acute Hospitals NHS Trust	✓	Worcestershire County Council		Worcestershire CCGs	
Worcestershire Health and Care NHS Trust		Wye Valley NHS Trust		Other (please state)	

Name of Lead for Activity	Viviana Weckemann (Neonatal Lead – Consultant Paediatrician)

Details of individuals completing this assessment	**Name**	**Job title**	**e-mail contact**
	Louise Williams	Lead Pharmacist	Louise.williams49@nhs.net
Date assessment completed	**11/03/2024**		

Section 2

Activity being assessed (e.g. policy/procedure, document, service redesign, policy, strategy etc.)	**Title:** Neonatal Parenteral Nutrition Guideline			
What is the aim, purpose and/or intended outcomes of this Activity?	Parenteral Nutrition (PN) is an important aspect of care for babies who are unable to meet their nutritional requirements through enteral feeding. This document has been widely based on the West Midlands Neonatal Operational Delivery Network Parenteral Nutrition Guideline (October 2023) and adopted for local use at Worcestershire Acute Hospitals NHS Trust.			
Who will be affected by the development & implementation of this activity?	❑ [x] ❑ ❑	Service User Patient Carers Visitors	[x] ❑ ❑ ❑	Staff Communities Other _____

Is this:	[x] Review of an existing activity ❑ New activity ❑ Planning to withdraw or reduce a service, activity or presence?
What information and evidence have you reviewed to help inform this assessment? (Please name sources, eg demographic information for patients / services / staff groups affected, complaints etc.	This document has been produced to replace the existing local neonatal Parenteral Nutrition guideline. It has been based on the West Midlands Network PN guideline but adapted for local practice. There are no equality issues identified as all babies who are administered PN will have fulfilled the inclusion criteria set out in the guideline which is evidence-based as per the reference list.
Summary of engagement or consultation undertaken (e.g. who and how have you engaged with, or why do you believe this is not required)	This policy describes the provision of Parenteral nutrition within the neonatal unit at Worcestershire Royal Hospital , therefore there are no equality issues identified.
Summary of relevant findings	Not applicable.

Section 3

Please consider the potential impact of this activity (during development & implementation) on each of the equality groups outlined below. **Please tick one or more impact box below for each Equality Group and explain your rationale**. Please note it is possible for the potential impact to be both positive and negative within the same equality group and this should be recorded. Remember to consider the impact on e.g. staff, public, patients, carers etc. in these equality groups.

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Age		x		
Disability		x		
Gender Reassignment		x		
Marriage & Civil Partnerships		x		
Pregnancy & Maternity		x		
Race including Traveling Communities		x		
Religion & Belief		x		
Sex		x		

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Sexual Orientation		x		
Other Vulnerable and Disadvantaged Groups (e.g. carers; care leavers; homeless; Social/Economic deprivation, travelling communities etc.)		x		
Health Inequalities (any preventable, unfair & unjust differences in health status between groups, populations or individuals that arise from the unequal distribution of social, environmental & economic conditions within societies)		x		

Section 4

What actions will you take to mitigate any potential negative impacts?	Risk identified	Actions required to reduce / eliminate negative impact	Who will lead on the action?	Timeframe
	None			
How will you monitor these actions?	**n/a**			

When will you review this EIA? (e.g in a service redesign, this EIA should be revisited regularly throughout the design & implementation)	**Every 3 years as part of the policy review.**

Section 5 - Please read and agree to the following Equality Statement

1. Equality Statement

1.1. All public bodies have a statutory duty under the Equality Act 2010 to set out arrangements to assess and consult on how their policies and functions impact on the 9 protected characteristics: Age; Disability; Gender Reassignment; Marriage & Civil Partnership; Pregnancy & Maternity; Race; Religion & Belief; Sex; Sexual Orientation

1.2. Our Organisations will challenge discrimination, promote equality, respect human rights, and aims to design and implement services, policies and measures that meet the diverse needs of our service, and population, ensuring that none are placed at a disadvantage over others.

1.3. All staff are expected to deliver services and provide services and care in a manner which respects the individuality of service users, patients, carer's etc, and as such treat them and members of the workforce respectfully, paying due regard to the 9 protected characteristics.

Signature of person completing EIA	Louise Williams
Date signed	11/03/2024
Comments:	
Signature of person the Leader Person for this activity	Dr. Weckemann
Date signed	10/04/2024
Comments:	

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	No
2.	Does the implementation of this document require additional revenue	No
3.	Does the implementation of this document require additional manpower	No
4.	Does the implementation of this document release any manpower costs through a change in practice	No
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	No
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval.