LRI Children's Hospital

(Children's Hospital Parenteral Nutrition Part 2of 4)

Monitoring Troubleshooting and Weaning

Staff relevant to:	Medical, nursing, pharmacy, dietetic staff
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Contents

1. Introduction and who Guideline applies to

Parenteral nutrition (PN) is nutrition that is delivered to the circulation without using the gut. It is complex and expensive. A multidisciplinary approach to the management of these patients is needed to optimise therapy and reduce complications. Close liaison between the patient's clinical team and the ward Dietician or Paediatric Gastroenterologist on service is vital to achieve optimum care.

This guideline applies to all Health Professionals who administer PN to Infants, Children and Young People cared for in UHL Childrens Hospital, including those aged 16-25 on Ward 27 (Teenage, Young Adult Cancer Unit) or in EMCHC. Young adults aged 16-18 years who are being cared for on all other UHL wards requiring PN should be referred to the Leicester Intestinal Failure team (LIFT)

Related documents:

For administration of PN in:

- **Adults - Parenteral Nutrition via a Central Venous Catheter UHL Policy B22/2015**
- **Neonates - Parenteral Nutrition UHL Neonatal Guideline C28/2018**
- **Refeeding Syndrome – Paediatric Inpatients at Risk UHL Nutrition and Dietetics Guideline B19/2010**

When considering using TPN for your patient there are a few questions to answer to demonstrate the benefits outweigh the risks of treatment

This guideline is in 4 sections:

1) UHL Parenteral Nutrition - Initiation UHL Childrens Hospital Guideline C42/2018

   a. **Indication** **Will TPN be beneficial?**
   b. **Vascular Access** **Is a central line present or planned?**
   c. **Nutritional requirements** **Is there enough volume available?**

2) This document - Parenteral Nutrition - Monitoring and Weaning UHL Childrens Hospital Guideline C43/2018

   a. **Monitoring** **Are these assessments feasible?**
   b. **Troubleshooting** **What can go wrong?**

3) UHL Parenteral Nutrition – Supporting Information UHL Childrens Hospital Guideline C44/2018

Appendices of forms and basis for advice

4) UHL Parenteral Nutrition – Administration by Nurses UHL Childrens Hospital Guideline C45/2018

Section 2 Monitoring

All monitoring of the patient is the responsibility of the doctors on the clinical team looking after the patient.

Biochemical Monitoring

Monitoring is necessary to identify those patients with, or at risk of, electrolyte disturbances.

Parameters	Baseline on day 1 commencing TPN	Week 1	Week 2, 3 and 4
Sodium, potassium urea, creatinine Blood glucose Triglycerides Calcium (albumin also done routinely), phosphate, magnesium LFTs	All to be done daily Triglycerides are to be measured daily while increasing lipids	All to be done daily	All to be done daily if unstable, otherwise all parameters to be done thrice weekly for week 2. On week 3 all parameters checked once a week if stable Measurement of random urine sodium and potassium is recommended to explain the cause/s of hypo/hypernatraemia or hypo/hyperkalaemia
Fe, Zn, Se, Cu, Cr, Mo,			Ferritin, Iron, zinc, selenium, copper, chromium and molybdenum monthly Check zinc sooner if poor weight gain against expected
FBC	To be done daily	To be done daily	To be done daily if unstable, otherwise to be done three times a week for week 2
Clotting screen	To be done daily	Do on day 3 and 5	Do once a week, unless unstable
Urinalysis	To be done daily	To be done twice a week	Weekly for week 2 then as needed by electrolyte requirements
Weight	To be done daily	To be done twice a week for < 1year old patients , unless unstable	To be done twice a week for < 1-year old patients , unless unstable

Adjustments based on Blood Results

Details on the rationale for adjustment to bag content based on blood results can be found in Part 3 of the Guideline found on Insite Policy & Guidelines Library

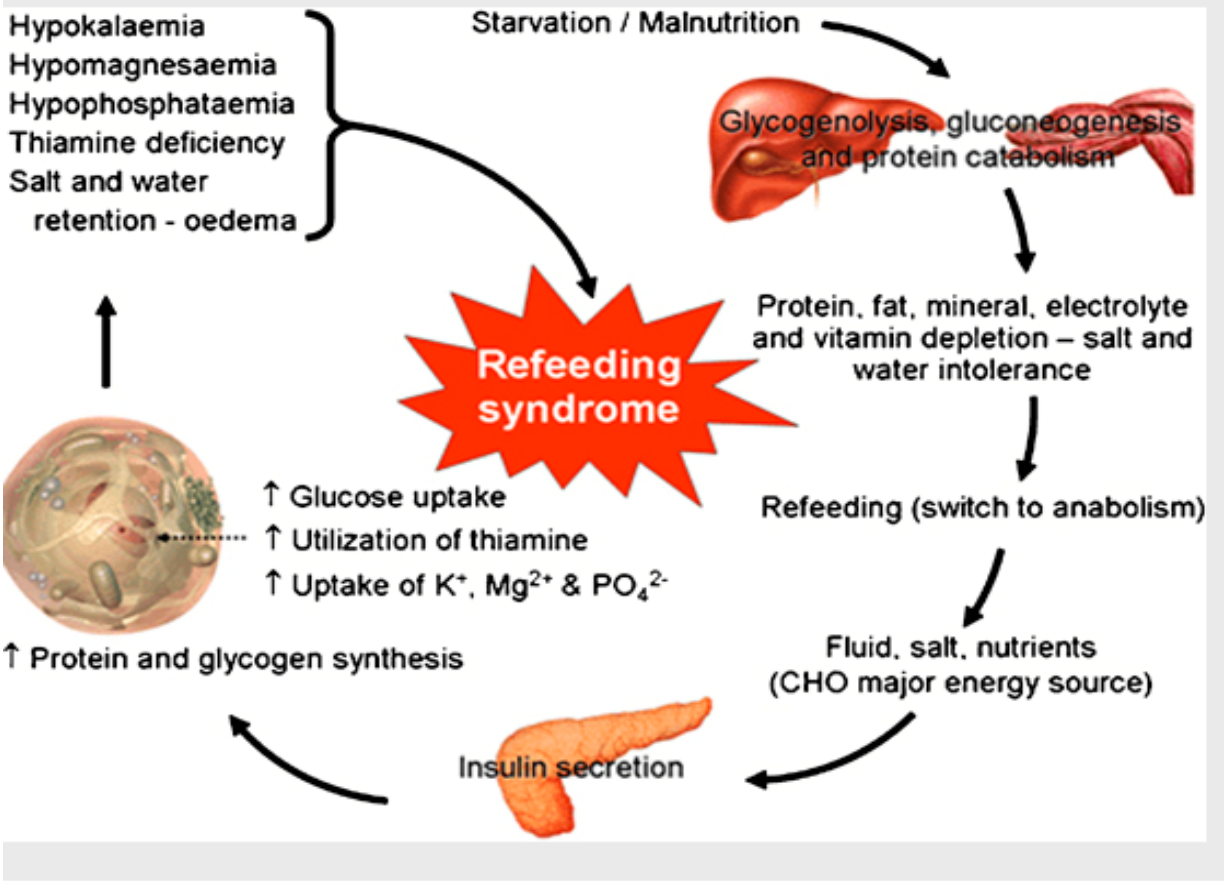
Physical Assessment:

- **Daily:** Daily weights are necessary for patients to assess fluid balance and growth.
- **Weekly:** Weight, height/length and head circumference should be measured and plotted 2-weekly on a centile chart for <1 year old. Ensure the child's growth is monitored and charted on centile charts in the medical notes.
- **Monthly:** Anthropometry (Mid-arm circumference (MAC) and tricep skin fold (TSF)) as per advice from ward Dietitian or Paediatric Gastroenterologist on service

Section 3 – Troubleshooting

Refeeding syndrome

- During starvation there is a reduction in the cell mass and in the intracellular concentration of phosphate, potassium, magnesium and water. The extra cellular concentration is maintained by the normal homeostatic mechanisms.
- Upon refeeding, the glucose stimulates insulin production and this stimulates not only intracellular glucose uptake but also the intracellular uptake of phosphate, potassium, magnesium and water.
- These shifts of ions, and in particular rapid intracellular uptake of phosphate, are central to the re-feeding syndrome and may manifest themselves as hypocalcaemia, hypomagnesaemia and hypophosphataemia. The metabolic pathways for releasing energy from glucose, via glycolysis and the Krebs cycle, requires phosphate.
- If this is seriously depleted there may be an energy deficiency followed by cardiac dysfunction, respiratory failure and red cell dysfunction.



Refeeding Syndrome Prevention

Patients who are at risk of refeeding syndrome can be identified with one or more of the following:

- Patients who have had inadequate or no nutrition for 5 days or more
- Patients with a previous history of refeeding syndrome
- Patients who have experienced acute weight loss of 5-10% in the past 2 months
- Patients who have experienced malabsorption, severe vomiting and/or diarrhoea for 5 days or more
- Patients who have low levels of potassium, magnesium or phosphate prior to feeding
- Patients who are severely underweight. Please plot patient's current and historical weight, height/length/head circumference and BMI on a growth chart to identify this
- The case must be discussed with the Paediatric Gastroenterologist on Service.

Algorithm for paediatric patients on PN suspected to be at risk of refeeding syndrome.

Identify patient at risk of refeeding syndrome. Document this clearly in the medical notes and send an urgent referral to the Dietician and see the **relevant guideline**

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Collect biochemistry straight away: Na, K, Ca, Mg and PO4, glucose.

Correct any electrolyte abnormalities. Refer to BNFC for dosage correction

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Prescribe vitamins for 10 days. See following page

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Dietitian to recommend feeding plan Dietician to refer to dietetic guideline regarding commencing and increasing feeds. If out of hours i.e. outside of 9am-430pm on Monday-Friday or a weekend please refer to dietetic guideline Table 1 for those under the age of 1 year or Table 2 for those between the age of 1 – 18 years

If feeding via parenteral nutrition please refer to the PN guidelines

If the patient is under CAMHS for an eating disorder please consult with the dietician and lead consultant psychiatrist regarding how to initiate feeds.

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If **feeding orally with nutritional supplement support, or via an enteral feeding tube or intravenously** then an additional multivitamin and mineral does not need to be routinely prescribed. It is the dietician's role to check that the feed is nutritional adequate for that patient. If **feeding orally without oral nutritional supplements support e.g. Fortisip,** prescribe oral prophylactic vitamins

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Continue to check electrolytes (**Na, K, Mg, PO4,**) at least once a day for at least 14

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If electrolytes **drop below normal range** do not increase feeds until electrolytes are being supplemented appropriately in the PN. Only further increase

If electrolytes **drop but stay within normal range** correct electrolytes appropriately in PN. Increase nutrition as per standard plan.

If **electrolytes do not change** continue to monitor once a day and Increase nutrition as per standard plan.

This may occur several days after feeding has recommenced. Calcium and phosphate are both under the control of the parathyroid hormone and there is an inverse relationship between the two. Phosphate cannot be added to the PN without sodium or potassium additions being made due to the commercially available preparations of phosphate. Refer to the relevant IV monographs for dosing and administration information

Prophylactic vitamins

There is currently no published data on use and dosing of vitamin supplementation for the prevention of refeeding syndrome. The following data has been found after an extensive literature search and provides initial dosing of vitamin supplementation. All dosing should be adjusted according to measured vitamin levels a well as assessment for symptoms of excessive dosing – refer to dietician or pharmacist for further advice.

Day 0 – day of first planned feeding – IV supplementation

IV Pabrinex Infusion (Licensed for age but off label for indication)

<6 years	2.5ml	of each of Pabrinex 1 and 2 ampoule
6 - 10 years	3.5ml	of each of Pabrinex 1 and 2 ampoule
10 – 11	5ml	of each of Pabrinex 1 and 2 ampoule
12 - 14 years	6ml	of each of Pabrinex 1 and 2 ampoule
14 years and over	10ml	of each of Pabrinex 1 and 2 ampoule

See Pabrinex IV Monograph for administration details.

Each IV Pabrinex No. 1 ampoule (5ml)	Each IV Pabrinex No. 2 ampoule (5ml)
Thiamine 250mg	Ascorbic Acid 500mg
Riboflavin 4mg	Nicotinamide BP160mg
Pyridoxine 50mg	Anhydrous Glucose 1000mg

Days 1-10 – Oral Supplementation (0.5mg/kg/day thiamine - very limited absorption) use Pabrinex IV if no oral intake

1 month - 1 years	Vigranon Liquid 5ml TDS
2 - 12 years	Vigranon Liquid 10ml TDS
12 years and over	Vigranon Liquid 15ml TDS

Or

Thiamine 100mg TDS And Vitamin B Co Strong 1-2 tabs TDS

Vigranon Liquid contains in 5ml

Thiamine 5mg	Nicotinamide 20mg	Panthenol 3mg
Riboflavin 2mg	Pyridoxine 2mg	

Metabolic complications

- Staff should be aware of symptoms occurring as a result of metabolic imbalances in order for appropriate intervention to be conducted as soon as possible.
- Weight monitoring is also done but can be deceptive.

- Dramatic weight gain can only be attributed to unwanted accumulation of fluid, signifying a need to reassess the rate and volume of infusions. The patient may require medical assessment and diuretic therapy. Vital signs should be observed and any pyrexia, tachycardia or dyspnoea should be reported as this may indicate infection, embolism or metabolic complications.

Complications	Symptoms
Hypoglycaemia	Sweaty, clammy, disorientated, drowsy, tremor, palpitations, visual disturbances, blood sugar < 2.6mmol, loss of consciousness
Hyperglycaemia	Polyuria, dehydration
Glucose intolerance - This is usually manifested as hyperglycaemia but also hypertriglyceridaemia. Insulin may be required in these patients. Refer to the Endocrinologist.	
Hypophosphataemia	Neuromuscular changes, tremor, ataxia, slurred speech, irritability, apprehension, stupor, coma
Hypocalcaemia	Tetany, neuromuscular irritability manifested by parasthesia around the mouth and extremities, muscle spasms, cramps and hyperflexion
Hypernatraemia	Dry, sticky mucous membranes, oliguria, agitation, loss of skin tone
Hyponatremia	Mental confusion, muscle twitching, seizures
Hypomagnesaemia	Impairs calcium and potassium metabolism. Signs of tetany, tremor, muscle twitching, nystagmus, convulsions, coma
Hyperkalaemia	Muscle weakness, colic, diarrhoea, arrhythmias
Hypokalaemia	Muscle weakness, reflexes decreased, arrhythmias, apnoea, respiratory arrest
Refer to part 3 of the guideline for advice on electrolyte adjustments	
Hepatobiliary dysfunction	Deranged liver function tests, jaundice, nausea, drowsiness, short attention span, pruritis, raised ALP
Nitrogen imbalance	Low protein stores eventually lead to muscle wasting, exhaustion, poor cardiorespiratory function, poor concentration, oedema, depression
Metabolic acidosis	Low bicarbonate concentration in blood. Deep rapid respirations, shortness of breath, weakness, disorientation

Hypoglycaemia

Hypoglycaemia occurs when blood sugar levels fall below 2.6mmol/L.

Need to identify the cause of hypoglycaemia and correct it. E.g. there has been a disconnection of the line containing glucose or a delay in feeding.

Intravenous 10% glucose should be provided as per hospital protocol and blood sugar level re-measured to establish effectiveness of intervention. Patient may need continuous IV fluids containing glucose.

Hyperglycaemia

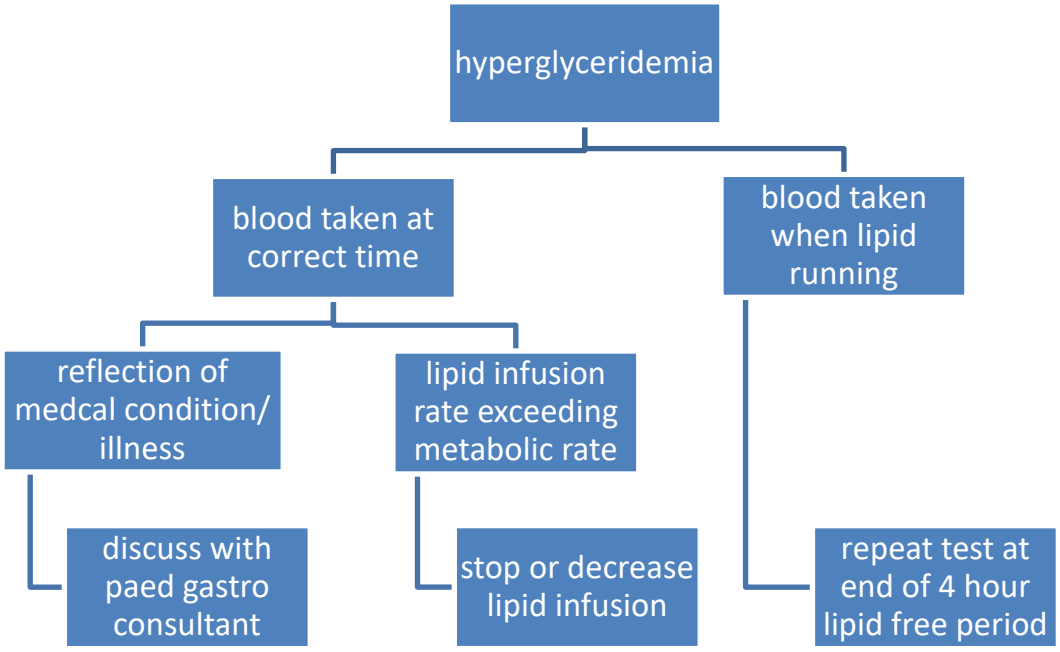
Hyperglycaemia is when blood sugar level is above 8.0mmol/L. Patients who are at high risk of developing hyperglycaemia include: post-surgery, sepsis, neonates <1000g and those patients on steroids.

Immediate management of hyperglycaemia may be to reduce the rate of glucose infusion. Note that reducing PN rate (to reduce glucose delivery) will also reduce delivery of other components in the PN (see weaning PN, next section) and should not be done without involvement of a consultant.

Hypertriglyceridemia

High triglyceride levels might indicate infusion rate being more rapid than hydrolysis rate

Apart from lipid overload syndrome, there is no solid evidence to be reducing parenteral lipid in any medical conditions – see chart below



Metabolic acidosis

Acidosis can be caused by excess chloride salts in the PN, greater than 3mmol/kg/day

Replace up to 6mmol/kg/day of chloride with acetate; Use sodium bicarbonate to urgently correct acidosis – discuss with PICU team if the sodium is high, use Tris-Hydroxymethyl Aminomethane (THAM).

Both the fat and protein may need to be restricted. Infused lipid is cleared by endothelial lipoprotein lipase which *in vitro* ceases to function at a pH < 7.23, so theoretically there is an increased risk hyper triglyceridaemia in acidotic babies.

Cholestasis

This is a common complication of long term parenteral feeding and is often associated with sepsis and poor gall bladder contractility due to lack of enteral nutrition.

Cyclical PN and trophic feeding may reduce the risk of this complication.

Minimal enteral or trophic feeding of 1-10ml/hr (dependent on age of child) is recommended to maintain intestinal mucosa integrity, reduce bacterial translocation and prevent biliary cholestasis.

Cyclical PN involves the total PN being infused faster than over 24 hours with a target of 12-16 hours overnight

Ursodeoxycholic acid should be considered for cholestasis as per BNFC if despite PN cycling; there is a continued increase in transaminases, alkaline phosphatase and bilirubin

In acute sepsis, significant acidosis, liver derangement
(including bilirubin >200micromol/litre) or platelet disorders

Reduce the lipid in the PN or reduce the rate of lipid until the new bag of lipid is made and delivered

Longer term options include reducing the overall fat per day or omit the fat at the weekend.

For young children if the triglyceride > 3mmol (<9.9kg) the fat may be restricted but not stopped as essential fatty acids are still needed. Usually in practice some fat is given and babies are treated with phototherapy for raised bilirubin.

For older children a triglyceride of 3.9-4.5mmol/litre (>9.9kg) would indicate that the lipid should be restricted. The fat is usually reduced by 0.5-1g/kg/day. A minimum of 0.5g/kg/day must be given.

If fat is reduced the protein should also be reduced to ensure the nitrogen g: non nitrogen energy ratio is 1:200. Do not assume all raised liver enzymes are due to the fat content in the PN. There are other causes which need to be ruled out. Please refer to the consultant; the patient can also be referred to the PN team.

Line infection Prophylaxis inc Taurolock

Use of Taurolock has been shown to reduce the rate of line infection in long term PN patients.

Taurolock should be locked in the line whilst not in use then withdrawn prior to PN administration in the following order

Instill TauroLock™ slowly (not more than 1 mL per second, infants and children less than two years of age not more than 1 mL per 5 seconds) into the access device in a quantity sufficient to fill the lumen completely. Consult the manufacturer's instructions for the specific fill volume or specify fill volume during implantation. The volume has to be strictly respected. TauroLock™ will remain inside the access device until the next treatment (up to a maximum of 30 days).

Prior to the next treatment, TauroLock™ must be aspirated (for further information see section A note 2) and discarded in accordance with the institution's waste policy

If aspiration of TauroLock™ is not needed or not possible, e.g. in parenteral nutrition, slow flushing of TauroLock™ (not more than 1 mL per 3 seconds) prior to the next treatment does not cause any systemic effect due to its active ingredients (note; not applicable to infants and children less than two years of age due to insufficient clinical experience).

- Stop PN; Flush line with sodium chloride 0.9%, lock with 3-4ml taurolock; Leave
- Withdraw taurolock and discard; flush with sodium chloride 0.9%; start next PN bag

If the Taurolock cannot be aspirated from the line it may be flushed very slowly using sodium chloride 0.9% 5ml. Taurolock may remain in the line for up to 30 days before replacement

Although Taurolock has some anticoagulant properties, patients at high risk of thrombosis in the line can use a heparin containing Taurolock preparation (100unit or 500unit per ml). Discuss with the paediatric Gastroenterology team. Supplies of all taurolock preparations are available from pharmacy.

Refer to Line sepsis guideline for more information

Line infection treatment inc line locks

Line infection can present as a full spectrum of “under the weather” to full sepsis

Refer to the CH Guideline for details on management Sepsis UHL Childrens Hospital Guideline

Line locks may be recommended by Consultant Microbiologist for gram positive line infections – instil appropriate volume as shown below into each lumen to fill the entirety of each line. Use sodium chloride 0.9% as diluent and then aspirate after 24hours; Levels are not necessary

Line type	PICC Line	Tunnelled line	Port-a-cath
Gentamicin (1.5mg/ml)	1.5mg (1ml)	4.5mg (3ml)	6mg (4ml)
Vancomycin (10mg/ml	10mg (1ml)	30mg (3ml)	40mg (4ml)

- Vancomycin for Gram positive organisms
- Gentamicin for Gram negative organisms

Chylothorax

This is a collection of a white milky drainage from the lymphatic system within the thoracic cavity that can impair respiratory status as it accumulates.

Discuss case with paediatric dietician – consider fat free enteral feeding or Medium Chain Triglyceride feeds; PN may be considered if low fat feeds are unsuccessful

Click on link for chylothorax management: Chylothorax Post Cardiac Surgery UHL Paediatric Intensive Care Guideline

Management of this uncommon complication can include administration of: PN, low fat enteral nutrition, thoracentesis to remove the chylous fluid, and surgical ligation of the thoracic duct, as well as octreotide infusion to control splanchnic blood flow.

Generally as a rule one gives relatively fat free enteral feeding, or very low long-chain triglyceride high medium chain triglyceride (MCT) enteral feeding. MCT (6-12 carbons in length) are absorbed directly into the portal system and do not enter the lymphatic system. Hence PN does not need to be MCT PN, as the fat in PN is delivered directly into the bloodstream so never enters the lymphatic system therefore, has no effect on the thoracic duct flow. Although TPN allows complete gut rest and may be necessary, (especially in the unstable patient,) it is preferable to try low fat or non-fat enteral feeding first.

Failure to thrive whilst on PN

Check: -

- PN prescription meets estimated energy requirements.
- Patient is receiving all of prescribed fluid volume (nursing records).
- PN prescription is correct for patient's current weight and fluid volume prescribed is appropriate.
- Urinary Na >20 mmol/L

Discuss with paediatric gastroenterology and dietetic team who will review at least weekly when the child is an inpatient

Section 4 - Administration Issues

Unavailability of PN

In cases where the PN has not been received, check:

- That an order has been requested and sent
- With other areas known to have PN e.g. ward 27, 10, 14, CICU and 12. Other areas rarely have PN
- With the on-call Pharmacist, relaying actions already taken.

As pharmacy does not provide PN after 5pm Monday to Friday, the PN will be ordered the following morning. If it is a weekend the pharmacy department should be contacted on Saturday between 9 and 12 noon, or Sunday 10-12 noon so they can arrange a starter regimen.

If there is no PN available, it has been damaged in transit or is otherwise unsuitable for use out of hours.

- Replace the PN with suitable maintenance fluid for up to 24 hours.
- The random blood glucose should be. If the blood glucose is stable the frequency of monitoring can be reduced and then stopped.

Increased fluid requirements

An increase in fluid requirement and/or aspiration replacement can be accommodated by "piggy backing" extra fluid (glucose 5% or 10%, sodium chloride 0.9%) in addition to the PN. Do not increase the PN rate. If other fluids, e.g. potassium containing fluids,

Plasmalyte are required contact the Pharmacy department. Avoid breaking into the line, instead adding an “Octopus” at the next bag change

Pump Failure

On the first episode, replace the pump and retain the bag/giving set. Send bag, pump and giving set to Medical Physics for testing

Don’t let the pump be used for more bags if there is an issue

Sending the bag allows them to test the exact kit in another device

Ward to complete a datix, allocated to medical physics (not pharmacy) including the pump bar code/serial numbers, last run rates and how early the bag ran out. Initials of staff who prepared bag to enable follow up to confirm the technique used

All the data suggests that this is not a manufacturing issue so by allocating to med phys ensures that it gets flagged to the relevant team ASAP

In the future the pump will download the last run rates but for now please add them as the team can then test the pump again the rates that appear to have gone wrong

The training team will be notified too and can have a chat with the nurses in charge to see how the team are and understand anything that may have affected the administration

Line Failure

If there is concern about the line, switch off the both bags and flush the line with 0.9% sodium chloride. A blind end hub should be applied to the end of the line using a non-touch technique.

When the PN line is dysfunctional run intravenous 10% glucose and take random blood glucose levels. Abrupt weaning leads to problems therefore monitor blood glucose. If the blood glucose is stable then reduce the frequency of monitoring.

Medication incompatibilities

Flush PN with sodium chloride 0.9% before administering any other medicate via that line

Co-administering medications with PN is not recommended.

Ideally a line for parenteral nutrition should not be used for drawing of bloods or infusion of other products, e.g. blood, unless necessary for patient or care needs.

Consult pharmacists prior to administration of medications with PN to check compatibility.

Section 5 - Weaning of PN

- The PN should never be stopped abruptly except for important clinical reasons (e.g. line infection).
- **DO NOT SIMPLY DECREASE OR INCREASE INFUSION RATES** as this might inadvertently change the balance of nutrients delivered to the patient.
- **Weaning of all PN must be discussed with** ward pharmacist, Dietitian or Paediatric Gastroenterologist on service **to ensure all issues are taken into account e.g. fluid restriction.**
- **Weaning of patients on long term or home PN must only be undertaken by the Paediatric Gastroenterologist on service with the Dietitian and pharmacist**

See Appendix 1 for a master weaning chart

See Appendix 2 on how to calculate reduced rates

Preterm and term infants

- Enteral nutrition should commence by two hourly bolus feeds or continuous infusion when weaning from PN.
- The PN should be scaled down according to volume of enteral nutrition tolerated i.e. *ml for ml* and to continue to run as a 24 hour protein/glucose solution and 24 hour lipid solution. (Appendix 2); In exceptional cases the reduction should be calorie for calorie instead. Discuss with the dietician
- Divide any reduction in PN proportionally between both the protein/glucose component and the fat component of PN. Never reduce just one phase.
- PN can stop once 75% enteral requirements are tolerated.
- For neonates PN is stopped when the baby is on 120ml/kg/day of enteral feeds.
- During weaning of PN it should be indicated on the prescribing sheet that patient is being weaned off the PN.
- Some of the prepared PN may be unused each day. The remaining PN must be discarded.
- Once weaning has commenced the PN can be run for up to 48 hours instead of 24 hours provided filters do not need changing.

Children

- The decision to discontinue PN should be made only when there is documented evidence by the Dietician that complete nutritional intake and absorption by the enteral route is possible, and when it is clear that no further imminent surgery, investigations or other stressful therapy is contemplated

- The PN should be weaned with the help from the Paediatric Pharmacist and Dietitian. The Paediatric Pharmacist will complete a sheet to advice you on how to wean PN.
- Appetite is often reduced during parenteral nutrition. Initially therefore PN should be administered overnight if possible to allow the child/infant to participate at meal times during the day.
- If the child/infant is not capable of eating, enteral tube feeding should commence.
- Oral or enteral tube intake should be accurately measured and the energy and protein intake of the PN scaled down accordingly as advised by the Dietitian.
- During this period the PN should continue at the full strength, the volume being gradually reduced as appropriate.
- Once the child is managing approximately 75% of nutritional requirements by enteral/oral feeding the PN should be discontinued. There will thus be an overlap between PN and enteral/oral feeding.

6. Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Monitoring of Central Line Infection on all Children on PN 100%	Line infections highlighted by UHL reporting system	Medical & Pharmacy Teams	Monthly/Quarterly	Local Quality & Safety Board
Procedure used by all staff administering PN to children (under 16yrs)	Peer review by LCAT assessment	Ward Sisters	Monthly/Quarterly	Senior Nurses Board

7. Education and Training

Any staff (including agency staff) who have not undertaken specific medication administration training and competence assessment, must receive local training before being involved in the administration of central line medication to patients under 16 years of age. (LMC 5th edition)

Medical Staff Introduction of the ordering and review of PN at induction; Specialist training regarding use and content within day to day ward teaching

Nursing Staff All staff who undertake administration of PN must:

a) Have been assessed as competent to administer medications to children via a central venous access device. This is achieved by attending a children's IV study day and completing the 'Administration of Central Intravenous Medications to Infants and Children' competency assessment.

b) Have attended a Children's Central Line/PN theory study day or equivalent local training and completed the 'Administering Parenteral Nutrition to Infants and Children' competency assessment

c) Competency for blood sampling from a central line can be achieved by attending Children's Central Line/PN theory study day or equivalent local training and completing 'blood sampling via central venous access device' competency assessment

Staff who are new to the Trust who have been trained and assessed elsewhere:

a) Provide evidence accepted by their Line Manager of the training and assessment of competence. If the member of staff is unable to provide suitable evidence they may be required to undertake UHL training. This must be discussed with the Line Manager and Children's Education Team
b) Staff member must read relevant Trust policies and undertake additional local training relating to equipment and documentation as required
c) Undertake a one off LCAT assessment of competency within own ward/department

Pharmacy Staff Successful completion of Assessment of Competency in ordering Neonatal and Paediatric PN

8. Supporting References

Afzal et al 2002 Refeeding syndrome with enteral nutrition in children: a case report, literature review and clinical guidelines *Clinical Nutrition* **21(6):** 515-20

Agostoni et al 2010 Enteral Nutrient Supply for Preterm Infants: Commentary from the European Society of Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. *Journal of Paediatric Gastroenterology and Nutrition (JPGN)* **50(1):** 85-91.
Boateng et al 2010 refeeding syndrome: treatment considerations based on collective analysis of literature case reports. *Nutrition***26 (2):** 156-67

Boullata et al 2014 ASPEN clinical guidelines: parenteral nutrition ordering, order review,compounding, labelling and dispensing *Journal of Parenteral Nutrition (JPEN*) **38(3):** 334-77

Crook et al 2001 The importance of the Refeeding Syndrome *Nutrition***17 (7-8):**632-7

Fusch et al 2009 Neonatology/Paediatric: guidelines on parenteral nutrition Chapter 13 *German Medical Science***Nov 18, vol 7**: Doc 15

Koletzkoet al 2005 Guidelines on Paediatric Parenteral Nutrition of the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) , Supported by the European Society of Paediatric Research (ESPR).*Journal of Paediatric Gastroenterology and Nutrition (JPGN)* **41:** S1- S87

Lapillonne et al 2013 Quality of newborn care: adherence to guidelines for parenteral nutrition in preterm infants in four European countries *BMJ open***3**: e003478

RCPSYCH 2015 Junior MARSIPAN: Management of really sick patients under 18 with anorexia nervosa. **CR 168**

Sydney Children's Hospital 2013 Refeeding syndrome: prevention and management

Kathrin Krohn, Olivier Goulet, R. Shamir Paediatric Parenteral Nutrition: A Practical Reference Guide. Karger Medical and Scientific Publishers, 2008

Tsang 2005 Nutrition of the preterm infant: scientific basis and practical guidelines. Digital Educational Publishing Inc.

Department of Health (2009) Reference guide to consent for examination or treatment

Department of Health (2007) Saving lives: reducing infection, delivering clean and safe care using High Impact Interventions (HII): HII no 1 Central Venous Catheter Care Bundle

Lewis J (1993) Justification for Use of 1.2.Micron End- Line Filters On Total Nutrient Admixtures, Hospital Pharmacy 28 (7) 656-658

Loveday, H.P, Wilson, J.A. Pratt, R.J. Golsorkhi, M. Tingle, A. Bak, A. Browne, J. Prieto, J. Wilcox, M. (2014) epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England ***Journal of Hospital Infection 86S1 (2014) S1–S70***

Nursing and Midwifery Council (2008) Standards for Medicines Management

Royal College of Nursing (2010) *Standards for Infusion Therapy.* London: RCN. tinyurl.com/ infusion therapy

Rowley S (2001) Aseptic non-touch technique. *Nursing Times;* 97: 7, 6-8.

Rowly S, Clare S (2009) Improving standards of aseptic practice through an ANTT trust-wide implementation process: a matter of prioritisation and care. *British Journal of Infection Prevention;* 10: 1, S18-S23.

Leicestershire Medicines Code Trust Ref: B60/2011
LNR Cytotoxic Policy Trust Ref: E13/2016
Midwives Policy Trust Ref: B13/2009

UHL Assessment and Administration of Medicines by Nurses and
UHL Children's IV Monographs (available via INsite)
UHL Control of Substances Hazardous to Health (COSHH) Policy Trust Ref: B10/2002
UHL Health and Safety Policy Trust Ref: A17/2002

UHL Infection Prevention & Control Policy Trust Ref: B4/2005

UHL IV Policy Preparation and Administration of Intravenous Medications and Fluids to Adults, Babies, Children and Young People Trust Ref: B25/2010
UHL Patient ID Band Policy Trust Ref: B43/2007
UHL Personal Protective Equipment Policy (PPE) Trust Ref: B9/2004
UHL Policy for Consent to Examination or Treatment Trust Ref: A16/2002

9. Key Words

Parental Nutrition, Central Lines, Medication, Infusions, Aseptic Non-Touch Technique, Babies, Children, Young People, Children's Nurses, Refeeding syndrome, Taurolock

The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.
As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

CONTACT AND REVIEW DETAILS	
Guideline Lead (Name and Title) David Harris – Principal Pharmacist Hemant Bhavsar - Consultant Anne Willmott - Consultant Rebecca Zseli – Children's Gastroenterology Specialist Nurse	**Executive Lead Chief Medical Officer**
Details of Changes made during review: **None** **Format changes only**	

Appendix 1 – Information Sheet for Weaning TPN

INFORMATION SHEET FOR WEANING TPN

Rates to be prescribed on the drug chart for each 24 hour period

Patients name:			Ward:
Unit number:			Weight:
DOB			Fluid requirements ml/kg/day:
Date /Time	Aqueous: Rate ml/hour Over ---- hours Ratio:	Lipid: Rate ml/hour Over ----- hours Ratio:	Rate ml/hour Over ---- hours

TPN bag to run over:----------Hours

Calculated by (Pharmacist)

Name: ---------- Signed: ---------- Date: ---------

Checked by (Pharmacist)

Name: ---------- Signed: ---------- Date: ----------

Appendix 2 - How to calculate reduced infusion rates of paediatric TPN

1. Calculate the proportions of Aqueous & Lipid in the TPN if infused at full rates.

a. Aqueous proportion = total volume of Aqueous to be infused over 24 hours = Total volume of TPN (Aqueous + lipid)
……..

b. Lipid proportion = total volume of lipid to be infused over 24 hours = Total volume of TPN (Aqueous + lipid)
……..

N.B. The Aqueous and lipid proportions (ratios) should add up to 1

If you have already checked the current fluids that are running add up to the total daily requirement on your shift, follow method A. If you have not, follow method B.

Method A

Decide how many mls per hour of TPN you need to "lose". E.g. If the oral feeds have just been increased by 2ml per hour, you will need to "lose" 2ml/hour of TPN.

Reduce the Aqueous rate by: …mls/hour TPN to "lose" x Aqueous proportion**(a)**…. = ….mls/hr

Reduce the lipid rate by: ……mls/hour TPN to "lose" x lipid proportion **(b)**……=…….mls/hr

Method B

Calculate the amount of fluid to be provided by the TPN:

i. Calculate the total amount of fluid that the child is to receive in 24 hours (weight x ml/kg/day) =……..mls/day

ii. Calculate the total amount of fluid the child is receiving in 24 hours from feeds, other infusions etc. …….mls/day

iii. Subtract **(ii)** from **(i)** to give the volume of fluid that needs to be provided by TPN. **(iii)** =……..mls/day

Then calculate the rates of Aqueous & lipid per hour:

- Volume of Aqueous = Volume of TPN required per day **(iii)** x Aqueous proportion **(a)** (over 24 hours)
  Divide volume of Aqueous by 24 to give volume per hour **Aqueous rate**
  =……mls/hr

- Volume of lipid = Volume of TPN required per day **(iii)** x lipid proportion **(b)** (over 24 hours)
  Divide volume of lipid by 24 to give volume per hour **lipid rate**
  =……mls/hr

Regardless of whether method A or B was used, once you have decided on your new rates of infusion, add up all the fluids that will be running and ensure the total volume is equivalent to the volume intended for your patient for that day in mls/kg/day.

Calculated by **Name: ---------- Signed: ---------- Date: ----------**

Checked by Name: ---------- Signed: ---------- Date: ----------