MARKHAM STOUFFVILLE HOSPITAL CORPORATION	**Parenteral Nutrition - Neonatal Paediatric and Adult Patients**
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PURPOSE AND SCOPE:

This document outlines the process for initiating, maintaining and monitoring patients requiring parenteral nutrition.

POLICY STATEMENT(S):

Indication for Parenteral Nutrition (PN)

1. PN should only be used in circumstances where it has been determined that it is not possible to meet the patient's nutritional requirements by mouth or by enteral nutrition routes (inclusive of trial of post-pyloric feeding).
2. PN is indicated in hemodynamically stable patients when intestinal tract access is unavailable or intestinal function does not allow for sufficient absorption of nutrients on a short term or long term basis. Inclusive of:
    - Neonates who cannot achieve adequate caloric intake via an enteral route within the first few days of life
    - Neonates with birth weight less than 1500 g
    - Neonates with birth weight between 1500 g – 2000 g and small for gestation age, less than the 10th percentile
    - Neonates demonstrating significant feeding intolerance
    - Enteral feeding access not possible/contraindicated
    - Malfunctioning gastrointestinal track
    - Post-operative ileus
    - Intractable vomiting
    - Major GI surgery or trauma where enteral nutrition is contraindicated, e.g. perforation
    - Short bowel syndrome
    - Extensive Crohn's disease exacerbation
    - High output fistula where position and volume prevent enteral feeding
    - Malabsorption due to chronic infectious enteritis, severe radiation enteritis;
    - Motility disorders, such as scleroderma.

- Extended non-absorption of enteral nutrition (inclusive of a Nasojejunal feeding trial)

PN Access

1. Adult patients being considered for peripheral parenteral nutrition (PPN) should meet the following criteria:
    a. Peripheral venous access is available
    b. Patient can tolerate increased fluid volumes (i.e. 30-50 mL/kg)
    c. Patient requires less than 10-14 days of PPN and the benefits of PPN outweigh the risks
2. Central parenteral nutrition (CPN) should be used over PPN in the adult population when:
    a. PN is required for 10-14 days or more
    b. Nutrient requirements exceed what can be provided by a PPN solution
    c. Fluid restriction is required
    d. Peripheral venous access is limited
3. In the neonatal population the central route is preferred. The peripheral route should be considered when the patient is not fluid restricted and the central route is not feasible.

Prescribing

1. The risks and benefits of PN will be discussed with the patient or substitute decision maker (SDM) prior to initiation
2. PN will be prescribed with interprofessional collaboration from nutrition support professionals (i.e. gastroenterologist, clinical dietitian, pharmacist)
3. Candidates for PN must have a consult and assessment completed by a Clinical Dietitian prior to initiation, whenever possible.
4. Neonatal patients transferred from another facility after the PN order cut off time will have PN orders written by the Neonatologist/Pediatrician who is accepting the transfer and/or on call the morning of transfer prior to their admission.
5. PN must be ordered using the applicable PN order set. Telephone and verbal orders should be avoided.
6. A new PN Order Set is required for every change in PN orders.
7. All new orders for PN should be started on weekdays whenever possible.
8. Orders, and changes to orders, should be written and scanned to Pharmacy by 1200h.Orders written after 1200h will be started on the following day.
9. PN will be delivered to the nursing units at cart exchange (to start at 1800h for adults and 1600h for neonates).
10. Infants admitted from another facility after the PN order cut off time can continue their existing PN if tubing it is compatible with pump; otherwise the patient will receive the unit stock
11. Pharmacy and the Clinical Dietitian must be notified immediately when PN orders are written or changed.

Labeling of PN Solution

1. All PN nutrition solutions will be labelled and will include the following information:
    a) Two patient identifiers
    b) Patient location
    c) Administration date/time
    d) Route of administration
    e) Prescribed volume
    f) Infusion rate expressed in mL/h
    g) Duration of the infusion (continuous vs cyclic)
    h) Complete list of all ingredients
    i) Barcode

Preparation and Administration

1. All PN solutions must be administered using the appropriate infusion line via infusion pump with guardrails.
2. When administering PPN, use of an 18 or 20 gauge IV is encouraged.
3. **No other** IV solutions, or blood products should be administered via the PN line or lumen.
4. Calcium will not be infused through any lumen in conjunction with PN
5. Drug compatibility MUST be determined before running concurrently with PN solutions (see Appendix A on administration of drugs)
6. There should be no blood draws from PN line or lumen.
7. Replacement fluids must be infused via a separate line.
8. PN should be kept refrigerated and protected from light exposure between the times it is dispensed until just before infusion. The lipid emulsion is stored at room temperature.
9. Infusion should begin within 1 hour of spiking into the container.
10. PN should not be interrupted for routine care or patient transport for diagnostic studies.
11. If PN is abruptly discontinued the most responsible physician must be notified. Consult Order Set for appropriate IV solution to infuse.

Table 1:

PN Solution	Population	Filter	Hang Time	Frequency of Tubing/Filter Change
Amino acid/dextrose solution (i.e. Primene, Clinimix)	Adult	0.22 micron (DEHP-free)	24 hours	With each new bag or every 24 hours whichever comes first
	Neonatal/ Paediatric	0.22 micron (DEHP-free)	24 hours	With every change of Trifuse or every 96 hours whichever comes first
Lipid	Adult		12 hours	With each new bag or every 12 hours whichever comes first
	Neonatal/ Paediatric		24 hours	With each new bag or every 24 hour whichever comes first

**Amino acid and Dextrose (2-in-1) bag should be hung on the secondary line with a 0.22 micron filter connected to the tubing.*
***Lipid bag should be hung on the primary line.*
******Solution will be discarded after 24 hours even if not used***

Medication Administration

1. Double check prescriber's orders
2. Don mask, gown and gloves
3. Stop PN
4. Clamp amino acid/dextrose solution line above the Y connector
5. Cleanse port with chlorhexidine swabs for 30 seconds and allow to dry for one minute (by the clock)
6. Flush line with 3 mL of 0.9% sodium chloride
7. Administer medication
8. Flush tubing with 3 mL of 0.9% sodium chloride
9. Unclamp amino acid/dextrose solution
10. Restart PN solution at ordered rate

Monitoring

1. The most responsible physician or designate must be notified if signs of inflammation or discharge at the CVC or IV site are observed.
2. Patients should be weighed (using metric measures) and documented before the initiation of PN and once a week at minimum in adult patients and daily in paediatric/neonatal patient within the appropriate assessment record.

3. Lab investigations (electrolyte, glucose, hepatic function, renal function and triglyceride) should be conducted as ordered via the Parenteral Nutrition ORDER SET form. Patients who are unstable should be monitored daily. Patient without changes in PN for 1 week or more should be monitored every 2-7 days.
4. If blood glucose is observed to be 10 mmol/L or greater contact the MRP
5. Where an IV insulin infusion is required, it will be initiated via a separate peripheral line
6. Patients will be assessed for their ability to transition to enteral nutrition

Documentation

1. The nutritional care plan as ordered, will be transcribed to the Kardex

PROCEDURE:

Adult/Paediatric Patient

Prescribing	
Prescriber	1. Patients or SDM will be informed of the risk/benefits of PN 2. The appropriate Parenteral Nutrition Order Set will be used for all PN orders 3. A new Parenteral Nutrition Order Set will be used when making changes to the PN prescription 4. The medical problem will be documented on the Order Set 5. The indication for PN is written on the Order Set
Dietitian	1. Will assess the patient's nutritional requirements and will provide recommendations for an PN including appropriate PN solution to meet patient nutritional and care needs 2. The care plan will be adjusted as indicated
Pharmacist	1. The PN orders will be reviewed and acknowledged by pharmacist 2. Will check that the osmolarity of the chosen solution is compatible with peripheral administration, if applicable 3. The PN order will be entered on the eMAR. The eMAR will have an entry for the amino acid/dextrose solution and an entry for the lipid solution. The entries will include total volume and rate (mL/h). 4. When a new order is written for a solution and/or rate change, the eMAR will be updated
Preparation	
Pharmacy Technician	1. PN will be prepared in Pharmacy under the sterile hood 2. Appropriate labels will be affixed to PN solutions
Nurse	1. The nurse will obtain the appropriate supplies to administer PN *Supplies Required:* • Appropriate PN solution from Pharmacy • Filter

	• Infusion pump • Infusion pump tubing (DEHP free) • 70% Alcohol swab • Clean gloves
Administration	
Nurse	1. Must complete relevant education, review PN information package and complete test prior to commencing care 2. The PN order will be reviewed and verified 3. An independent double check will be performed as per the *Management of High Alert Medications* policy 4. The vascular access will be verified prior to administration. 5. The tubing will be correctly labeled 6. The pump settings will be confirmed with the appropriate guardrails activated 7. The PN label will be checked for the patient's name, the ordered solution and electrolyte additions, expiry date, route and rate of delivery and the bag for presence of particulate 8. PN should not be infused if visual changes or precipitates are apparent. Notify Pharmacy immediately if order discrepancies or solution abnormalities are present 9. Use sterile technique when manipulating vascular access device 10. Perform hand hygiene 11. Prime tubing and filter according to manufacturer's instructions, refer to table 1 12. If administering PN via Central Venous Catheter (CVC), clamp off CVC 13. Don clean gloves 14. Cleanse tubing connection with 70% alcohol swab for a minimum of 15 seconds 15. Disconnect and discard existing tubing, and attach PN tubing to extension tubing, being careful to maintain asepsis 16. Check all connections 17. Set infusion pump to the prescribed rate 18. Open all clamps and begin infusion
Monitoring	
Nurse	1. Assess the entire PN infusion system q1h to ensure proper functioning 2. The most responsible physician or designate must be notified if a patient develops a fever greater than 38ºC
Documentation	
Nurse	1. Document on the eMAR when a new solution is started 2. The PN infusion volume will be documented in the GEN IV/TPN

	Fluid Volumes assessment • The following assessments will be documented: • GEN Weight • GEN Intake and Output 3. GEN Gastrointestinal 4. The patient's line site will be assessed daily and will be documented in the appropriate IV Site screen (i.e. GEN IV PICC Site, GEN IV Central Line Site, GEN IV Port-A-Cath Site, GEN IV Peripheral Site, GEN IV Midline Site or GEN IV Hickman Site) 5. Document time of PN initiation, rate of infusion, infusion type and route of delivery
Dietitian	1. The nutritional assessment and care plan will be documented. The documentation will outline the patient's nutritional requirements, goals and the provisions provided by the PN prescription.
Care Transitions	
Health Care Providers	1. PN care plan will be discussed at care transitions

Neonatal Patient

Prescribing	
Prescriber	1. Patients or SDM will be informed of the risk/benefits of PN 2. The appropriate Parenteral Nutrition Order Set will be used for all PN orders 3. A new Parenteral Nutrition Order Set will be used when making changes to the PN prescription 4. The medical problem will be documented on the Order Set 5. The indication for PN will be written on the Order Set 6. The lipid infusion rate will be calculated daily based on the neonate's weight and day of infusion 7. Electrolyte-free solutions may be used within the first 48 hours of life 8. The calcium-free solutions may be used if the patient has peripheral access 9. The daily TFI will be ordered Target Protein Provision: • Initiate at 2-2.5 g/kg/d and increase by 0.5 g/kg/d until at 3.5-4 g/kg/d Target Lipid Provision: • Day 1: 1 g/kg/d (0.2 mL/kg/h, based on a 20% emulsion rate) • Day 2: 2 g/kg/d (0.4 mL/kg/h) • Day 3 and onwards: 3 g/kg/d (0.6 mL/kg/h)

Dietitian	1. Will assess the patient's nutritional requirements and will provide recommendations for PN including appropriate PN solution to meet patient nutritional and care needs 2. The care plan will be adjusted as indicated
Pharmacist	1. The PN orders will be reviewed and acknowledged by pharmacist 2. Will check that the osmolarity of the chosen solution is compatible with peripheral administration, if applicable 3. Assess if patient is on any medications that may be incompatible with PN (see appendix A) and make recommendations 4. The PN order will be entered on the eMAR. The eMAR will have an entry for the amino acid/dextrose solution and an entry for the lipid solution. The entries will include total volume and rate (mL/h). 5. When a new order is written for a solution and/or rate change, the eMAR will be updated.
Preparation	
Pharmacy Technician	1. PN will be prepared in Pharmacy under the sterile hood 2. Prime first bag of PN 3. Draw up the requested volume of 20% lipid emulsion in a syringe and attached tubing and Y connector. This will not be primed. 4. Appropriate labels will be affixed to PN solutions
Nurse	1. The nurse will obtain the appropriate supplies to administer PN *Supplies Required:* • Appropriate PN solution from Pharmacy • Filter • Infusion pump • Infusion pump tubing (DEHP free) • 70% Alcohol swab • Clean gloves
Administration	
Nurse	1. Must complete relevant education, review PN information package and complete test prior to commencing care of a neonate 2. The PN order will be reviewed and verified. Ensure any recommendations are co-signed by the prescriber prior to implementing. 3. An independent double check will be performed as per the Management of High Alert Medications policy 4. The vascular access will be verified prior to administration 5. The tubing will be correctly labeled. 6. The pump settings will be confirmed with the appropriate guardrails activated. 7. Adjust Primene rates accordingly as enteral feeds are increased and within the ordered TFI (lipid rate must not be adjusted without

	an order) 8. Follow UVC policy for UVC monitoring and care guidelines (policy 070.606.005) 9. Inspect the UVC site integrity and infusion function hourly and document 10. If a separate site is not possible to deliver medication, check to ensure that the medication can be delivered through Y-connection to the PN line (see Appendix A) 11. The PN label will be checked for the patient's name, the ordered solution and electrolyte additions, expiry date, route and rate of delivery and the bag for presence of particulate. 12. PN should not be infused if visual changes or precipitates are apparent. Notify Pharmacy immediately if order discrepancies or solution abnormalities are present. 13. Use sterile technique when manipulating vascular access device. 14. Perform hand hygiene. 15. Prime tubing and filter according to manufacturer's instructions, refer to table 1 16. If administering PN via Central Venous Catheter (CVC), clamp off CVC 17. Don clean gloves 18. Cleanse tubing connection with 70% alcohol swab for a minimum of 15 seconds 19. Disconnect and discard existing tubing, and attach PN tubing to extension tubing, being careful to maintain asepsis 20. Check all connections 21. Set infusion pump to the prescribed rate 22. Open all clamps and begin infusion
Monitoring	
Nurse	1. Assess the entire PN infusion system q1h to ensure proper functioning. 2. The most responsible physician or designate must be notified if a patient develops a fever greater than 37.5º auxiliary 3. Assess for signs of infection/complications in the neonate and report to Pediatrician if indicated
Documentation	
Nurse	1. Document on the eMAR when a new solution is started 2. The PN infusion volume will be documented in the GEN IV/TPN Fluid Volumes assessment 3. Ensure weight is measured and documented daily 4. Document head circumference, length and weight weekly on the growth chart 5. Document Gastrointestinal assessment

	6. Assess line site daily and document in the appropriate IV Site screen (i.e. MC PICC Assessment, MC PICC Initial Assessment, MC UVC/UAC Insertion, MC UVC/UAC Assessment, GEN IV Peripheral Site) 7. Document intake and output every 12 hours including weight of diapers 8. Document time of PN initiation, rate of infusion, infusion type and route of delivery
Dietitian	1. The nutritional assessment and care plan will be documented. The documentation will outline the patient's nutritional requirements, goals and the provisions provided by the PN prescription.
Care Transitions	
Health Care Providers	1. PN care plan will be discussed at care transitions

DEFINITION(S):

Peripheral Parenteral Nutrition (PPN): Administration of parenteral nutrition via a peripheral route. PN solutions with a max osmolarity of approximately 900 mOsm/L are generally well tolerated when administered peripherally.

Central Parenteral Nutrition (CPN): Administration of parenteral nutrition via a central route.

TFI: Total fluid intake combining all sources, usually represented in ml/kg/d. For neonates this would be lipids, Primene solution, enteral feeds and other infusions.

REFERENCE(S):

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Koletzko B., Goulet O., Hunt J., Krohn K., Shamir R.; Parenteral Nutrition Guidelines Working Group; European Society for Clinical Nutrition and Metabolism; European Society of Paediatric Gastroenterology, Hepatology and Nutrition; European Society of Paediatric Research (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), SuOrder Setrted by the European Society of Paediatric Research (ESPR) J Pediatr Gastroenterol Nutr 41 Suppl 2: S1-87

Koletzko B, Poindexter B, Uauy R (eds): Nutritional Care of Preterm Infants: Scientific Basis and Practical Guidelines World Rev Nutr Diet. Basel, Karger, 2014, vol 110, pp 177–189
The A.S.P.E.N. Nutrition SuOrder Setrt Practice Manual. (2005). 2nd ed. Silver Springs, MD: American Society for Parenteral and Enteral Nutrition, pp.91-117.

RELATED DOCUMENTS:

070.914.914.100 Central Venous Access Devices – Management of Occlusion in Adults
080.914.916.185 Extravasation of Chemotherapeutic/Vesicants/Irritants: Management Guidelines

RESPONSIBILITY:

Required Endorsements	Sponsor	Approval Authority
Medical Operations Surgical Operations Interprofessional Advisory Committee	Drug Utilization Pharmacist	Drugs and Therapeutics Committee (DTC)

DOCUMENT HISTORY:

Type	Individual/Committee	Date	Outcome
Draft	Drugs and Therapeutics Committee	16/08/2018	New Document; Combined 290.914.916.150 Total Parenteral Nutrition (TPN) Adult, 570.914.914.030 Total Parenteral Nutrition (TPN) Initiation and Maintenance, and 320.606.020 Total Parenteral Nutrition (TPN) Therapy in the Neonate; Approved
Revised	Drugs and Therapeutics Committee	27/01/2021	Major revision; Approved.

APPENDICES:

Appendix A
Medication Compatibility Chart

- Administration of other medications through the same line/lumen as the PN solution should be avoided, if possible. If a separate site is not possible, the drug may be administered through a separate line that has a Y connection to the PN line as close as possible to the patient. The TPN should NOT be running, the line must be clamped above the Y and the common tubing must be adequately flushed before and after medication administration.
- Only if the patients clinical status requires uninterrupted TPN administration can medication considered compatible with TPN be administered through the same Y connection with the TPN and lipids still running (this applies only to standard solutions or to solutions with lower than standard electrolyte concentrations.
- Medications NOT compatible with the PN must not be run simultaneously with PN.
- Consult with Pharmacist to determine compatibilities

Drugs compatible with TPN	Drugs not compatible with TPN
Amikacin	Acetazolamide
Ampicillin	Acyclovir
Cefazolin	Amphotericin
Cefotaxime	Antithymocyte Globulin
Cefoxitin	Ciprofloxacin
Ceftazidime	Cisplatinum
Cefuroxime	Cyclosporin
Clindamycin	Deferoxamine
Ceftriaxone (incompatible with calcium)	Doxorubicin
Cloxacillin	Etoposide
Cyclosporin	Ganciclovir
Dobutamine	Midazolam
Dopamine	Pantoprazole
Epinephrine	Paraldehyde
Erythromycin	Phenytoin
Famotidine	Sodium Bicarbonate
Fentanyl	Voriconazole
Fluconazole	Teniposide
Furosemide	
Gentamicin	
Heparin (incompatible with lipids)	
Hydromorphone	
Insulin	
Isoproterenol	
Lidocaine	
Mannitol	
Meperidine	
Methylprednisolone	
Metoclopramide	
Metronidazole	
Meropenem	
Morphine	

Drugs compatible with TPN	Drugs not compatible with TPN
Norepinephrine	
Octreotide	
Penicillin G	
Phenobarbital (incompatible with lipids)	
Piperacillin/Tazobactam	
Tobramycin	
Vancomycin	