Disclaimer

- Omnicare, Inc., as a provider of Infusion Pharmacy Services, is committed to the establishment and maintenance of the highest quality of care in infusion therapy services.

- This Infusion Therapy Education Program ("Program") has been developed entirely by Omnicare Infusion Services ("Omnicare") and is not intended to replace your infusion service practice guidelines and nursing requirements. Moreover, the contents of this training are guidance only and do not supersede applicable laws, guidelines and your specific employer’s policies, procedures and processes.

- The nature of infusion therapy requires frequent updates. It is the responsibility of the healthcare professionals involved with infusion management to remain current in his/her practice.

- This Program will reference various sources of authority including but not limited to statutes, regulations, standards and treatment guidelines. It is the obligation of every training participant to review these sources of authority and exercise independent skill and judgment in the implementation of this information in the clinical setting.

- This educational program is not intended to replace good professional judgment by the healthcare provider nor is it intended to supersede the necessity for clinically sound prerogatives of a healthcare organization.

- Skills validation checklists are available in the Omnicare Nurses Infusion Manual and electronically on Omniview, Omnicare’s web portal. Omnicare’s provision of these tools are to assist practitioners in providing quality infusion services, however, these tools and guides do not replace independent skills and sound clinical judgment.
Objectives
1. Define the types of parenteral nutrition
2. Identify the clinical indications for parenteral nutrition
3. Review the components of parenteral nutrition solution
4. List complications of parenteral nutrition
5. Identify appropriate monitoring of patients receiving parenteral nutrition
6. Explain nursing responsibilities related to the administration of parenteral nutrition
7. Discuss administration of premixed formulas

Introduction
- Parenteral nutrition (PN) is the intravenous administration of nutrients needed for metabolic functioning
- Total parenteral nutrition (TPN) contains glucose, amino acids, lipids, vitamins, electrolytes and minerals
- Physician/licensed independent practitioner (LIP) must weigh the proposed benefits against the risk of possible complications

Introduction
- The role of the licensed nurse is critical in preventing complications and ensuring the success of therapy
- A multidisciplinary approach to care of the patient receiving parenteral nutrition is required to achieve positive outcomes and minimize complications. The multidisciplinary team should include the patient, dietitian, infusion pharmacist, physician/LIP and nurse
Definition

Total Parenteral Nutrition (TPN)
• A highly concentrated form of parenteral nutrition that is given through a central vein
• Contains a dextrose solution of greater than 10%. Higher glucose concentrations should be administered through a central vascular access device (CVAD) because the high venous flow rate rapidly dissipates the high osmolarity.
• Indicated for parenteral nutrition needed for more than 7 days

Total Parenteral Nutrition (TPN)
• Satisfies all body requirements
• Can be short term (providing nutrition during critical illness) or long term (providing nutrition for chronic illnesses for months or years)
• May be a continuous or cyclical infusion (TPN and PPN)
  - If cyclical, specific tapering schedule must be ordered.
  - Cyclical PN is usually administered at night
  - Cyclical must be for patient’s convenience, not to meet the needs of facility staffing

Definition

Peripheral Parenteral Nutrition (PPN)
• May be administered through a peripheral vein and has a lower concentration of glucose that should not exceed 10%.
• Higher concentrations of glucose have a higher osmolarity that can cause damage to the peripheral venous endothelium, increasing the risk for venous thrombosis and sclerosis.
• PPN has fewer calories than TPN and usually the larger percentage of calories are provided by lipids rather than carbohydrates.
• PPN is indicated for parenteral nutrition needed for less than 7 days.
Peripheral Parenteral Nutrition (PPN)

- Parenteral nutrition may be given through a peripheral access device if:
  - Dextrose concentration is equal to or less than 10%
  - Amino acid concentration is equal to or less than 5%
- Short peripheral vascular access sites must be rotated every 24-48 hours, and as needed.

Goals of Parenteral Nutrition

The goals of parenteral nutrition therapy include:
- Preventing unwanted weight loss and skin breakdown
- Promoting positive nitrogen balance
- Maintaining visceral and somatic protein stores

The patient needs adequate caloric and protein intake to achieve these goals.

The Keys to Successful Parenteral Nutrition Therapy

**Early Identification Early Intervention**

- Illness and injury promote catabolism and hyper-metabolism. The patient is burning calories faster to keep up with his body’s demands. If adequate nutrition is not provided, the body will break down lean muscle for glucose, which could slow healing and prolong recovery.
- Providing adequate nutrition through administration of parenteral nutrition will reduce morbidity and mortality, promote tissue repair, and enhance immune system response.
Indications for Parenteral Nutrition

- Patient cannot tolerate oral/enteral nutrition for extended periods
- Complete bowel rest indicated
- GI dysfunction – number one indication for TPN
  - Inflammatory bowel disease, short bowel syndrome, pancreatitis, bowel obstruction, fistula, intractable diarrhea, malabsorption
- Hepatic failure

Parenteral Nutrition Risks

- Increased risk of infection and metabolic complications
- PN does not preserve GI tract structure and function

Is a patient who has had a stroke, and cannot swallow, a candidate for PN?
Components of Parenteral Nutrition Solution

Water
- 30 to 40 ml/kg/day

Carbohydrates
- 4-5 grams/kg/day
- In the form of dextrose (up to 25% dextrose as final concentration)
- Primary source of energy (calories)
- Spares protein

Components of Parenteral Nutrition Solution

Protein
- In the form of amino acids
- 1-3 grams/kg/day depending on clinical status
- Illness and infection increases the body's protein requirements
- Needed for tissue maintenance, growth and repair

Components of Parenteral Nutrition Solution

Fats (Lipid Emulsion)
- Secondary source of energy after carbohydrates
- May contain triglycerides, egg phospholipids, glycerol, soybean and water
- 20-30% of calories may be in the form of lipids
- Prevents essential fatty acid deficiency (EFAD)
- Concentration of 10-30%
- Lipids can be mixed with PN solution (3:1 solution)
- Lipids may be given as a separate infusion

Check for allergy to egg or soybean prior to administering lipids/ or solutions containing lipids
Components of Parenteral Nutrition Solution

Electrolytes and Trace Elements (Minerals)

- Electrolytes play a critical role in all body functions
- Trace elements are minerals needed for normal metabolism
- Requirements based on individual needs, lab results (fax to pharmacist)
- Added by pharmacist

Components of Parenteral Nutrition Solution

Additives

- Due to instability, some additives must be added to the solution container by the nurse just prior to administration
- All additives must be compatible with parenteral nutrition solution
- Additives added by the nurse may include:
  - Vitamins
  - Insulin
  - Heparin
  - H2 Antagonists

Components of Parenteral Nutrition Solution

Additives

- May be in glass ampules (must use filter straw to withdraw from ampules)
- No more than 3 additives (using no more than 2 punctures into the solution container) may be added by the nurse to a parenteral nutrition solution. If more than 3 additives are ordered consult with the infusion pharmacist for guidance. A transfer device may need to be used.
Filters

- Parenteral nutrition solution needs to be filtered
- Lipids do not require an inline filter if administered separately
- A 2:1 PN solution (does not contain lipids) only requires a 0.2 micron filter
- No additional filter required if piggybacking lipids into the lower Y-site of a PN 0.2 micron administration set (note: the Y-site is located below the 0.2 micron filter)
- If lipids are piggybacked into a higher Y-site above the filter, an administration set containing a 1.2 micron filter must be used

Admitting the Parenteral Nutrition Patient

PN Admission Criteria

The facility must provide the pharmacy with advance notice when a decision is made to accept a patient receiving total parenteral nutrition (TPN) or peripheral (partial) parenteral nutrition (PPN).

To ensure safe management of the patient requiring parenteral nutrition, the following information must be obtained prior to admission:

- Medical necessity for parenteral nutrition
- Medical history, medical treatments, medication and allergy profiles, laboratory test results, functional status
- Nutritional habits, food and drug allergies, previous enteral and parenteral treatment, and dietary consult
- Appropriate vascular access device
Innovative Solution to Current PN Challenges

• Increased demands for PN in LTC
• Shortages of many of components of Parenteral Nutrition formula
• Increased need to provide PN to remote locations
• Looking more closely at patients that are receiving hydration for extended periods of time and quickly assessing for, and providing, PPN as a solution

Goal

Parenteral Nutrition/Clinimix Initiative

To provide a quality PN product to meet the needs of LTC patients

Advantages of Pre-mixed/Clinimix

• Commercially prepared under the most stringent sterile compounding practices
• End-product sterilization
• Fewer concerns with drug shortages
• Adverse reactions seen by 56% with commercial vs. 76% with compounded PN

Advantages of Pre-mixed/Clinimix

• Reduced ordering complexity for the clinician
• PN readily available (facilities with high PN utilization may have formulas available in e-kit)
• Reduced formula manipulations/errors
• Extended shelf life
Clinimix vs. Compounded PN

Clinimix may not meet the needs of patients that are:
- Fluid restricted (e.g., hemodialysis)
- In need of large protein amounts (e.g., burns)
- In need of electrolyte replacement (e.g., severe electrolyte abnormalities)

These patients may benefit from compounded PN.

Pre-mixed TPN/PPN Solutions

Clinimix and Clinimix E
- Clinimix is a pre-mixed TPN solution containing amino acids and dextrose, the same components that are in customized TPN solutions
- Clinimix E contains amino acids, dextrose and a standard amount of electrolytes*
  *(Clinimix E contains (per liter): Na+ 35mEq/L, K+ 30mEq/L, Mg2+ 5mEq/L, Ca2+ 4.5mEq/L, PO4 15 mmol/L)
- The first number in the formulation name corresponds to the % amino acids and the second is the dextrose concentration (e.g., Clinimix 4.25/10 = 4.25% Amino Acids and 10% Dextrose)

Pre-mixed Clinimix Formulations
- Sterile, non-pyrogenic, hypertonic solutions manufactured in a dual-chamber container
  - One chamber contains sulfate-free amino acids 2.75 – 5%
  - One chamber contains dextrose 5-25%
  - Add in lipids (3-in-1) or infuse separately (2-in-1)
- Available with and without electrolytes
  - 1- and 2-liter volumes
  - Central and peripheral formulations
  - Can add in additives such as insulin, vitamins, etc.
Pre-mixed TPN/PPN Solutions

Administering Clinimix and Clinimix E

- Prior to administration, the amino acid chamber must be mixed with the dextrose chamber.
- In most cases, the pharmacy will mix the contents in the sterile compounding area and add additional electrolytes and lipids. When this is done, the bag will need to be refrigerated prior to use. Remove from the refrigerator prior to administration (at least one hour per liter).

Parenteral Nutrition Orders

- Verbal orders are not acceptable.
- The attending physician/LIP may request that the previous provider’s formulation be continued. The pharmacist will use the previous provider’s formulation as a template for reducing the formulation to writing and converting ingredient units of measure to match the units of measure on pharmacy label.
- Fax current hospital parenteral nutrition orders to infusion pharmacy as soon as admission is anticipated.

Parenteral Nutrition Orders

- Call infusion pharmacy to verify receipt of orders.
- Pharmacist will reduce hospital orders to writing on TPN/PPN Order Form and fax back to facility.
- The formulation reduced to writing by the pharmacy will NOT be considered a valid order until the physician/LIP has reviewed and signed the order, or reviewed and authorized by telephone order.
Parenteral Nutrition Orders

Physician/LIP orders should include:

- Parenteral nutrition solution
- Additives
- Volume and rate
- Continuous or cyclical (if cyclical, specific tapering schedule must be ordered)
- VAD flush protocol
- Laboratory monitoring

Parenteral Nutrition Orders

Physician/LIP orders should include (cont):

- Daily/weekly weights
- Vital signs
- Blood glucose monitoring
- Intake and output
- Back-up D10 W solution or pre-made standard
- TPN formulation (i.e. Clinimix) in the event of unplanned interruption of TPN solution

*D10W may be administered through a peripheral access device via an manual flow-control device if an electronic infusion device is not available

Parenteral Nutrition Orders

- Labs:
  - Baseline recommended on admission
  - Blood sampling is not recommended via the lumen used to administer TPN/PPN
  - If the patient has a single-lumen catheter, blood sampling should be drawn by accessing a peripheral vein
  - Fax all lab results to infusion pharmacy as soon as they are available from lab provider. Call pharmacy to verify receipt of results.

  * Adjustments to formula are based on lab results. Abnormal lab results may also indicate presence of PN related complication(s).
Parenteral Nutrition Orders

- **Weights:**
  - Baseline recommended on admission
  - Ongoing weights per physician/LIP orders or per suggested monitoring
  - Must be accurate: same time each day, same scale, same clothing, etc.

- **Vital Signs:**
  - Baseline recommended on admission
  - Per physician/LIP orders

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Parenteral Nutrition Orders

- **Glucose monitoring and insulin coverage using sliding scale:**
  - Glucose monitoring should be performed per physician/LIP orders or per suggested monitoring
  - Orders should also include specific parameters for physician/LIP notification
  - Orders should include specific insulin doses for coverage, if applicable

- **Intake and Output**
  - Per physician/LIP orders or per suggested monitoring
  - Document every shift

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Suggested PN Monitoring Schedule

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline</th>
<th>Acute Resident</th>
<th>Stable Resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight**</td>
<td>Yes</td>
<td>Daily</td>
<td>1-3 times/week</td>
</tr>
<tr>
<td>I &amp; O</td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
</tr>
<tr>
<td>Labs, Including a1C, Lipids</td>
<td>Yes</td>
<td>2-3 times/week</td>
<td>Weekly</td>
</tr>
<tr>
<td>BHP &amp; BUN</td>
<td>Yes</td>
<td>2-3 times/week</td>
<td>Weekly</td>
</tr>
<tr>
<td>CBC with Differential and Platelets</td>
<td>Yes</td>
<td>Weekly</td>
<td>Q2-4 Weeks</td>
</tr>
<tr>
<td>Blood Glucose</td>
<td>Daily</td>
<td>2 times daily</td>
<td>Daily</td>
</tr>
<tr>
<td>LFT &amp; Lipase</td>
<td>Yes</td>
<td>Weekly</td>
<td>Q2-4 Weeks</td>
</tr>
<tr>
<td>Prothrombin Time &amp; TIBC</td>
<td>Yes</td>
<td>Weekly</td>
<td>Q2-4 Weeks</td>
</tr>
<tr>
<td>Monophasic Balance</td>
<td>Yes</td>
<td>Weekly</td>
<td>Q2-4 Weeks</td>
</tr>
</tbody>
</table>

** Weight gain of greater than 5lbs per week and orders an indication of fluid overload.
Completing the PN Prescription Form

Step 1

Fill in the patient demographics.
Completing the PN Prescription Form

Step 2. Select Trace Elements

Step 3. Select Lipids

Step 4. Select Additional Additives
Completing the PN Prescription Form

**Step 5. Select Additional Orders**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Order Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infusion</td>
<td>0027</td>
<td>Rate: 35ml/hr</td>
</tr>
<tr>
<td>Drip Chamber</td>
<td>0029</td>
<td>Fluid: D5W</td>
</tr>
<tr>
<td>Infusion Pump</td>
<td>0030</td>
<td>Rate: 5ml/hr</td>
</tr>
<tr>
<td>Extension Set</td>
<td>0031</td>
<td>Fluid: NS 1000ml</td>
</tr>
</tbody>
</table>

**Assessment of Vascular Access Device (VAD)**

**Identify Type of VAD**
- Location
- Single vs. multiple-lumen
  Parenteral nutrition should be administered via a dedicated lumen
- Tunneled, non-tunneled, PICC, implanted port, peripheral site (for PPN only)

**Note Date of Insertion**
- Infection control issues
- Short-term non-tunneled may need to be replaced

**Signatures**

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescriber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN Verification</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment of Vascular Access Device (VAD)

Verification of Tip Placement

- If CVAD, obtain confirmation of tip placement in superior vena cava (SVC) from party responsible for insertion
- Must have SVC tip location to be considered CVAD
- Document tip location in patient's chart
- Request order for STAT, portable CXR if report/results are not readily available from insertion facility

Assessment of Vascular Access Device (VAD)

Site Assessment

- Observe/document any redness, swelling, tenderness, drainage, leaking or other IV related complication
- If suspected IV related complication exists, take appropriate nursing action
- Note condition of sutures, if present
- Measure external catheter length to evaluate for catheter migration (compare to previous measurements)
Steps to Administration

- Clean work area using appropriate disinfectant
- Wash hands
- Choose a low traffic area free of dust, currents of air and conversation

Be as meticulous as possible: remember, when PN is prepared at the pharmacy preparation is done in a clean room under a laminar flow hood

Steps to Administration

- Parenteral nutrition solution should be removed from the refrigerator prior to infusion:
  - 1000 ml or less = 1 hour prior to infusion
  - 1000-2000 ml = 2 hours prior to infusion
  - 2000-3000 ml = 3 hours prior to infusion
- NEVER use a microwave or warm water bath to warm solution
- Check expiration date
- Use containers in numerical order/or per most recent physician/LIP order

Steps to Administration

- Inspect container for leaks, discoloration, cloudiness, precipitate or separation of solution ("oiling out" or "cracking")
Steps to Administration

- Compare container label with order sheet
- Verify the label on the PN container for accuracy with the most current physician/LIP order prior to initiating an infusion

Steps to Administration (cont)

- Gather Supplies
  - Administration set and appropriate filter (0.22 micron vs. 1.2 micron)
  - Solution container
  - Additive vials
  - Safety syringes and needles
  - Alcohol pads
  - Filter straw (if drawing additives up from glass ampules)
  - Additive labels
  - Appropriate flush solutions based on VAD
  - Needleless connector
  - Gloves
  - Transfer Device when adding more than 2 additives

Steps to Administration (cont)

- Electronic Infusion Device
  - All parenteral nutrition must be administered via an electronic infusion device
### Additives

Many additives have limited stability in solution and must be added by the nurse just prior to hanging PN.

No more than 3 additives (using no more than 2 punctures into the solution container) may be added by the nurse to parenteral nutrition. If more than 3 additives are ordered, consult with infusion pharmacist for guidance.

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### Management of Complications of PN Therapy

<table>
<thead>
<tr>
<th>Complication</th>
<th>Cause</th>
<th>Signs/Symptoms</th>
<th>Prevention/Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Overload</td>
<td></td>
<td>Weight gain of greater than 2 lbs per week, SBO, rales, edema</td>
<td>Monitor weight as ordered. Report excessive weight gain to physician/LP. Monitor for edema, pulmonary edema, and skin turgor.</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td>Rapid infusion of PN solution</td>
<td>Serum glucose greater than 150 mg/dL, Urine glucose of + or +++. Hyperviscosity is usually first sign. Increased urine specific gravity, ketoacidosis, altered mental status changes, polyuria, deep rapid breathing, and dry skin.</td>
<td>Perform glucose monitoring as ordered. Obtain and adhere to specific parameters set by physician/LP related to glucose monitoring and insulin coverage. Swear infused PN solution. Add insulin to solution as ordered.</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>Failure to add correct amount of insulin to PN solution as ordered</td>
<td>Headache, weakness, dizziness, hunger, blurred vision, trembling, chills, tachycardia, altered level of consciousness</td>
<td>Hypoglycemia is an emergency situation. Monitor glucose as ordered. A series of VAD or IV drip will rapidly correct the immediate problem. Initiate or terminate all PN infusions gradually. Avoid abrupt interruptions of solution during administration.</td>
</tr>
</tbody>
</table>

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### Management of Complication of PN Therapy

<table>
<thead>
<tr>
<th>Vascular Access Device-Related</th>
<th>Causes</th>
<th>Signs/Symptoms</th>
<th>Prevention/Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
<td>Unsterile technique, use of poor aseptic technique, failure to follow policies and procedures related to VAD maintenance, and use of infusate-irritating PN solution.</td>
<td>Sudden onset of fever, hypotension in a previously afebrile patient, increase RBC, WBC, platelets, increase in WBC, anorexia, right-sided, fetal cardiac, hypotension.</td>
<td>Check each solution container for appearance, integrity, and expiration date. Change solution administration set, and needless connector every 24 hours. Maintain strict aseptic technique during all aspects of PN Therapy. Monitor VAD closely and report any S/S of infection to the responsible RN or physician.</td>
</tr>
<tr>
<td>VAD Occlusion</td>
<td>Improper flushing of VAD.</td>
<td>Failure to flush VAD, no blood return on aspiration. Failed to flush VAD, although usually sluggish, no blood return on aspiration.</td>
<td>Maintain VAD per Infusion Maintenance Table located in The Omnicare Handbook/Infusion Procedure Manual for PN. Follow flush and lock using appropriate type and amount of flushing solution. Flush immediately upon completion of therapy or anytime therapy must be interrupted. Flush all unused lumens per Infusion Maintenance Table.</td>
</tr>
</tbody>
</table>
## Management of Complication of PN Therapy

<table>
<thead>
<tr>
<th>Complication</th>
<th>Cause</th>
<th>Signs/Symptoms</th>
<th>Prevention/Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAD Malposition</td>
<td>Improper insertion of VAD</td>
<td>Swelling around AV access, arterial or venous puncture, pain on insertion site, increased blood pressure</td>
<td>DO NOT use the VAD for infusion until problem is resolved. Use the VAD for infusion only after it is inserted correctly.</td>
</tr>
<tr>
<td>VAD Breakage</td>
<td>VAD being pulled on by staff or resident</td>
<td>Swelling around AV access, arterial or venous puncture, difficulty flushing VAD, no blood flow after VAD is flushed</td>
<td>DO NOT use the VAD for infusion until problem is resolved. Use the VAD for infusion only after it is inserted correctly.</td>
</tr>
</tbody>
</table>

**Documentation**

**Label**
- Solution container
- Administration set
- VAD lumens

**MAR/POS**
Documentation

Nursing Progress Notes
- Date and time
- Flushing agent(s)
- Medication additives/solution
- Volume and rate
- Tapering schedule, if ordered
- Site assessment
- Complications and interventions
- Patient response to procedure and/or medication

Intake and Output Totals
Weights
Vital Signs

See attached signed order/formula

Documentation

PARENTERAL NUTRITION ORDERS:
Transcribe Orders for Additives onto MAR
Review & Verify, peripheral nutrition prescription, administration of additives, and compare bag label with chart order

- Total Parenteral Nutrition
  - Continuous Infusion
  - Cycled Infusion
  - Partial Parenteral Nutrition

Total Parenteral Nutrition
- Infusion
- Partial Parenteral Nutrition
- Cycled Infusion
- Taper down hours
- Taper down hours

Volume
- 3100 ml
- 12 hours
- 41 hours
- 1 hour
- 3 hours

Complications and interventions
- Patient response to procedure and/or medication

See attached signed order/formula

Documentation
Next Steps

• Complete Exam with an 80% or above

• Receive an email with your Certificate of Completion

• Schedule practicum with your local Omnicare Pharmacy, or your employer