PARENTERAL NUTRITION CARE OF THE CHILD GUIDELINE	
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CONTENTS

1.0 Introduction

Our Lady's Children's Hospital Crumlin promotes the safe and accurate administration of medication to all children. The purpose of this guideline is to provide guidance to nursing staff in relation to the administration of parenteral nutrition (PN). Therefore, like all other medications, PN management requires nurses to incorporate the assessment, planning, implementation and evaluation of the nursing process in providing care (NMBI 2015), while working within the Code of Professional Conduct and Scope of Practice (NMBI 2014, 2015).

2.0 Definition

PN is a solution containing amino acids (protein), lipids (fat), glucose (carbohydrate), electrolytes, vitamins, minerals, trace elements and water (ESPGHAN 2005). It is administered intravenously and indicated when malnutrition or growth failure cannot be prevented or reversed by enteral nutrition (Puntis 2001). The limited energy reserves and the growth and development needs of infants and children place them at particular risk from the effects of under-nutrition (Puntis 2001); hence there is a more extensive list of indication for the use than that of adults.

3.0 Indications of PN use

(Puntis 2001) (ESPGHAN2005)

PN is used when it is not possible to meet the nutritional requirements via the oral or enteral route, often due to intestinal immaturity or intestinal failure.

The decision to commence PN, will depend on the infant or child's individual circumstances and their age and size. Children differ from adults in that their nutritional intake must be sufficient not only for maintenance of body tissue but also for growth. *(ESPGHAN 2005) (NCPPN 2016)* This particularly true in infancy and during adolescence when children grow extremely rapidly (ESPGHAN 2005). Older children and adolescents, however, can tolerate longer periods of inadequate nutrition than preterms, where starvation for even one day can be detrimental *(ESPGHAN 2005) (NCPPN 2016)* Preterm infants are initially dependent on receiving their nutrition parenterally due to the immaturity of their gastrointestinal tract.PN should be discontinued when an adequate intake from oral or enteral feeding is tolerated*. (NCPPN 2016)*

(This is not an exhaustive list; each child will be continually assessed depending on their individual clinical needs)

<table>
<tr><th colspan="2">NEWBORN</th><th colspan="2">OLDER INFANTS & CHILDREN</th></tr>
<tr><td rowspan="3">Intestinal failure</td><td>Functional immaturity</td><td rowspan="4">Intestinal Failure</td><td>Postoperative gastrointestinal surgery</td></tr>
<tr><td>Short bowel</td><td>Short bowel</td></tr>
<tr><td rowspan="2">Necrotising enterocolitis</td><td>Protracted diarrhoea</td></tr>
<tr><td>Chronic intestinal pseudoobstruction</td></tr>
<tr><td colspan="2">Prevent growth failure in preterm infants < 32 weeks gestation</td><td>Intensive care / multi organ failure</td><td>Hypercatabolism e.g. extensive burns, severe trauma</td></tr>
<tr><td colspan="2" rowspan="2">Prevention of necrotising enterocolitis</td><td rowspan="2">Exclusion of luminal nutrients</td><td>Crohn's disease</td></tr>
<tr><td>Pancreatitis</td></tr>
</table>

4.0 Complications associated with the administration of PN: *(Pennington 2000) (ESPGHAN 2005)*

Nutritional and Metabolic	Catheter Related	Effect on other organ systems
Hyperglycaemia	Infection	Hepatic disease
Hypophosphataemia	Occlusion	Biliary tract disease
Electrolyte imbalance	Central venous thrombosis	Bone disease
Refeeding syndrome	Fracture	
Micronutrient deficiencies		

5.0 Prevention of catheter-related infection:

Infusion sets must be primed using an aseptic non touch technique.

An aseptic technique must be used when accessing the catheter, disinfect hub with alcohol-containing chlorhexidine wipes to reduce contamination.

If the PN bag is disconnected from the CVAD or peripheral line it must be discarded. PN should not be reconnected to the same or other sites. Infection should be suspected in any child with a central venous catheter that develops a pyrexia (greater than 38.5 degrees C, or 2 episodes of temperature between 38 – 38.5 degrees C) Metabolic acidosis, thrombocytopenia or glucose instability. *(ESPGHAN 2005)*

PN should be stopped and central cultures obtained at the same time as peripheral cultures. Antibiotics are started as per child's clinical background and clinician directed.

Removal of CVAD is indicated in all patients with positive fungal cultures, multi resistant bacteria, patients with signs of septic shock or patients not responding to appropriate antibiotic use after 48-72 hours (Chesshyre et al 2015)

6.0 Constituents of Parenteral Nutrition

PN solutions are available in several different forms

Amino Acids (Protein / Nitrogen)

Proteins are the major structural and functional components of all cells in the body and are made up of chains of amino acids (AAs). Children need amino acids in their PN solution to repair tissue and to grow.

- Certain amino acids are not fully metabolised by neonates, for this reason it is important to use an amino acid solution that is primarily designed for children.

Certain amino acids are essential for neonates, therefore:

- for children less then 10kg, an amino acid solution should be used which contains a profile of amino acids based on that of breast milk

- for children over 10kg, an appropriate amino acid solution for older infants and children should be used

It is important that amino acids are used for anabolism and not as a source of energy. 25-32 non-protein calories per gram of amino acid should be used to allow for efficient net use of the amino acids in protein building

Each gram of amino acid contains approximately 4kcals.

Carbohydrate (Glucose)
Carbohydrate is the main source of energy in PN. Glucose is the preferred intravenous carbohydrate source as it can be utilised by all cells and serves as metabolic fuel for muscle, liver, heart and kidneys as well as the brain, renal medulla and erythrocytes which need glucose as their energy source.

Carbohydrate should contribute a higher proportion of the non-protein calories than fat. It is recommended that 60-75% of non-protein calories come from carbohydrate in patients on maintenance PN.

Each gram of carbohydrate contains approximately 4kcals.

Lipid
Lipid emulsions are used in neonatal and paediatric PN as a non-carbohydrate source of energy and to provide a source of essential fatty acids.

Approximately 25-40% of non-protein calories are recommended to come from lipid in patients receiving PN as a sole source of nutrition.

Lipid emulsions currently available in Ireland include Intralipid 20% and SMOFlipid®.

The lipid solution of choice is SMOF lipid®, as it thought to reduce the incidence of parenteral nutrition associated liver disease (Attard *et al.*, 2012). SMOFlipid® contains fish oils (n-3 fatty acids), which may have anti-inflammatory properties, and reduce risk of hypertriglyceridaemia and cholestasis.

In an intravenous lipid solution, each gram of fat contains 10kcals (Intralipid 20%, SMOFlipid®)**.**

Fluid (Water)
Water is an essential carrier for nutrients and metabolites and it comprises a major part of human body mass at any age. Total fluid requirements include maintenance requirements, and requirements for growth.
Water and electrolyte requirements per unit body mass are very high after birth and decrease with age until adulthood.

Acetate
Chloride in PN can be partly replaced by acetate to reduce metabolic acidosis and/or hyperchloraemia (Peters *et al*., 1997).

Electrolytes
Electrolytes can be added to PN as required by the patient.

The main electrolytes added are:

Sodium	Potassium	Magnesium
Calcium	Phosphate	

Trace Elements

There are two solutions currently used to add trace elements to PN – Peditrace® and Additrace®.
Peditrace® is used to meet basal requirements for trace elements in children up to 40kg and contains:

Trace element	Peditrace® composition per mL
Copper	20 microgram (0.315µmol)
Manganese	1 microgram (18.2µmol)
Iodine	1 microgram (7.88 µmol)
Fluoride	57 microgram (3 µmol)
Selenium	2 microgram (25.3 µmol)
Zinc	250 microgram (3.82 µmol)

For children up to 15kg it is prescribed at 1ml/kg.
For children 15-40kg 15ml is prescribed.

Additrace® is currently used for children over 40kg at a dose of 10ml, and contains:

Trace element	Additrace® composition per 10mL vial
Copper	-(20µmol)
Manganese	-(5µmol)
Iodide	-(1µmol)
Fluoride	-(50µmol)
Selenium	-(0.4µmol)
Zinc	-(100µmol)
Iron	-(20µmol)
Chromium	-(0.2µmol)
Molybdenum	-(0.2µmol)

Vitamins

Both water soluble and fat soluble vitamins are added to PN.

Water soluble vitamins are vitamins B and C, and fat soluble vitamins are vitamins A, D, E and K.

Solivito N® is used to cover the daily requirements of water soluble vitamins, and is prescribed at 1ml/kg up to a maximum of 10ml per day.

Solivito N® can be added to the aqueous or lipid phase of the PN.

Vitamin Solivito N®	Composition per ml
Thiamine (B1)	0.25mg
Riboflavin (B2)	0.36mg
Niacin (B3)	4mg
Pantothenic Acid (B5)	1.5mg
Pyridoxine (B6)	0.4mg
Biotin (B7)	6microgram
Folic Acid	40microgram
Cobalamin (B12)	0.5microgram

Vitlipid N® infant is used to cover the daily requirements of fat soluble vitamins in children up to the age of 11 years, at a dose of 1ml/kg to a maximum of 10ml daily.

Vitlipid N® Adult is used in children over the age of 11 years at a dose of 10ml.

Vitlipid N® is added to the lipid phase of the PN.

- Vitamin Vitlipid infant (per ml)
- Vitlipid Adult (per ml)
- Vitamin A (Retinol)
- Vitamin D (Ergocalciferol)
- Vitamin E (Alpha tocopherol)
- Vitamin K (Phytomendione)

Vitamin	VitlipidN® Infant (per ml)	VitlipidN® Adult (per 10ml)
Vitamin A (Retinol)	69µg (230IU)	990µg (3300IU)
Vitamin D (Ergocalciferol)	1µg (40IU)	5µg (200IU)
Vitamin E (α tocopherol)	0.64mg (0.7IU)	9.1mg (10IU)
Vitamin K (Phytomendione)	20µg	150µg

Routes of administration of PN: According to ESPEN (2009), PN is ideally administered via a CVAD; however, a peripheral cannula may be used in some circumstances. ESPEN (2009) advocate that for hospitalised patients, PN can be delivered 'short term' (less than 2weeks) or in some instances long term (more than 2 weeks) or when there are limitations in osmolalarity and glucose concentration (less than 12.5%) of PN through non tunneled central venous access devices (CVAD's), peripherally inserted catheters (PICC) or peripheral cannulas.

It is recommended that a CVAD is used for PN in Neonates ESPGHAN (2005)

Central venous access devices: are used with glucose concentrations of above 12.5% or an Amino Acid concentration of 3.5g per kg ESPGHAN (2005) as this solution is hypertonic and acidic. This can cause phlebitis and lead to extravasation if administered via a peripheral cannula (Puntis 2001). An appropriate CVAD will ensure the successful provision of short or long term PN (Hamilton 2000).

Central Catheters must be inserted under strict aseptic conditions and proper care of the site and all connections and tubing is essential to reduce the risk of infection.

Peripherally sited cannula: can be used but with extreme care therefore site should be checked every 30 minutes during infusion and condition of site documented, to minimise the risk of extravasation (Trigg & Mohammed 2010). Furthermore, a low calorie content and a glucose concentration of less than 12.5% is required to minimise the risk of peripheral vein thrombophlebitis (Burnett 2000). Peripheral cannula should only be used for the administration of PN in consultation with the CNS in Nutrition Support and / or the prescribing medical/surgical team and the following are points that should be considered, when the:

- Patient is waiting insertion of a CVAD
- Patient is receiving antibiotic therapy for a CVAD infection
- Duration of PN is to be short term (Less than 2 weeks)
- PN solutions is of low osmolarity (not exceeding 850 mOsm/L) (ESPEN 2009)

7.0 How is PN dispensed?

Patient specific PN

Patient specific PN is usually dispensed for administration to in-patients in OLCHC in two separate bags:

- Bag 1: PN 2 in 1 (contains amino acids and carbohydrates Aqueous Phase) and
- Bag 2: Lipids (contains lipids Lipid Phase) and tailored to the specific nutritional requirements of patients.

Standard PN bags

The standard bag used is based on the weight of the patient and the volume they have available for PN.

> 10kg - off the shelf combination bag containing amino acid, glucose and lipid
< 10kg - standard bag with no lipids just a clear yellow amino and glucose bag

Home Parenteral Nutrition Patients receive a patient specific 3 in 1 bag ordered by the Nutrition support team only (see section 13 for procedure for using home bags if a home patient is admitted into hospital)

8.0 Infection Control

The high glucose constituent of PN poses a higher risk of infection (Clynes & O'Connor 2010, ESPEN 2009, Trigg & Mohammed 2010) and so, strict Aseptic Non-touch technique (ANTT) Level 2 must be used when priming, connecting, and disconnecting PN whether PN is infusing via a peripheral cannula or Central Venous Access Device (CVAD) (OLCHC 2013a). This is achieved by preventing direct contact to open parts of the PN equipment and the hub of the CVAD / cannula, thereby preventing contamination. Further precautions should be adhered to in order to reduce the incidence of infection, these include:

- Preparing in the treatment room or a room set aside for this purpose with access restricted to the nurses preparing the PN solutions. This also provides ease of access to required resources.
- A two person technique must be employed (Clynes & O'Connor 2010).
- Doors and windows must be closed and bins should not be opened in the preparation room.
- Turn off fans, to prevent dust particles and airborne micro-organisms from entering the atmosphere.
- Administration sets and filters used with PN and Lipid solutions must be changed every 24 hours (also refer to product instructions) (NICE 2003, ESPGHAN 2005, Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014).
- Single lumen (from CVAD) should be reserved for PN access, where possible *(ESPGHAN 2005, Pratt et al 2007, ESPEN 2009, Clynes & O'Connor 2010)*

Precautions: Do not add any medications or solutions to the PN/Lipid solution.

Mixing of medication with PN administration lines should be avoided unless validated by the manufacturer.

This prevents precipitation and maintains stability of the solution, as parenteral nutrition is incompatible with numerous medications, *Dougherty & Lister (2015)*

The line used for PN should not be interrupted for giving of antibiotics or medications. A separate I.V line should be used *ASPEN 2004, ESPGHAN 2005.*

If co infusion is unavoidable through the PN line, medication stability and compatibility with the PN must be established and verified by the PN / responsible pharmacist prior to administration. ESPGHAN 2005
If there is no information regarding compatibility the medication should be infused separately from the PN.

If the line used from PN administration is required for other infusions, this must be risk assessed by the child's consultant and documented. NCPPN (2016)

The PN/Lipid solutions can be protected from light by protective covers to prevent peroxidation and degradation of light sensitive vitamins. ESPGHAN (2005) (Trigg & Mohammed 2010), and protected from heat by positioning the PN/Lipid solutions away from direct heat sources.

Administering multivitamins with the lipid emulsion using light protected dark tubing is recommended as the most effective way to prevent peroxidation of the lipid and minimise vitamin loss and is essential during phototherapy. ESPGHAN 2005.

In preterm infants all PN tubing, syringes and bags must be covered from light using either photo protected delivery system or manually covering exposed lines and bags/ syringes. *Chessex et al (2015)*

9.0 Storage of Parenteral Nutrition

- PN bags are normally delivered to the ward on the same day as ordering, usually in the evening.
- Parenteral Nutrition must be stored in a designated refrigerator at 2 – 8 degrees Centigrade. No food stuff must be stored in this fridge.
- Expiry date of standard /stock bags must be checked on a regular basis and stock rotated so that bags with the nearest expiry date are used first.
- The Aqueous solution (2 in 1) and Lipid bag should be removed from the fridge 1 hour prior to commencing the infusion and a maximum of 24 hours to infusion completion. NCPPN (2016)

10.0 Weaning Parenteral Nutrition

- A small amount of enteral nutrition should always be attempted when using Parenteral Nutrition, as it helps to prevent gut atrophy, bacterial colonisation and cholestasis.
- There should be a gradual transition from Parenteral Nutrition to enteral nutrition or oral diet once a clinical decision has been made to commence feeding.
- As enteral feed volumes increase and are tolerated PN should be reduced accordingly
- Full PN volumes should continue until at least 25% of nutritional requirements are met from enteral or oral nutrition
- When reducing PN ensure that the aqueous and lipid solutions are reduced in correct proportion. Appendix 1
- 1 ml of PN is not equal to 1 ml of enteral feed.
- Full PN bags should be ordered and PN weaned by reducing flow rates. This allows PN to be increased if enteral feeds are not tolerated and does not have any cost implications for the hospital.
- PN can be stopped when 70% of the child's requirements are being met enterally. The dietician can calculate the child's intake from enteral feeds/diet. The PN form is a prescription in its own right and states the correct flow rate prescribed. When weaning or cycling parenteral nutrition, the flow rate is

variable and it should also be prescribed in the child's IV administration section of the child's medication chart with the flow rate and number of hours clearly stated. (OLCHC Medication Policy)

Weaning PN for Older Children

Ideally the dietitian is involved as it varies for different children and conditions. In particular anyone who has been on PN for greater than 1 week should be assessed by the dietitian – firstly to make sure the PN order is accurate and secondly to assist in weaning off PN and onto suitable nutrition – whether that is food, supplements or enteral feeds

Need to determine:

1. What the current order is providing – fluid, nutrients, electrolytes, vitamins and minerals. If the child is only on PN – then check the sheet to see the total amount of calories, fluid etc is being provided. If also on feed/ diet/ supplements need to include these also

2. What are the child's requirements? Dependent on age and clinical condition. PN may have been providing all or just some of requirements. Has the child lost weight since admission or since starting PN?

3. How quickly are you going to be able to wean? Dependent on clinical condition. If only on PN for a few days, then should be able to wean off over 2 – 3 days. If on PN long-term – need slower weaning and need to involve dietitian

Need to assess

Fluid Intake – if reducing PN then ensure the child's overall fluid intake does not drop dramatically
Nutrients – PN nutrients need to be replaced by diet, feeds or supplements.

Remember the calorie content of each PN bag is different, unlike in enteral feeds and supplements, so it is not a simple replacement of one for the other.

Example

40kg boy, post perforated appendix

PN order per kg is 1.5 g amino acid, 7g CHO, 1.5g lipid

Total kcals per kg = 49kcals

Total fluid volume = 1700mls

So per day child is getting 1960 kcals = approx 2000kcals.

To wean the PN – short term patient so aim to wean off in 3 – 4 days

Weaning from PN onto oral intake:

Day 1 – allow to start eating small amounts and continue full PN

Day 2 – aim to reduce PN by 25 % so he must eat the equivalent = 500 calories and drink 400mls approx

Day 3 – aim to reduce PN by further 25 % so only getting 50 % of original order .So he must eat the equivalent = 1000 calories and drink 800mls

Day 4 – aim to reduce PN by further 25 % so only getting 25 % of original order .So he must eat the equivalent = 1500 calories and drink 1200mls

What is calorie content of foods easily available on the ward?

Approx values:

1 full fat yoghurt 100 – 125 calories

1 digestive biscuit = 70 calories

1 piece of fruit = 50 calories

1 glass (200mls) full fat milk = 130 calories

1 glass (200mls) juice = 80 calories

30g breakfast cereal and 200mls milk = 250 calories

2 slices bread with butter and 200mls milk = 250 calories

1 carton (200mls) high calorie supplement (e.g. Fortisip, Ensure Plus) = 300 calories

1 sandwich with 2 slices of bread & butter with filling & 200mls milk = 500 calories

Meal with meat / chicken / fish, 2 potatoes, veg & 200mls milk juice = 500 calories

Day 1: he needs to eat small amounts e.g cereal, yoghurt, glass of milk

Day 2: Needs 500 calories
Cereal & milk in morning plus 2 slices toast & butter in evening
Needs to drink 400ml in milk, water, juice

Day 3: needs 1000 calories
Cereal & milk in morning plus 2 slices toast & butter in evening
Add in sandwich at lunchtime
Needs to drink 800ml in milk, water, juice

Day 4: needs 1500 calories
Cereal & milk in morning plus 2 slices toast & butter in evening
Add in sandwich at lunchtime
Add in ward meal at teatime
Needs to drink 1200ml in milk, water, juice

Day 5: Stop PN. Full normal diet plus 1.5 litre fluid intake

Weaning from PN onto enteral feed – refer to dietitian:

Day 1 – aim to reduce PN by 25% so he must tolerate the equivalent = 500 calories = 500mls of standard feed

Day 2 – aim to reduce PN by further 25% so only getting 50 % of original order. So he must tolerate the equivalent = 1000 calories, 1000mls of standard feed

Day 3 – aim to reduce PN by further 25% so only getting 25 % of original order. So he must tolerate the equivalent = 1500 calories, 1500mls

Day 4 – Stop PN. Aim for 2000 calories in 2 litre volume.

11.0 Administration of PN is divided into the following sections *(colour coded as shown)*

Part 1	Preparation and connection of PN 2 in 1 and Lipid Solution	1 - 59
Part 2	Monitoring of child / infant and equipment and solutions during infusion	60 - 66
Part 3	Disconnection of PN 2 in 1 and Lipid Solution	67 - 101

Function

Nurse 1	**'ANTT Nurse**	**Nurse 2**	**'Assisting Nurse'**

11.1 Part 1: Preparation and Connection of PN 2 in 1 and Lipid Solution

EQUIPMENT NEEDED
Dressing Trolley
Orange Needles X 2
10ml syringe x 2
2% Chlorhexidine, 70% Alcoholic wipes x 17 (Alcoholic 2% Chlorhexidine wipes)
Sharps bin
0.9% Sodium chloride (NaCL) 10mls x1
PN Giving Set
Paper Towel
Non injectable (needle free) bung x 2
Sterile Klinidrape
Gloves (Sterile X I pair and Non sterile X 1pair)
Sterile Gallipot

PN giving set contain:	PN 2 in 1 bag – 0.2 micron filter Lipid bag – 1.2 micron filter	PN 3 in 1 – 1.2 micron filter

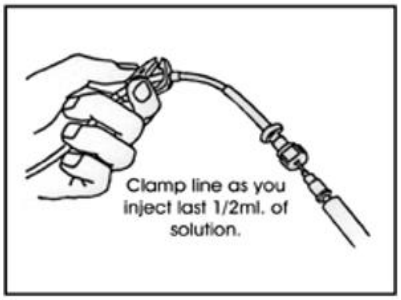
Part 1: Preparation and Connection of PN 2 in 1 and Lipid Solution

	ACTION	RATIONAL AND REFERENCE
	USE AN ASEPTIC NON-TOUCH TECHNIQUE	
1.	Prepare PN immediately prior to connection	To reduce the risk of infection and errors
2.	Check that the child's HCR number on their health care record matches that on the PN bag and that the PN prescription matches the PN label on the bag and manufacturers therapy sheet. See checking guidance for PN Appendix 1	To ensure the correct prescription and solution is prepared for the correct child and minimise risk of error, in adherence with Medication Policy (N.M.B.I 2014); OLCHC 2010b), and to ensure appropriate nutrition is maintained (Tait 2000)
	♦ Route of administration	
	♦ Glucose concentration	
3.	Prior to priming the PN solutions, Check the PN solution for discolouration, leakage, precipitate, crystallisation or cloudiness, if evident, contact Pharmacy Department.	This is to ensure PN is fit for use and to minimise the risk of infection (Trigg & Mohammed 2010).
4.	Child's actual weight must be written on the prescription sheet.	To avoid the risk of over or under prescribing fluids, nutrients and electrolytes, of which if administered in disproportion to the child's body weight can have detrimental side effects (OLCHC 2010b)
	Working weight (to which PN solution is calculate by) should not be more than 200g–300g higher than actual weight	
5.	Intravenous pumps appropriate for the age of the child and solution must be used	To ensure accuracy of infusion (Dougherty & Lister 2015, Howe *et al* 2010)
6.	If child is not in a single cubicle bring them to treatment room for connection, where possible.	To minimise the risk of infection
7.	**Nurse 1:** Collect materials required in advance of the procedure	To prepare environment (Trigg & Mohammed 2010)
8.	**Nurse 1 and 2:** Wash hands with antiseptic solution before commencing procedure at ANTT Level 2. Apply alcohol hand gel and allow to dry	To prevent cross infection (OLHSC 2005a, OLCHC 2013a, OLCHC 2013b, OLCHC 2011b)
9.	**Nurse 1 and 2:** Check the contents of PN and Lipid solution bags from the labels against the Parenteral Nutrition Prescription Sheet	In adherence with Medication policy (N.M.B.I 2015OLCHC 2010B)
10.	**Nurse 1**: Apply apron	To prevent Cross infection (NICE2003, OLCHC2011B)
11.	**Nurse 2:** Clean a suitable trolley with detergent and water, and dry thoroughly with a paper towel. Then wipe the surface of the trolley with an Alcoholic 2% Chlorhexidine wipe, from the centre outwards in a circular motion. Allow to dry thoroughly.	To create a clean working area (Green & Huby 2010, OLCHC 2011b) and to prevent cross infection (OLCHC 2006a, Pratt *et al* 2007)

12.	**Nurse 1 and 2:** Thoroughly wash your hands with antiseptic hand-washing solution at ANTT Level 2 and dry thoroughly with a paper towel. Apply alcohol gel to hands and allow to dry	To prevent cross infection (OLHSC 2005a, OLCHC 2013a, OLCHC 2013b)
13.	**Nurse 2:** Clean a preparation area away from the prepared sterile field (counter top for example) with detergent and water, allow to dry. Then wipe the area with an Alcoholic 2% Chlorhexidine wipe, allow to dry	To create a clean working area away from the sterile field for the application of sterile gloves and to protect the key parts of the sterile field from contamination (OLHSC 2005a, Dougherty & Lister 2015, Trigg & Mohammed 2010, OLCHC 2011b Soothill et al 2009)
14.	**Nurse2**: Open sterile gloves packaging for **Nurse 1**, in the area prepared in point 12	To prevent cross infection of clean ungloved hands on the sterile field (trolley) (OLHSC 2005a, OLCHC 2011b)
15.	**Nurse 1**: apply gloves	
16.	**Nurse 2:** Hang the PN 2 in 1 and Lipid solution bags on the drip stand and ensure the light protective cover is placed over the 2 in 1solution bags	Prepare the environment and to secure the PN solutions
		Do not put the Lipid Solution or PN bags on the sterile field as the solution bags are not sterile
		To prevent photo degradation of the PN and Lipid solutions (Trigg & Mohammed 2010)
17.	**Nurse 2:** Clean both bags and all ports with alcohol wipes, discard and allow at least 40 seconds to dry prior to spiking both the PN and Lipid infusion bags	To prevent cross contamination of the access ports (Howe et al 2010, Trigg & Mohammed 2010) and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, OLCHC 2011b, O'Sullivan 2011,)
18.	**Nurse 2:** Places sterile trolley drape on trolley	Prepare the environment (Trigg & Mohammed 2010)
19.	**Nurse 2:** Open all equipment, (holding all equipment in close proximity to the trolley) for Nurse 1 to place them on the trolley. Ensure packages are peeled back to ensure sterility	To create a clean working area (Dougherty & Lister 2015, Green & Huby 2010) and to prevent equipment packaging contaminating the equipment and sterile field
20.	**Nurse 1:** Connect PN and IV giving sets together.	Prepare your equipment (Dougherty & Lister 2015)
	Place the end of the PN line over the Sterile Gallipot.	To prevent contamination at tip of PN infusion line
	Do not remove the cap at the end of the PN line	
21.	**Nurse 2:** Apply non-sterile gloves	
	If any part of equipment becomes contaminated discard and restart	To prevent contamination of the equipment and PN and lipid infusion bags (Trigg & Mohammed 2010).
22.	**Nurse 2:** Pull back the other two unwanted ports of the lipid bag with an Alcoholic 2% Chlorhexidine wipe	To prevent cross contamination from the unwanted ports by Nurse 2 when inserting the IV giving set (Trigg & Mohammed 2010)
23.	**Nurse 1:** Clean access ports of the lipid bag with an Alcoholic 2% Chlorhexidine wipe, discard and allow to dry for at least 40 seconds.	To prevent cross contamination (OLHSC 2005a) by Nurse 1 when accessing the port and to ensure maximum efficacy of Alcoholic 2% Chlorhexidine

	If Nurse1 touches lipid bag with her/his gloved hands gloves must be changed	wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
24.	**Nurse 1:** Hold access port with a new Alcoholic 2% Chlorhexidine wipe being careful not to touch plastic parts with gloved hands, and remove port seal with a second Alcoholic 2% Chlorhexidine wipe being careful not to touch the ports directly with gloved hands. Discard the port seal and the second Alcoholic 2% Chlorhexidine wipe.	To prevent cross contamination (OLHSC 2005a) by Nurse 1 when accessing the port and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014)
25.	**Nurse 1:** Remain holding the access port with the Alcohol wipe and clean the end of the port with another Alcoholic 2% Chlorhexidine wipe, then discard this Alcoholic 2% Chlorhexidine wipe and allow port to dry for at least 40 seconds.	To prevent contamination from the port (OLHSC 2005a) and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
26.	**Nurse 1:** Remove the cover of the spike for the lipid line, immediately prior to spiking infusion bag without it touching anything prior to spiking the port of the Lipid bag	To prevent contamination of the spike by airborne microorganisms and the surrounding environment (Trigg & Mohammed 2010)
27.	**Nurse 1:** Directly inserts the spike into the port, ensuring it does not touch the surrounding environment. Insert the spike until the port line meets the ridge at the end of the spike. If the spike touches the surrounding environment, it is then contaminated and the giving set must be discarded.	To form a seal, and prevent leakage of the infusion fluid and entry of micro-organisms into the infusion bag, causing contamination
28.	**Nurse 1:** Discard the original Alcoholic 2% Chlorhexidine wipe used to hold the access port (i.e. Point 23).	
29.	**Nurse 1:** Fill IV lipid giving set chamber and slowly prime the line, into the sterile gallipot. Slowly eliminate any air from the line and the filters. Clamp giving sets once the lipid solution is approximately 2 cm from the end of the IV giving set. Check the giving set for air and eliminate if present	To prevent the infusion fluid contaminating the sterile field and reduce risk of air embolus (Dougherty &Lister 2015)
30.	**Nurse 1:** Do not remove the cap off the end of the (Lipid / PN 2 in 1) giving sets to prime line. Place line securely on the sterile trolley to ensure it remains sterile until connected to patient.	To prevent contamination of the giving set & Lister 2015)
31.	**Repeat Points 20 – 29 for the PN 2 in 1 solution**	

32.	*If Nurse 1 contaminates the spike prior to inserting the spike into the PN bag, discard the PN giving set and disconnect from above the blue lipid filter.*	To prevent contamination of the spike from the surrounding environment and reduce the risk of infection (Trigg & Mohammed 2010)
	Nurse 2: *Gets a new PN giving set and recommence spiking the PN bag with a new spike as per point 27, and prime the rest of the new PN giving set. The consequences of this are that there will be a reduced amount of lipids for the patient for the next 24-hour period.*	
33.	**Nurse 1:** Without removing the cap from the end of the PN line, cover the end of the PN line with an Alcoholic 2% Chlorhexidine wipe.	To prevent contamination of the end of the PN infusion line (OLHSC 2005a)
34.	**Nurse 2:** Clean neck of the 0.9% NaCl vials with Alcoholic 2% Chlorhexidine wipe and allow to air dry for at least 40 seconds. Draw up the prescribed 0.9% NaCl, expelling any air bubbles.	To prevent contamination and to prepare for administration (Dougherty & Lister 2008) and to ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
35.	**Nurse 1:** Place non-injectable bung on syringe tips.	To prevent contamination of syringe tips and the end of the IV infusion line (OLHSC 2005a)
36.	Discard needles appropriately.	To prevent needle stick injuries (NICE 2003, OLCHC 2014)
37.	Ensure contents of the syringes are clearly identifiable.	To prevent errors in administration *(Trigg & Mohammed 2010)*
38.	Place a sterile prep towel over the sterile field if the prepared equipment needs to be moved from the preparation room and brought to the child	To minimise the risk of infection
39.	**Nurse 1 and 2:** Take the prepared equipment to the child and explain the procedure to the child & family, relative to the child's age and cognitive development. Nurse 1 remains sterile.	To insure the child and family understand the procedure and gives his/her consent (Hockenberry 2006, Dougherty & Lister 2015, Trigg & Mohammed 2010)
40.	**Nurse 1 and 2:** Check child's identification name band against the PN prescription chart and follow the principles of the bedside medication checks as per OLCHC Medication Policy.	To minimise the risk of error and to ensure procedure is carried out on the correct child (OLHSC 2016, OLCHC 2006b)
41.	**Nurse 2:** Wash hands again with antiseptic solution at ANTT Level 2, when ready to handle the PN line.	To prevent cross infection (OLHSC 2005a, OLCHC 2007, OLCHC 2010)
42.	**Nurse 2:** Expose the end of the catheter, close all clamps and turn off the infusion pumps.	For easy access (Trigg & Mohammed 2010)
43.	**Nurse 2:** Before accessing the line, check for damage to the line or attachments. Observe for leakages of fluid/blood from the exit site of any attachments or connections	To ensure the line and connections are intact (Trigg & Mohammed 2010)

44.	**Nurse 2:** Clean the catheter and Needle Free bung with an Alcoholic 2% Chlorhexidine wipe, allowing at least 40 seconds to dry 2.5cm from the tip. If the child has an existing administration set attached, clean 2.5cm on either side of the join.	To prevent cross infection (OLHSC 2005a, Trigg & Mohammed 2010) and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
45.	**Nurse 1:** Pick up catheter with an Alcoholic 2% Chlorhexidine wipe in non-dominant hand and thoroughly clean the Needle free bung with a 2nd Alcoholic 2% Chlorhexidine wipe. Allow the Needle free bung to dry for at least 40 seconds. (Change the needle free bung, weekly, as per hospital guidelines and manufacturer's instructions)	To minimise the risk of contamination at the connections (Dougherty & Lister 2015) and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011) (As per hospital guidelines (OLSCH 2005a)
46.	**Nurse 1:** Securely attach appropriate size syringe containing 0.9% NaCl priming flush to Needle free bung - open clamp. (The volume of the flush should be appropriate to the child's age and catheter size, and accordance to IV Guidelines)	To establish connection between catheter and syringe and to ensure a secure fit to prevent disconnection (Dougherty & Lister 2008), in accordance with IV Guidelines (OLHSC 20005a)
47.	**Nurse 1:** Draw back gently to assess blood return, and slowly inject 0.9%NaCL (using a push–pause method), (If no blood return or not flushing, stop, consult the IV Guidelines (OLHSC 2005a) and inform the Surgical / Medical / Anaesthetic Team for advice and support, before progressing to the next step)	 To check for blood return (central line access only) and for patency on the IV line and to assess blood return (OLHSC 2005a, Dougherty & Lister 2015)
48.	**Nurse 2:** Close clamp.	
49.	**Nurse 1:** Clean with an Alcoholic 2% Chlorhexidine wipe and allow at least 40 seconds to dry.	To prevent contamination (OLHSC 2005a) and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
50.	**Nurse 1:** Remove cap from giving set and attach PN administration set directly to the Needle free bung as before without touching the tip of the giving set.	To prevent entry of air or leakage of blood via the catheter; to minimise the risk of infection; to enable treatment to commence (Dougherty & Lister 2015)
Note	*When an IV infusion is already in place. Clamp line and remove old IV infusion set. Clean Needle free bung with an Alcoholic 2% Chlorhexidine wipe and allow to dry for at least*	

	40 seconds. (Flush the IV line with 0.9% NaCL prior to attaching the PN giving set new infusion set)	
51.	**Nurse 1 and 2:** Ensure the whole system from the child to the IV fluid bag / syringe is complete and secure.	To prevent contamination, entry of air or leakage of blood via the catheter or accidental disconnection (Dougherty & Lister 2015)
52.	Attach the administration set to the line and thread through the infusion pump. A volumetric infusion pump must always be used to administer PN	To minimise complications with rapid infusion and ensure accuracy of infusion (Howe et al 2010, Clynes & O'Connor 2010)
53.	**Nurse 1 and 2:** Set both PN 2 in 1 and Lipid infusion pumps to the prescribed rates by Nurse 1 and 2 and commence the infusions.	To maintain patient safety and prevent medication errors (OLHSC 2016) and begin the nutritional infusion (Clynes & O'Connor 2010)
54.	**OPEN ALL CLAMPS from the pump downwards, ensuring IV line/Broviac/CVC line is opened last.**	To facilitate flow of PN (Dougherty & Lister 2015)
55.	Ensure the catheter is secured safely to the child's chest, as appropriate	To prevent accidental dislodgement of the line and prevent contamination by soiling from nappy area (Trigg & Mohammed 2010)
56.	Ensure child is comfortable throughout the procedure.	To help maintain a trusting relationship between the child and nurse (Hockenberry 2006)
57.	If PN is disconnected for whatever reason it must never be reconnected	To minimise risk of infection (OLHSC 2005a) To ensure the safety of the child.
58.	If accidental disconnection occurs • Discard PN • Flush (and heparinise central line) as prescribed. [if intended that heparin sodium 10units /ml is used this needs to be specified] Seek medical/ surgical/ anaesthetic advice	To minimise risk of infection and maintain patency of IV line (OLHSC 2005a)
59.	Dispose of all equipment appropriately	To promote safety and prevent cross infection (NICE 2003, OLCHC 2011c, OLCHC 2014, Green & Huby 2010)
60.	Wash hands with antiseptic solution at ANTT level 2.	To prevent cross infection (OLCHC 2013b, OLHSC 2005a)
61.	Document procedure in child's medication prescription chart and nursing notes.	Maintains accountability through accurate recording of nursing intervention (N.M.B.I 2015)

11.2 Part 2: Monitoring Children / Infants during PN 2 in 1 and Lipid Solution

1.	Careful monitoring of the child on PN is an important aspect of care	To ensure the nutritional needs of the patient are being met, to assess the effectiveness of treatment and to allow for early detection and management of complications (Tait 2000, Hockenberry 2006, Trigg & Mohammed 2010)
2.	The following should be monitored and recorded hourly: • Infusion rate • Fluid volume infused If PN is administered via a **peripheral I.V cannula** check the site for redness, swelling, inflammation, leakage, oozing, tenderness at **30 minute intervals** If PN is administered via a **Central Venous Access Device (CVAD)** check the site for redness, swelling, inflammation, leakage, oozing, tenderness and respiratory function at **hourly intervals**	To enable the early detection and management of extravasation and phlebitis (Tait 2000, Palmer & Mac Fie 2001) To enable the early detection and management of extravasation and phlebitis (Tait 2000, Palmer & Mac Fie 2001, Clynes & O'Connor 2010) To minimise the risk of infection, haemorrhage, embolism and to avoid potentially life threatening complications (Tait 2000, Clynes & O'Connor 2010)
3.	All lines and connections should be checked hourly for leakage and kinking leaking and kinking.	To avoid potential complications (Tait 2000, Clynes & O'Connor 2010 O'Connor 2010)
4.	Assess the child's general condition using a systematic nursing model as condition warrants	To obtain information via observation, history taking and physical examination which provides a baseline for immediate action and ongoing assessment, and assist in developing a plan of action (Trigg & Mohammed 2010) To assist in the early detection and management of the complications associated with the administration of PN (Pennington 2000)
5.	Monitor the child's temperature 4 hourly or as condition warrants. Observe for the signs and symptoms of sepsis, taking into consideration the child's age, gestation and underlying condition. (***Note:*** *these signs may be subtle, vague and non-specific*). If any of these signs present or if you have any concerns, inform the medical/ surgical/ anaesthetic team immediately. Following consultation with these teams and based on assessment of the child's condition, the PN infusion may be stopped.	To assist in the early detection and management of infection and other potential complications (Tait 2000, Hockenberry 2006, Trigg & Mohammed 2010)

6.	Cardiovascular / Respiratory function – perform 4 hourly assessments or as condition warrants, taking into consideration the child's age, gestation and underlying condition. Observe for deviations from the child's normal pattern. • Heart rate • Respiratory rate • Blood pressure • Peripheral perfusion (warmth of extremities, capillary refill, strength of peripheral pulses)	To assist in the detection and management of the early signs of infection and avoid potential complications such as sepsis (Tait 2000, Hockenberry 2006, Clynes & O'Connor 2010, Trigg & Mohammed 2010)
7.	Strictly assess and record the child's fluid intake and output	To monitor fluid status and to assist in the early detection and management of altered fluid distributions and/ or electrolyte imbalances (Tait 2000, Clynes & O'Connor 2010, Trigg & Mohammed 2010)
8.	Observe for the signs and symptoms of fluid overload, taking into consideration the child's age, gestation and underlying condition. (***Note:*** *these signs may be subtle, vague and non-specific).*	To observe for alterations in body fluid distribution and to assist in the early detection and management of altered fluid distributions and/or electrolyte imbalances (Tait 2000, Colletti *et al* 2010, Clynes & O'Connor 2010, Trigg & Mohammed 2010, Hockenberry 2006)
9.	Perform urinalysis daily and as condition warrants for glucose, ketone and pH levels.	To detect glycosuria and monitor tolerance to glucose in the PN and can also be used as an early indicator of sepsis (Tait 2000, Clynes & O'Connor 2010, Corcoran 2010, Howe *et al* 2010, Trigg & Mohammed 2010)
10	Blood glucose levels should be monitored and recorded:- • 4 hourly until stable or as condition warrants and as • per medical /surgical/ anaesthetic instructions • 12 hourly once condition stabilises • Whenever the glucose concentration and / or PN rates have been increased or decreased.	To monitor tolerance to glucose in the PN (Tait 2000, Clynes & O'Connor 2010, Trigg & Mohammed 2010)
11	Assess the child's oral mucosal integrity, and perineum area for signs and symptoms of candidiasis Provide mouth care and encourage teeth brushing where appropriate especially if the child / infant is nil orally A pacifier / soother may be encouraged for infants, where appropriate	The administration of PN increases the risk of candidiasis due to hyper alimentation (Singhi & Deep 2009). To maintain a health oral cavity (Trigg & Mohammed 2010). To encourage oro motor skills development in infants (Trigg & Mohammed 2010)

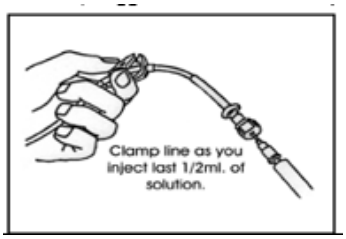
12	Monitor the child's weight and height / length as clinically indicated	To determine and monitor the child's growth over time using a growth chart, in order to ensure the child is thriving (de Onis *et al.* 2004, Clynes & O'Connor 2010, Corcoran 2010) To avoid the risk of over or under prescribing fluids, nutrients and electrolytes, of which if administered in disproportion to the child's body weight can have detrimental side effects (OLCHC 2010b)
13	Refer to the PN Prescription Sheet for type and frequency of laboratory investigation, while also using clinical judgement as condition warrants. See also Appendix 2	To assist in the early detection and management of the complications associated with the administration of PN (Pennington 2000, Johnston *et al* 2003, Clynes & O'Connor 2010)

Part 3: Disconnection of PN 2 in 1 and Lipid Solution

Equipment needed
Dressing Trolley
Non-injectable (needle free) bung x 3
10ml syringe x 3
Orange Needles X 2
Sterile Drape
Gloves (Sterile X I pair and Non Sterile X 1pair)
Alcoholic 2% Chlorhexidine wipes x 9
0.9% Sodium Chloride 10mls x 2
Sharps bin
Heparin sodium (10 units / ml)
Paper Towel

Part 3: Disconnection of PN 2 in 1 and Lipid Solution

	Action:	Rational and Reference
	USE AN ASEPTIC NON-TOUCH TECHNIQUE	
	Repeat Steps 7 – 19 from Part 1: Preparation and connection of PN 2 in 1 and Lipid Solution	
1	Nurse 1: Draw up all prescribed medications, flushing solutions and Heparin Sodium (10 units/ml), using a separate needle per syringe (as per 34-37) Draw up an extra 0.9% sodium chloride flush for emergency use only.	To prepare for administration (Dougherty & Lister 2015)
2	Nurse 2: Place opened Alcoholic 2% Chlorhexidine wipes onto tray.	To prepare for administration (Dougherty & Lister 2015)
3	Nurse 1 + 2: Check child's identification band against the medication chart as per OLCHC Medication Policy.	To minimise the risk of error and to ensure that the procedure is carried out on the correct child (OLCHC 2016, Dougherty & Lister 2015)
4	Nurse 2: Wash your hands again at ANTT Level 2, prior to touching the catheter, with antiseptic solution for 3 minutes, dry thoroughly with paper towel then apply alcohol solution, allow to dry thoroughly	To prevent cross infection (OLHSC 2013, OLCHC 2013a,), from the preparation room and the child's bed space.
5	Nurse 2: Close clamp and turn off the infusion pumps	
6	Nurse 2: Expose end of the catheter for Nurse 1	
7	**Nurse 2:** Clean the PN line and IV catheter with an Alcoholic 2% Chlorhexidine wipe and allow to dry for at least 40 seconds.	To prevent cross infection (OLHSC 2005a), for easy access and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
8	**Nurse 1:** Pick up catheter in your non-dominant hand through an Alcoholic 2% Chlorhexidine wipe, and the PN giving set in your dominant hand through an alcohol wipe; thoroughly clean the connection between PN giving set and Needle free bung with the Alcoholic 2% Chlorhexidine wipes.	To minimise the risk of contamination at the connections (Dougherty & Lister 2015)
9	**Nurse 1:** Discard the Alcoholic 2% Chlorhexidine wipes and allow to dry for at least 40 seconds.	Ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipes (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
10	**Nurse 1:** Pick up catheter in your non-dominant hand with an Alcoholic 2% Chlorhexidine wipe and the PN giving set with your dominant hand through two Alcoholic 2% Chlorhexidine wipes. Disconnect the PN giving set from the Needle free bung by rotating to the left and set-aside	

	with the Alcoholic 2% Chlorhexidine wipe.	
11	**Nurse 1:** Clean away any residual PN drops from the top of the needle free bung with an Alcoholic 2% Chlorhexidine wipe and allow to dry for at least 40 seconds.	To prevent cross infection (OLHSC 2005a) and ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipes (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
12	**Nurse 1:** Clean the needle free bung and allow to dry for at least 40 seconds.	Ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Loveday, H.P., Wilson, J.A., Pratt, R.J. 2014, O'Sullivan 2011)
13	**Nurse 1:** Connect syringe containing 0.9% sodium chloride flush solution to Needle free bung by inserting and rotating the syringe to the right.	To prevent precipitation of medications (Dougherty Lister 2015)To ensure a secure fit
14	Nurse 2: OPEN CLAMP	
15	Nurse 1: Flush with 0.9% sodium chloride (using a push pause method) as per line lumen prime volumes and as prescribed by medical staff, closing the clamp as the last 0.5mls is being injected	This helps to maintain a positive pressure by preventing back flow of blood into the catheter. Thus blood clot formation and subsequent line occlusion are avoided (Blagdon et al 2007, Trigg & Mohammed 2010) 
16	Nurse 1: CLAMP CATHETER.	
17	Nurse 1: Remove syringe by rotating to the left. Clean needle free bung with an Alcoholic 2% Chlorhexidine wipe and allow to dry for at least 40 seconds	Ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Pratt et al.2007, O'Sullivan 2011)
18	Nurse 1: Attach syringe containing Heparin sodium (10 units/ml) to Needle free bung (as before).	
19	Nurse 2: OPEN CLAMP	
20	Nurse 1: Inject heparin sodium volume as per line lumen prime volumes and as prescribed by medical staff, closing the clamp as the last 0.5ml is being injected (as before).	This helps to maintain a positive pressure by preventing back flow of blood into the catheter. Thus blood clot formation and subsequent line occlusion are avoided (Trigg & Mohammed 2010)
21	Nurse 2: CLAMP CATHETER	
22	Nurse 1: Remove syringe (as before) and clean. Needle free bung with an Alcoholic 2% Chlorhexidine wipe, allowing it to dry for at least 40 seconds.	Ensure maximum efficacy of Alcoholic 2% Chlorhexidine wipe (Pratt et al.2007, O'Sullivan 2011)
23	Nurse 1: Ensure the catheter is secured safely.	To prevent accidental dislodgement of the line (Trigg & Mohammed 2010)

24	Ensure the child is comfortable.	To help maintain a trusting relationship between the child and nurse (Hockenberry 2006, Trigg & Mohammed 2010)
25	Dispose of all equipment appropriately.	To promote safety and prevent cross infection (NICE 2003, Green & Huby 2010, OLCHC 2014, OLCHC
26	Wash hands with antiseptic solution.	To prevent cross infection (OLHSC 2005a, OLCHC 2010)
27	Document procedure in child's prescription chart.	Maintains accountability through accurate recording of nursing intervention (NMBI 2015)

12.0 Home Parenteral Nutrition (HPN) programme

Every effort should be made to avoid HPN with the use of adequate care, specialised feeds and artificial feeding devices as appropriate. HPN is not indicated in patients with adequate small intestinal function in whom nutrition may be maintained by oral or gastrostomy feeding (Guidelines on Paediatric Parenteral Nutrition of ESPGHAN and ESPEN supported by ESPR. Journal of Paediatric Gastroenterology and Nutrition Vol 41, suppl. 2, November 2005)

Patients should be in a stable condition. This includes stability of the underlying condition, fluid and electrolyte requirements and reliable venous access (ESPGHAN 2005)

While in hospital a GI/Nutrition consult specifically requesting a work up as potential home PN candidate is done to ensure that all other means of nutrition provision has been explored. Part of this consult includes a social and family assessment. A decision not to proceed with home PN can be made based on these assessments.

The child should be metabolically stable and on an all in one PN bag only requiring any changes to a prescription on a 1-2 weekly basis.

The child will require HPN for one year at least.

The child requires only one infusion as an 'all in one' PN bag is given

Parenteral nutrition will run over 14 hours maximum

If enteral feeding is required via an enteral feeding tube an appropriate gastrostomy tube is inserted where appropriate.

Discharge is done in conjunction with the home care company. No definite date of discharge is given to families or hospital staff as unforeseen circumstances may delay this and cause unnecessary upset to families.

If appropriate the child is referred to UK hospital for further treatment/ assessment.

Whatever the medical indication social and familial criteria must be fulfilled prior to organisation of Home PN programme (ESPGHAN 2005)

A multidisciplinary meeting with the parents will be held to include Consultant, Nutrition Nurses, Dietician, Social worker and psychologist to discuss Home parenteral Nutrition for their child.

Family must be willing to provide high dependency care at home and must be physically and emotionally able to undertake HPN training (AuSpen)
Parents will be fluent in English both oral and written as training involves written and oral education. If parents are not fluent in English an interpreter will be used and all written instructions translated into relevant language.

Parents will undergo Basic life support education in the hospital prior to discharge and be competent in same.

The structured teaching programme must have a written plan, step by step instructions as well as comprising theoretical and practical aspects. Audio-visual tools will also be used (ESGHAN 2005) (AuSPEN 2008)

All patients will be referred to GI social worker.

Social worker will arrange community meeting with relevant community personnel, 2 – 3 meetings may be require prior to discharge, Nutrition Nurses, Consultant, Dietician and social worker to attend these meetings.

Social worker will assess housing circumstances

- Is present housing suitable for the child on HPN
- Does the family require rehousing
- Child requires own room with adequate storage space
- If privately rented is land lord willing to allow renovations to child's bedroom e.g carpets removed, sink
- If family require rehousing this must be completed prior to training being commenced.

Social worker will assess family dynamics

Do both parents work, one parent may have to give up work to care for child, how will this effect finances?
If one parent continues to work will they be able to commit to the HPN programme both training in Hospital and at home for as long as the child requires it?

If helpers are required for connection and disconnection these must be applied for and people identified in the community.

Only 2 people will be trained to administer Parenteral Nutrition. If both parents are unable to commit or parents are separated a second person i.e. family member over 21 yrs of age may be trained providing they have met with the psychologist to ensure that they fully understand the commitment they must give and they must perform 2 connections and 2 disconnections per week to ensure they keep up their skills.

Separated parents who share the child's care should be trained providing they each connect/ disconnect HPN at least twice a week. (ESPGHAN 2005)
Nursing hours applied for and an appropriate agency identified in the community.

Home help hours applied for and people identified in the community.

Psychology

Psychologist will assess the parental level of comprehension for undergoing the programme.

13.0 Nursing Responsibilities for Home PN Patients when admitted to hospital

Anyone accessing a CVAD for a child on Home Parenteral Nutrition must use strict sterile technique at all times as per Professor Billy Bourke Nutrition Support Consultant

- At least two bags of home PN solution should be brought into hospital by the family for use. Home PN bag are a 3 in 1 bag and contains Protein, Carbohydrate and Fat and includes all vitamins and trace elements.
- Doctor to order the volumes to be infused of home PN on intravenous prescription or as a written
- Order on PN Prescription. ??
- All Home PN patients up to date prescriptions are available on the G Drive in GI Unit – Nutrition Support - HPN Patients
- Home PN should be removed from the refrigerator 4-5 hour's pre connection as solution can be very 'bubbly' if not at room temperature.
- A single PN giving set with a 1.2 micron filter is required for the home PN. These can be obtained from ACU.
- If child is medically stable parents should continue to connect and disconnect PN while their child is in hospital

Note: *Home PN patients have their PN solutions made and supplied by an outside pharmacy these prescriptions can only be change on a weekly basis. If a change of PN prescription is required while child is inpatient ACU will organise PN from Hospital supplier.*

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Appendix 1

Formula for weaning separate Amino Acid/Glucose and Lipid infusion:

Number of mL/hr by which to reduce flow rate of each infusion = (Total number of mL to be weaned/hr) x (rate of each) AA/Glucose mL/hr + Lipid mL/hr.

Example:

Infant on 10mL/hr Amino Acid/Glucose and 2mL/hr of Lipid required to reduce total TPN by 3mL/hr:

For Amino Acid/Glucose:

$$\frac{3 \times 10}{12} = 2.5 \text{ mL} \Rightarrow \text{reduce to } 7.5 \text{ mL}$$

For Lipids:

$$\frac{3 \times 2}{12} = 0.5 \text{ mL} \Rightarrow \text{reduce to } 1.5 \text{ mL}$$

Appendix 2 **MONITORING THE CHILD RECEIVING PARENTERAL NUTRITION**

	PRE PN	TWICE WEEKLY	WEEKLY	MONTHLY	3 MONTHLY
Weight	*	*			
Height	*				
Sodium	*	*			
Potassium	*	*			
Calcium	*	*			
Magnesium	*	*			
Inorganic Phosphate	*	*			
Urea	*	*			
Creatinine	*	*			
Alk Phos	*		*		
Ast	*		*		
Alt	*		*		
Albumin	*		*		
Total Protein	*		*		
Lipaemia Index		*			
Full Blood Count	*		*		
Copper	*			*	
Zinc	*			*	
Selenium	*			*	
	PRE PN	**TWICE WEEKLY**	**WEEKLY**	**MONTHLY**	**3 MONTHLY**
Iron/Ferritin				*	
Folate/Vit B12				*	
Vit A,D +E				*	
Urinary Sodium				*	
Urine for Candida		*			

Note

- Twice a week blood tests for the first 2 weeks until regimen established after which once a week is sufficient
- If there is conjugated hyperbilirubinaemia, clotting should be checked weekly
- Nutritional bloods (Cu, Zn & Se) are not necessary for short-term PN
- Check GGT if cholestasis is suspected

  Please discuss with a member of the Nutrition Support Team if you have any queries.

The Lipaemia Index measures the turbidity of serum in a semi-quantitative manner. Because it measures the amount of unmetabolised (parenteral) fat in serum it is a better indicator of tolerance of infused Lipid in Patients on Parenteral Nutrition than other laboratory measures such as cholesterol and triglyceride levels. A value of between 1 and 1.5g/l suggests that the patient is not metabolising the infused lipid efficiently (the infusion rate should then be halved) and a value above 1.5 g/l risks hyperlipidaemia related consequences necessitating temporary discontinuation of all infused PN Lipid.

Appendix 3

Checking PN bags against the prescription

Before checking the PN bag two nurses must check that the HCR number on the prescription matches the HCR number on the patient's health care record.

Two nurses **must** check the prescription against the parenteral nutrition bag label to ensure that the contents of the bag match the prescription.

Read from the prescription and check:

- Patient name
- HCR number
- Date of Birth
- Weight
- Peripheral or Central
- Date of infusion

That totals of all additives on prescription match those on the bag label (from nutritional composition section).

- Solvito, Vitlipid N Infant or Adult, Additrace or Peditrace
- Final bag volume
- Percentage glucose in the bag – is it appropriate for available access?
- Hours to be administered over
- Doctor has signed the prescription
- Pharmacist has signed the prescription
- Infusion rates
- Integrity of bags
- Colour of solutions

The insert that comes with the PN bag has the same information on it as the PN bag label. This insert must be signed and dated and filed in the patient's HCR.

Infusion Sets

Two types of infusion sets for PN are kept in the hospital:

- Infusion set with two filters (1x0.2 micron and 1x1.2 micron) for use with separate aqueous / clear PN bag (0.2 micron filter) and lipid bag (1.2 micron filter) *(code number 4186842).*

- Infusion set with one 1.2 micron filter for use with 'all in one' PN bags, Home PN bags with lipid in them and the standard bag for patients >10kg *(code number 4186850).*

'L is for LIPID'
Remember the Seven L's

Avoiding infusion rate errors with patient specific PN

Label – Always label infusion lines and infusion pumps

Light Blue filter – **Lipid through 1.2 micron Light blue filter**

Lipid bag on the LEFT – Always hang the **Lipid** bag on <u>your</u> **Left**-hand side of the infusion stand

Lipid pump LEFT or LOWER – **Lipid** infusion pump on the **Left** or **Lower** on the stand than the pump for the Aqueous bag (amino acid/glucose, pale yellow colour)

Lipid rate – set LAST – Always set the infusion pump for **Lipid** bag **Last**

Lipid rate is LOWER – **Lipid** is ALWAYS infused at a **Lower rate** than Aqueous bag (amino acid/glucose, pale yellow

Lights on – Always have **Lights** on when setting/checking infusion pump rates