Overview of the Parenteral Nutrition Process and use of PN in Long Term Care

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Disclosures

- The speaker is an employee of Fresenius Kabi USA, LLC
Objectives

- Objectives:
  - Recognize indications and goals of PN therapy related to long term care
  - Review the steps of the PN process, including assessment, ordering, preparation, and administration
  - Discuss clinical recommendations and review tools available to help clinicians navigate the PN process
  - Identify PN formulation options for long term care facilities
“PN serves as an important therapeutic modality that is used in adults, children and infants for a variety of indications.”

PN has been shown to:

- be life saving in patients with intestinal failure and subacute/chronic radiation enteropathy
- significantly reduce morbidity in malnourished patients
- reduce the risk of complications in patients receiving preoperative PN

The PN process is complex and involves multiple disciplines.
Standardizing the PN Process: ensuring safety is in the process

- Standardization incorporates technical and practice standards into a process so the **same level of safe care** is delivered
- Standardization opportunities **exist at each step** of PN process
- A.S.P.E.N. and ISMP guidelines and recommendations **encourage** standardization of the PN process

**Develop**
- Policies
- Procedures
- Education
- Competency Assessments

**Use**
- PN order and label
- Templates
- Standardized commercially available PN

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A.S.P.E.N. = American Society for Parenteral and Enteral Nutrition; ISMP = Institute for Safe Medication Practices

The PN Process: Assessment
The PN Process: Assessment

Nutrition Care Team and/or Dietitian

- Reviews patient data
- Conducts nutrition assessment
  - History and Physical Exam, Anthropometrics, Laboratory tests
- Estimates nutrient requirements
- Determines nutrition intervention and nutrition prescription based on therapy goals and clinical condition
- Communicates with prescriber as needed

The PN Process: Prescription

Assessment

Prescription

Review, Verification, Transcription

Preparation, Compounding, Dispensing

Administration

Monitoring

Nutrition Care Team/Dietitian

Clinician

Pharmacist

Pharmacist/Pharmacy Tech

Nurse/Patient Care Giver

Nutrition Care Team/Nurse
When determining an appropriate prescription, a clinician must decide:

### Appropriate Use
- Indications

### IV Access
- Peripheral
- Central

### PN Ingredients
- Macronutrients (protein, lipids, dextrose)
- Micronutrients (vitamins, trace elements, electrolytes)
- Fluid

### PN Instructions
- Total volume
- Infusion rate
- Start and stop times

Prescription: Indications\(^1-4\)

**INDICATIONS**

- Mechanical or physiological failure of GI tract
  - Prolonged or paralytic ileus
  - Intestinal obstruction
  - Mesenteric ischemia
  - High output fistula
  - Dysmotility
  - Malabsorption
  - Short bowel syndrome
  - Intractable vomiting
  - Severe diarrhea

- Intolerance or inadequacy of enteral/oral feeding

- Inability to gain access to the GI tract

GI = gastrointestinal

Selection of Vascular Access Device

Central
- Central venous catheter placed into a large vein (jugular, subclavian)
  - Single, double, or triple lumen catheter
  - PICC (peripherally inserted central catheter)
- Confirm tip location in superior vena cava

Peripheral
- Peripheral venous catheter placed in small peripheral vein (typically in upper extremities)
## Prescription: determining IV Access (Peripheral vs Central)

<table>
<thead>
<tr>
<th></th>
<th>Peripheral</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td>1 to 2 weeks</td>
<td>&gt;1 week</td>
</tr>
<tr>
<td><strong>Protein Calorie Malnutrition</strong></td>
<td>None to Mild</td>
<td>Moderate to Severe</td>
</tr>
<tr>
<td><strong>Fluid</strong></td>
<td>High volume</td>
<td>May minimize volume</td>
</tr>
<tr>
<td><strong>Meet Nutrient Requirements</strong></td>
<td>Minimally</td>
<td>Needs met</td>
</tr>
<tr>
<td><strong>Osmolarity</strong></td>
<td>&lt;900 mOsm/L</td>
<td>No restriction</td>
</tr>
</tbody>
</table>
Ordering PN

- Determine fluid needs
- Determine nutrient requirements
  - Amino acids, carbohydrates, lipids, total energy, electrolytes
- Calculate the composition of the PN solution
  - Impact of drug shortages
  - Disease state considerations
- Use a standardized order form
# Prescription: Macronutrients

**A.S.P.E.N. Suggested Intake for Adult Patients**

<table>
<thead>
<tr>
<th></th>
<th>Stable Patient</th>
<th>Critically Ill Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluid Requirements</strong></td>
<td>30 to 40 mL/kg/day</td>
<td>Minimum needed to deliver adequate macronutrients</td>
</tr>
<tr>
<td><strong>Energy Needs</strong></td>
<td>20 to 30 kcal/kg/d</td>
<td>25 to 30 kcal/kg/d</td>
</tr>
<tr>
<td><strong>Protein Needs</strong></td>
<td>0.8 to 1 g/kg/d</td>
<td>1.2 to 2 g/kg/d</td>
</tr>
<tr>
<td><strong>Lipid Needs</strong></td>
<td>1 g/kg/d OR 20-30% energy needs</td>
<td>Hold or limit to 100g 1st week then ≤1 g/kg/d</td>
</tr>
<tr>
<td><strong>Carbohydrate Needs</strong></td>
<td>≤7 mg/kg/min (4 to 5 mg/kg/min)</td>
<td>≤4 mg/kg/min</td>
</tr>
</tbody>
</table>

3. Barber et al. *ASPEN Core Curriculum* 2012;261
PN Prescription: Micronutrients
Vitamins and Trace Elements

Vitamins and trace elements should always be considered when prescribing PN

<table>
<thead>
<tr>
<th>VITAMINS</th>
<th>A, mg</th>
<th>D, IU</th>
<th>E, mg</th>
<th>K, mcg</th>
<th>B₁, mg</th>
<th>B₂, mg</th>
<th>B₃, mg</th>
<th>B₅, mg</th>
<th>B₆, mg</th>
<th>B₁₂, mg</th>
<th>C, mg</th>
<th>Biotin, mcg</th>
<th>Folate, mcg</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV MVI¹ (10 mL)</td>
<td>1 mg</td>
<td>200</td>
<td>10</td>
<td>± 150</td>
<td>6</td>
<td>3.6</td>
<td>40</td>
<td>15</td>
<td>6</td>
<td>5</td>
<td>200</td>
<td>60</td>
<td>600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DOSE</th>
<th>Zn (mg/mL)</th>
<th>Cu (mg/mL)</th>
<th>Mn (mcg/mL)</th>
<th>Cr (mcg/mL)</th>
<th>Se (mcg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTE-4</td>
<td>3 - 5 mL</td>
<td>1</td>
<td>0.4</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>MTE-4 Concentrate</td>
<td>1 mL</td>
<td>5</td>
<td>1</td>
<td>500</td>
<td>10</td>
</tr>
<tr>
<td>MTE-5</td>
<td>5 mL</td>
<td>1</td>
<td>0.4</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>MTE-5 Concentrate</td>
<td>1 mL</td>
<td>5</td>
<td>1</td>
<td>500</td>
<td>10</td>
</tr>
</tbody>
</table>


† RDA = Recommended Dietary Allowances & Adequate Intake
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### PN Prescription: Micronutrients – Electrolytes

<table>
<thead>
<tr>
<th>Electrolyte⁴</th>
<th>Standard Daily Requirement</th>
<th>Factors that Increase Needs</th>
<th>Available Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>1 to 2 mEq/kg³</td>
<td>Diarrhea, vomiting, NG suction, GI losses</td>
<td>Sodium Chloride, Sodium Acetate, Sodium Phosphate</td>
</tr>
<tr>
<td>Potassium</td>
<td>1 to 2 mEq/kg³</td>
<td>Diarrhea, vomiting, NG suction, medications, refeeding, GI losses</td>
<td>Potassium Chloride, Potassium Acetate, Potassium Phosphate</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>20 to 40 mmol</td>
<td>High dextrose intake, refeeding</td>
<td>Sodium phosphate, Potassium phosphate</td>
</tr>
<tr>
<td>Acetate</td>
<td>As needed to maintain acid-base balance</td>
<td>Renal insufficiency, metabolic acidosis, GI bicarbonate losses</td>
<td>Sodium Acetate, Potassium Acetate</td>
</tr>
<tr>
<td>Chloride</td>
<td>As needed to maintain acid-base balance</td>
<td>Metabolic alkalosis, volume depletion</td>
<td>Sodium Chloride, Potassium Chloride</td>
</tr>
<tr>
<td>Calcium</td>
<td>10 to 15 mEq</td>
<td>High protein intake</td>
<td>Calcium gluconate</td>
</tr>
<tr>
<td>Magnesium</td>
<td>8 to 20 mEq</td>
<td>GI losses, drugs, refeeding</td>
<td>Magnesium Sulfate</td>
</tr>
</tbody>
</table>

# Prescription: Calculation of PN Components

<table>
<thead>
<tr>
<th>PN Component</th>
<th>Stable Adult¹</th>
<th>80 kg Adult Daily Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluid</strong></td>
<td>30-40 mL/kg/dᵃ</td>
<td>2400-3200 mL</td>
</tr>
<tr>
<td><strong>Total Energy</strong></td>
<td>20-30 kcal/kg/dᵇ</td>
<td>1600-2400 kcal</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>0.8-1 g/kg/d</td>
<td>64-80 g protein</td>
</tr>
<tr>
<td><strong>Lipids</strong></td>
<td>1 g/kg/d OR 20-30% total energy</td>
<td>80 g OR 48-72 g/d</td>
</tr>
<tr>
<td><strong>Carbohydrate</strong></td>
<td>≤ 7 mg/kg/min¹</td>
<td>≤806 g dextrose¹</td>
</tr>
<tr>
<td></td>
<td>4-5 mg/kg/min²</td>
<td>460-576 g dextrose²</td>
</tr>
<tr>
<td></td>
<td>3 mg/kg/min³</td>
<td>346 g dextrose³</td>
</tr>
</tbody>
</table>

ᵃ May vary if the patient has ongoing fluid losses
ᵇ Varies according to activity levels

3. Clinical Practice
Lipids: A.S.P.E.N. Guidelines and Recommendations\textsuperscript{1,2,3,4}

- ILE are “an essential component to PN”
  - 20 – 30\% daily kcal from fat
  - Choice of Soybean Oil or 4-oil blend (Soy, MCT, Olive, Fish-Smoflipid\textsuperscript{®})

- EFA:
  - 2 – 4\% total calories from linoleic acid
  - 0.25 – 0.5\% total calories from alpha-linolenic acid

- Long term patients- provide up to 1 gm/kg/day (Soybean Oil) or 1-2 g/kg/day Smoflipid\textsuperscript{®}

- Hold ILE for TG > 400 mg/dL (All types of Lipid Emulsions)

\textsuperscript{1} Hise M and Brown JC. Chapter: Lipids. The ASPEN Adult Nutrition Support Core Curriculum, 2\textsuperscript{nd} Ed. p63-82.
\textsuperscript{3} McClave S et al. JPEN J Parent Enteral Nutr 2016; 40 (2): 159-211
\textsuperscript{4} Staun M et al. Clin Nutr 2009; 28: 467-79
## Prescription: Calculation of PN Components

<table>
<thead>
<tr>
<th>PN Component</th>
<th>Stable Adult(^1)</th>
<th>80 kg Adult Daily Req. EXAMPLE</th>
<th>Central PN Formula (Progression to Goal) EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluid</strong></td>
<td>30 to 40 mL/kg/day</td>
<td>2400-3200 mL</td>
<td>Start 1000-1500mL; advance to 2400 mL as tolerated</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>20 to 30 kcal/kg/d</td>
<td>1600-2400 kcal</td>
<td>~2000 kcal (25 kcal/kg)</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>0.8 to 1 g/kg/d</td>
<td>64-80 g protein</td>
<td>80 g amino acids (320 kcal)</td>
</tr>
<tr>
<td><strong>Lipid</strong></td>
<td>1 g/kg/d OR 20-30% energy needs(^3,4)</td>
<td>80 g OR 48-72 g/d</td>
<td>50 g lipid Soybean (500 kcal) OR 80 g Smoflipid</td>
</tr>
<tr>
<td><strong>Carbohydrate</strong></td>
<td>(\leq 7 \text{ g/kg/min}(^1))</td>
<td>(\leq 806 \text{ g dextrose}(^1))</td>
<td>Remainder kcal: Start 100-150 g dextrose(^2); advance to 260-350 g dextrose(^3) (880-1190 kcal)</td>
</tr>
<tr>
<td></td>
<td>4-5 mg/kg/min(^2)</td>
<td>460-576 g dextrose(^2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 mg/kg/min(^3)</td>
<td>350 g dextrose(^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(&lt;2 \text{ mg/kg/min})</td>
<td>(&lt;300 \text{ g dextrose}(^3))</td>
<td></td>
</tr>
</tbody>
</table>

---

3. Clinical Practice
## Prescription: Calculation Example of PN Components

<table>
<thead>
<tr>
<th>PN Component</th>
<th>Stable Adult</th>
<th>80 kg Adult Requirements</th>
<th>Central PN Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>1 to 2 mEq/kg/d</td>
<td>80 to 160 mEq/d</td>
<td>80 mEq Sodium Chloride</td>
</tr>
<tr>
<td>Potassium</td>
<td>1 to 2 mEq/kg/d</td>
<td>80 to 160 mEq/d</td>
<td>80 mEq Potassium Acetate</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>20 to 40 mmol/d</td>
<td>20 to 40 mmol/d</td>
<td>30 mmol Sodium Phosphate</td>
</tr>
<tr>
<td>Calcium</td>
<td>10 to 15 mEq/d</td>
<td>10 to 15 mEq/d</td>
<td>12 mEq Calcium Gluconate</td>
</tr>
<tr>
<td>Magnesium</td>
<td>8 to 20 mEq/d</td>
<td>8 to 20 mEq/d</td>
<td>10 mEq Magnesium Sulfate</td>
</tr>
<tr>
<td>Multivitamin Injection</td>
<td>Full Dose</td>
<td>Full Dose</td>
<td>Full Dose</td>
</tr>
<tr>
<td>Multi trace element injection</td>
<td>Full Dose</td>
<td>Full Dose</td>
<td>Full Dose</td>
</tr>
</tbody>
</table>

Calculating the PN Solution: An Example

Compound PN Solution using available components:
10% Amino Acids, 50% dextrose, 20% ILE (soybean oil)

RX: 80 gm amino acids, 350 gm dextrose, 50 gm lipid, 2.4 liters

**Amino acids**
800 mL of 10% amino acids (80 g x 4 kcal/g = 320 kcal)

**Dextrose**
700 mL of 50% dextrose (350 g x 3.4 kcal/g = 1190 kcal)

**Lipid**
250 mL of 20% ILE (50 g x 10 kcal/g = 500 kcal) Note: Lipid ≥ 2% final concentration for TNA stability (20g/L minimum)

**Fluid**
800 mL + 700 mL + 250 mL = 1750 mL + electrolytes + sterile water to equal 2400 mL

**Energy** (25 kcal/kg) 320 + 1190 + 500 = 2010 kcal
### PN Order Form Using Calculations for 80 kg Person (Example)

#### Patient Information
- **Patient Name __________________**
- **Medical Record Number __________________**
- **Birth Date/Age______**
- **Patient Location __________________**
- **Allergies __________________**
- **Height and Dosing Weight: Ht: ______ cm **
- **Dosing Wt: ______ kg**
- **Diagnosis(es)/Indication(s) for PN______________________________**
- **Vascular Access Device/Location CVC type________________**
- **Location________________**

#### Administration Date/Time ________________________

#### Macronutrients

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Amount/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amino acids</td>
<td>80 g</td>
</tr>
<tr>
<td>Dextrose</td>
<td>350 g</td>
</tr>
<tr>
<td>IV fat emulsion</td>
<td>50 g</td>
</tr>
</tbody>
</table>

#### Electrolytes

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium phosphate</td>
<td>30 mmol</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>80 mEq</td>
</tr>
<tr>
<td>Sodium acetate</td>
<td>— mEq</td>
</tr>
<tr>
<td>Potassium phosphate</td>
<td>— mmol</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>— mEq</td>
</tr>
<tr>
<td>Potassium acetate</td>
<td>80 mEq</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>10 mEq</td>
</tr>
<tr>
<td>Calcium gluconate</td>
<td>12 mEq</td>
</tr>
</tbody>
</table>

#### Vitamins, Trace Elements, Additives
- **Multi-component vitamins** 10 mL
- **Multi-component trace elements** 1-5 mL **Dose depends on product**
- **Other additives** (eg, individual vitamins or trace elements, cysteine, regular insulin) as clinically appropriate and compatible

#### PN Instructions
- **Total volume ______________________ mL**
- **Infusion rate _________ mL/h**, **Start and Stop times _____________**
- **Cycle information ________________________**
- **Prescriber and contact information ________________________________**

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**Note:** Electrolytes ordered as salts

**Ingredients dosed per day**

**Pharmacist MUST evaluate prescription for compatibility**
The PN Process: Review, Verification, Transcription

Assessment → Prescription → Review, Verification, Transcription → Preparation, Compounding, Dispensing → Administration → Monitoring

Nutrition Care Team/Dietitian → Clinician → Pharmacist → Pharmacist/Pharmacy Tech → Nurse/Patient Care Giver → Nutrition Care Team/Nurse

Boullata J. *JPEN J Parenter Enteral Nutr.* 2012;36:11S.
**Review/Verification**

- Prior to preparation/compounding, the PN order has to be reviewed and verified by a pharmacist.

- The review process includes two steps:
  - **Clinical review**: check if the dosing of each nutrient is appropriate for the individual patient.
  - **Pharmaceutical review**: check if the ordered components are compatible and if the preparation is expected to be stable.

**Transcription**

- Transcription of PN order from handwritten or printed RX into the pharmacy system.
- Computerized physician order entry (CPOE) system eliminates this step.
The PN Process: Preparation, Compounding, Dispensing

Assessment

Prescription

Review, Verification, Transcription

Preparation, Compounding, Dispensing

Administration

Monitoring

Nutrition Care Team/Dietitian

Clinician

Pharmacist

Pharmacist/Pharmacy Tech

Nurse/Patient Care Giver

Nutrition Care Team/Nurse

Boullata J. *JPEN J Parenter Enteral Nutr.* 2012;36:11S.
Types of PN Preparations

**Compounded**
- Customized [patient specific]
- Standardized [institution specific]

**Manufactured**
- Multi-chamber [commercially available]
Purpose: The survey evaluated practices and technologies related to dispensing and administration.

Methods: A stratified random sample of pharmacy directors at 1435 general and children’s medical-surgical hospitals in the US were surveyed by mail.

Results:

<table>
<thead>
<tr>
<th>Predominant Method of Compounding Nutrition Support Preparations</th>
<th>% Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td># Staffed Beds</td>
<td>N</td>
</tr>
<tr>
<td>&lt; 50</td>
<td>85</td>
</tr>
<tr>
<td>50 – 99</td>
<td>54</td>
</tr>
<tr>
<td>100 – 199</td>
<td>48</td>
</tr>
<tr>
<td>200 – 199</td>
<td>70</td>
</tr>
<tr>
<td>300 – 399</td>
<td>57</td>
</tr>
<tr>
<td>400 – 599</td>
<td>65</td>
</tr>
<tr>
<td>≥600</td>
<td>46</td>
</tr>
<tr>
<td>All Hospitals 2014</td>
<td>425</td>
</tr>
<tr>
<td>All Hospitals 2011</td>
<td>559</td>
</tr>
</tbody>
</table>
Commerically Available Multi-Chamber PN: Pros and Cons

**Potential Advantages**
- Ease and convenience for prescribers
- Minimizes misinterpretation of orders and calculation errors
- Decreases compounding errors
- Increases cost savings from decreased nurse/pharmacist time
- Minimizes impact of shortages

**Potential Disadvantages**
- Education required for new bag technology
- 1L or 2L multi-chamber bags may not meet total nutrient requirements in 24 hrs
- Requires additives, such as vitamins and trace minerals
- 2-chamber bags may require addition of IV lipid emulsion or piggybacking
- May not meet all patients’ nutrient needs

Gervasio J. *JPEN*. 2012;36:40S-41S.
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The PN Process: Dispensing

- Labeling, storage and delivery of PN prior to administration

- Labels for PN formulations should be standardized and should include:
  - Content
  - Route of administration
  - Date and time of administration
  - Infusion duration and infusion rates

### PN Label for 80 kg Person (Example)

**Patient Information**
- Patient Name: ____________________
- Medical Record Number: ________________
- Birth Date/Age: ____________
- Patient Location: ____________________
- Height and Dosing Weight: Ht: 183 cm, Dosing Wt: 80 kg
- Diagnosis(es)/Indication(s) for PN: Intestinal Obstruction
- Vascular Access Device/Location: CVC type ____, PICC ________, Location: Right Superior Vena Cava
- Administration Date: ____________________
- Administration Time: ____________

**Macronutrients**
- Amino acids: 80 g
- Dextrose: 350 g
- IV Fat emulsion: 50 g

**Electrolytes**
- Sodium phosphate: 30 mmol of phosphate (Sodium ____mEq)
- Sodium chloride: 80 mEq
- Sodium acetate: ____mEq
- Potassium phosphate: mmol of phosphate (Potassium ____mEq)
- Potassium chloride: ____mEq
- Potassium acetate: 80 mEq
- Magnesium sulfate: 10 mEq
- Calcium gluconate: 12 mEq

**Vitamins, Trace Elements**
- Multi-component vitamins: 10 mL
- Multi-component trace elements: 5 mL

**Other Additives** (eg, individual vitamins or trace elements, regular insulin)

**PN Instructions:** FOR CENTRAL (PERIPHERAL) VEIN ADMINISTRATION ONLY
- Total volume: 2400 mL
- Infusion rate: 100 mL/h
- Cycle information: ____________
- Do not use after date/time: ____________

**Label should have same sequence of ingredients and must match order**

**Ingredients dosed in amount per day**

<table>
<thead>
<tr>
<th>Ingredients dosed</th>
<th>Amount/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amino acids</td>
<td>80 g</td>
</tr>
<tr>
<td>Dextrose</td>
<td>350 g</td>
</tr>
<tr>
<td>IV Fat emulsion</td>
<td>50 g</td>
</tr>
<tr>
<td>Sodium phosphate</td>
<td>30 mEq</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>80 mEq</td>
</tr>
<tr>
<td>Sodium acetate</td>
<td>____mEq</td>
</tr>
<tr>
<td>Potassium phosphate</td>
<td>____mEq</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>____mEq</td>
</tr>
<tr>
<td>Potassium acetate</td>
<td>80 mEq</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>10 mEq</td>
</tr>
<tr>
<td>Calcium gluconate</td>
<td>12 mEq</td>
</tr>
</tbody>
</table>

**Prescriber and Contact Information**
- ______________________________________________________________________

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The PN Process: Administration

Boullata J. *JPEN J Parenter Enteral Nutr.* 2012;36:11S.
The PN Process: Administration

The first step is the verification of the PN order according to the five “rights”

- Right patient
- Right drug
- Right dose (and rate)
- Right route
- Right time

This process includes:

- Safe and effective management of all medical devices and equipment used
- Safe administration of medications in conjunction with PN therapy and optimal care of vascular access devices

Administration – The First 24 Hours

- Initial volume may be lower than goal volume (start at goal amino acids and lipids; progress to goal volume and dextrose as tolerated)
- Check labs before and after initiation of PN, including electrolytes, glucose, and acid-base status
- Observe for changes in fluid status: monitor intake and output, presence of edema, vital signs, and weight
The PN Process: Monitoring

Assessment | Prescription | Review, Verification, Transcription | Preparation, Compounding, Dispensing | Administration | Monitoring

Nutrition Care Team/Dietitian | Clinician | Pharmacist | Pharmacist/Pharmacy Tech | Nurse/Patient Care Giver | Nutrition Care Team/Nurse

Boullata J. *JPEN J Parenter Enteral Nutr.* 2012;36:11S.
## Monitoring Parameters and Frequency

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initiation</th>
<th>Critically Ill</th>
<th>Stable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrolytes</strong></td>
<td>Daily</td>
<td>Daily*</td>
<td>1-2 x / wk</td>
</tr>
<tr>
<td><strong>Glucose</strong></td>
<td>Daily</td>
<td>Daily</td>
<td>1-2 x / wk</td>
</tr>
<tr>
<td><strong>Triglycerides</strong></td>
<td>Day 1</td>
<td>Weekly</td>
<td>Weekly</td>
</tr>
<tr>
<td><strong>Liver Enzymes</strong></td>
<td>Day 1</td>
<td>Daily*</td>
<td>Weekly</td>
</tr>
<tr>
<td><strong>CBC</strong></td>
<td>Day 1</td>
<td>Daily*</td>
<td>Weekly</td>
</tr>
<tr>
<td><strong>Dyspnea/SOB</strong> /Edema</td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
</tr>
<tr>
<td><strong>Weight, I/O</strong></td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
</tr>
</tbody>
</table>

*Until stable and then 1-2x per week.


† CBC = complete blood count
†† SOB = shortness of breath
††† I/O = intake and output
The PN Process: Monitoring for complications

**Metabolic**
- Refeeding Syndrome
- Fluid and electrolyte abnormalities
- Acid/base imbalance
- Hepatic complications
  - LFT elevation
  - Fatty liver
  - Cholestasis
  - Liver failure
- Metabolic imbalances
  - Hyper/hypoglycemia
  - Essential fatty acid deficiency
  - Vitamin/trace element deficiencies
  - Metabolic bone disease

**Infectious**
- Catheter-related bacteremia or sepsis
  - Related to:
    - Access device
    - Exit site
    - Surrounding skin
- Septic thrombosis

**Mechanical**
- Occlusions, thrombosis, leakage, breakage, malposition of access device
- Equipment failure

LFT = liver function test

PN Complications

- Can result in serious morbidity or mortality\(^1\)
- A.S.P.E.N. survey\(^2\)
  - 25% of reported adverse events related to PN caused temporary or permanent harm
  - 4.8% resulted in a near-death event or death
- Severe complications may lead to increased LOS and additional costs\(^{1,3,4}\)
  - refeeding syndrome, hyperglycemia, catheter infections

LOS = Length of Stay

Transitioning Off PN

1. Gradual transition to avoid complications
2. Combine PN and enteral to provide all nutrient goals during transition
   - Provide multivitamins and trace minerals orally as well as via IV during transition
3. Provide PN until 60% of energy needs can be met enterally
4. Communicate with primary team that PN is being stopped as:
   - Other IV fluid may be needed
   - Electrolyte supplementation may be needed
   - Insulin in PN bag is being stopped
   - Glucose source is being stopped
Transitions of Care: Long Term Care to and from hospital and home

Discharge from hospital or Healthcare Facility (HCF)
- Communication is KEY!
- Request
  - Discharge PN order form for LTC facility infusion
  - Copy of patient flowsheet with labs, notes etc.
  - Contact information of in-house PN prescriber
- Ensure that there is a an outpatient physician to sign PN orders

LTC Facility to HCF or Home
- Communication is KEY!
- Send:
  - RX to HCF or Home Infusion provider
  - Copy of patient flowsheet with labs, notes, etc.
  - Contact information of LTC facility prescriber
- Maintain contact during discharge from LTC to home or HCF
Risks in the PN Process

Assessment Errors:
- PN not indicated
- Inexperienced clinician
- Order inappropriate

Dosing Errors:
- Doses outside normal ranges
- Incorrect PN volume
- Incorrect infusion rate
- Prescription of incompatible components

Review/Verification/Transcription errors:
- Misinterpretation of abbreviations and dose designations
- Incomplete/missing evaluation for compatibility and stability
- Selection of the wrong ingredient
- Drug omission

Preparation/Compounding/Dispensing Errors:
- Product mix-up
- Errors in sterile compounding technique
- Incompatible or missing additives
- Incorrect or incomplete labelling
- Incorrect storage – not kept at recommended temperature

PN Administration Errors:
- Wrong patient, drug, dose, route, time
- Contamination of infusion system

Monitoring Errors:
- Inexperienced
- Monitoring labs not ordered or reviewed
- PN not adjusted as needed
- Absence of essential PN components unnoticed
Long term Care

- LPN’s may not be permitted to care for or use the PN catheters in many states
- RN may be the only person on LTC staff with central line catheter care responsibilities. RN experience with catheter care and PN administration varies.
- Infection is the most serious consequence of non-sterile catheter care and may result in sepsis/death
- RNs can be trained in catheter care by certified infusion nurses familiar with PN administration and catheter care
  - Check with RN manager in facility to learn of interest/skill set
  - Ask pharmacy if RN catheter care/PN administration teaching available
  - Infusion Nurses Society (INS) skilled in catheter care and administration
Resources Available to Promote Safe Administration of the PN Process

PN Safety Checklists
- PN Safety Preparation Checklist
- PN Prescribing Checklist
- PN Order Review and Verification Checklist
- PN Compounding Checklist
- PN Administration Checklist

Parenteral Nutrition Safety Consensus Recommendations

Product Shortages

Adverse Event and Error Reporting Program

Related Publication

Educational Opportunities

www.nutritioncare.org/pnsafety
Summary

- The PN process is complex, starting with patient assessment and progressing through order writing, compounding, and administration.

- Standardization of the PN Process can help improve safe provision of PN. Multichamber PN bags may be part of the standardized process.

- Regulatory requirements may affect compounding decisions.

- Published clinical guidelines, nutrient recommendations, and toolkits are available to help clinicians navigate each step of the PN process and provide appropriate, safe care for their patients.
Check your Knowledge!

1. What is/are indications for parenteral nutrition?
   a. Patient at the end of life who can no longer eat or drink
   b. Patient refuses a gastrostomy tube
   c. Patient has had a partial intestinal resection and GI fluid losses have caused dehydration, despite tube feedings, oral rehydration solutions and a modified diet
   d. Patient has a complete intestinal obstruction and a feeding tube and surgery are not options.
   e. c and d
2. What are the steps to ordering PN: Sort in order from beginning to end

a. Use a standardized order form
b. Determine nutrient and fluid requirements
c. Calculate the composition of the PN solution
d. Verify indication for and appropriateness of PN
3. Severe complications of PN may be prevented by:
   a. Standardizing the PN process
   b. Using only Enteral Nutrition
   c. Hiring more pharmacists
   d. Including insulin in PN bags
   e. Restricting prescribing privileges to physicians only
4. Risks for errors in the PN process exist at which step the process (SELECT ALL THAT APPLY)

a. PN ordering
b. PN compounding
c. PN administration
d. PN monitoring
e. Transitions of care
Questions?