Emerging Trends in Parenteral Nutrition: An Evidence-Based Approach
## Thank You to Our Distinguished Faculty

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alan Buchman, MD, MSPH</td>
<td>Northwestern University</td>
<td>Chicago, Illinois</td>
</tr>
<tr>
<td></td>
<td>Feinberg School of Medicine</td>
<td></td>
</tr>
<tr>
<td>Mark DeLegge, MD</td>
<td>Baxter Healthcare Corporation</td>
<td>Deerfield, Illinois</td>
</tr>
<tr>
<td>Mary Hise, RD, PhD</td>
<td>Baxter Healthcare Corporation</td>
<td>Deerfield, Illinois</td>
</tr>
<tr>
<td>Donald Kirby, MD</td>
<td>The Cleveland Clinic</td>
<td>Cleveland, Ohio</td>
</tr>
<tr>
<td>Gordon Jensen, MD, PhD</td>
<td>Penn State University</td>
<td>University Park, Pennsylvania</td>
</tr>
<tr>
<td>Stephen O’Keefe, MD, MSc</td>
<td>University of Pittsburgh School of Medicine</td>
<td>Pittsburgh, Pennsylvania</td>
</tr>
<tr>
<td>Charles Van Way, III, MD</td>
<td>University of Missouri-Kansas City</td>
<td>Kansas City, Missouri</td>
</tr>
<tr>
<td>Gary Zaloga, MD, MA</td>
<td>Baxter Healthcare Corporation</td>
<td>Deerfield, Illinois</td>
</tr>
</tbody>
</table>
Discussion Overview

- General Indications and Administration
- Goal-Directed Nutrition Therapy
- Mortality Risk: Enteral vs Parenteral Nutrition
- Improved Parenteral Nutrition Safety
General Indications and Administration
A.S.P.E.N. Practice Guidelines Indications for Specialized Nutrition Support

- Enteral nutrition (EN) is recommended in patients with a functioning gut.

- Proposed advantages of EN vs parenteral nutrition (PN) include better maintenance of gut integrity and ↓ cost, infection, and hospital Length of Stay (LOS).

- Major controversy concerns the relative indications of PN vs EN.

Source: Guidelines for the Use of Parenteral and Enteral Nutrition in Adult and Pediatric Patients. JPEN. 2002;26(suppl 1):1SA-138SA.
### General Indications for Enteral and Parenteral Nutrition in Adults

<table>
<thead>
<tr>
<th>Enteral</th>
<th>Parenteral (Central)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Patients with or at risk of malnutrition</td>
<td>• Patients with or at risk of malnutrition</td>
</tr>
<tr>
<td>• Patient has a functional GI tract</td>
<td>• Nonfunctioning or inaccessible GI tract</td>
</tr>
<tr>
<td>• Oral intake is impossible, inadequate or unsafe</td>
<td>• Patient has failed EN trial</td>
</tr>
<tr>
<td>• Severely malnourished preoperative patients</td>
<td>• EN is contraindicated or intestinal tract severely diminished function</td>
</tr>
</tbody>
</table>

## General Contraindications for Enteral and Parenteral Nutrition in Adults

### Enteral
- Nonoperative mechanical GI obstruction
- Intractable vomiting/diarrhea refractory to medical management
- Short-bowel syndrome
- Paralytic ileus
- High-output fistulas
- Severe GI bleed
- Severe GI malabsorption
- Mesenteric ischemia
- Inability to gain access to GI tract
- When need is expected <5-7 days for malnourished patients
- Aggressive intervention not warranted/desired

### Parenteral (Central)
- Functional gastrointestinal tract

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## Complications Associated With Enteral and Parenteral Nutrition

<table>
<thead>
<tr>
<th>Enteral</th>
<th>Parenteral</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Infection</td>
<td>• Infection</td>
</tr>
<tr>
<td>• Fluid and Electrolyte Imbalances</td>
<td>• Fluid and Electrolyte Disturbances</td>
</tr>
<tr>
<td>• Trauma</td>
<td>• Trauma</td>
</tr>
<tr>
<td>• Nutrient Deficiency</td>
<td>• Nutrient Deficiency</td>
</tr>
<tr>
<td>• Hyperglycemia</td>
<td>• Hyperglycemia/Hypoglycemia</td>
</tr>
<tr>
<td>• Nausea/Vomiting</td>
<td>• Hypertriglyceridemia</td>
</tr>
<tr>
<td>• Abdominal Distension</td>
<td>• Essential Fatty Acid Deficiency</td>
</tr>
<tr>
<td>• Maldigestion/Malabsorption</td>
<td>• Azotemia</td>
</tr>
<tr>
<td>• Diarrhea or Constipation</td>
<td>• Refeeding Syndrome</td>
</tr>
<tr>
<td>• Aspiration</td>
<td>• Hepatobiliary</td>
</tr>
<tr>
<td>• Acid-Base Disturbances</td>
<td>• Metabolic Bone Disease</td>
</tr>
<tr>
<td>• Mechanical</td>
<td>• Mechanical</td>
</tr>
</tbody>
</table>

Administration of Enteral and Parenteral Nutrition

Central Parenteral Nutrition (CPN)
- Central venous access is defined as a catheter whose tip lies in the distal vena cava or right atrium

Peripheral Parenteral Nutrition (PPN)
- Limited by mixture osmolarity (≤900 mOsm/L)
- Must be able to tolerate large volumes (2.5-3 L) of fluid

Enteral Nutrition (EN)
- Feeding provided through the gastrointestinal tract via a tube, catheter, or stomach

Goal-Directed Nutrition Therapy
Objectives of Goal-Directed Nutritional Therapy

• Goal-directed nutritional support ensures appropriate caloric and protein intake
  – EN and PN are tools for the delivery of nutrition

• Goal-directed enteral nutrition therapy has demonstrated
  – ↑ wound healing, ↓ infection risk, ↓ length of stay, and
  ↑ survival from injury and illness

Malnutrition Is Common in U.S. Hospitalized Patients

- Malnutrition is present in 30%-50% hospitalized patients at admission
- On a general medical ward, 27% patients became undernourished after hospital admission
- Malnutrition in acute care hospitals
  - Poor recognition and monitoring
  - Inadequate intake of nutrients for days at a time
  - Severity of illness
- If there is evidence of protein-calorie malnutrition on admission & EN is not feasible, some studies suggest that it may be appropriate to initiate PN as soon as possible following admission

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Specialty</th>
<th># Pts</th>
<th>Malnourished Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston, MA¹</td>
<td>General</td>
<td>251</td>
<td>44%</td>
</tr>
<tr>
<td>Birmingham, AL²</td>
<td>General</td>
<td>134</td>
<td>48%</td>
</tr>
<tr>
<td>Multiple V.A. sites³</td>
<td>General</td>
<td>2,448</td>
<td>39%</td>
</tr>
<tr>
<td>Huntington, VA⁴</td>
<td>General</td>
<td>500</td>
<td>55%</td>
</tr>
<tr>
<td>Boston, MA⁵</td>
<td>Pediatric</td>
<td>224</td>
<td>25%</td>
</tr>
<tr>
<td>Syracuse, NY⁶</td>
<td>ICU</td>
<td>129</td>
<td>43%</td>
</tr>
<tr>
<td>Chicago, IL⁷</td>
<td>General</td>
<td>404</td>
<td>54%</td>
</tr>
<tr>
<td>St Louis, MO⁸</td>
<td>Sub-acute care</td>
<td>489</td>
<td>29%</td>
</tr>
<tr>
<td>Boston, MA⁹</td>
<td>General</td>
<td>320</td>
<td>33%</td>
</tr>
</tbody>
</table>

* Various malnutrition assessment methods were used

Higher Risk of Complications Has Been Associated with Malnutrition

- Prospective, observational cohort to evaluate predictive value of malnutrition for complications
  - 155 patients with internal or GI diseases
- 45-62% patients were malnourished at admission
  - Patients admitted over weekend excluded
- Risk of subsequent complications ↑ in malnourished patients
- Disease category a confounding variable that strongly predicted complications
  - Cancer patients more at risk

Higher Mortality Rate Has Been Associated With Malnutrition

- Prospective study of nutrition status in 134 seriously ill patients
  - 48% patients determined to have a high likelihood of malnutrition
  - 8 nutrition parameters
- Malnourished patients
  - ↑ hospital stay almost 2X
  - ↑ mortality >3X (13% vs. 4%)
- Nutrition status ↓ with hospitalization in 69% of 44 follow-up patients

Malnutrition in Critically Ill Patients

- Excess costs for Patients with a likelihood of malnutrition
  - $5,575 per Surgery Patient
  - $2,477 per Medical Patient
- Elderly represent 12.4% of Population, but 36% of health care costs
- Those malnourished at admission had hospital charges that were double patients without malnutrition
- Average LOS was 5.6 days longer than patients without malnutrition

Inadequate Delivery of Enteral Nutrition Is Common

- Frequent problems are associated with the delivery and tolerance of EN
- Discrepancies exist between the delivered vs. prescribed EN

<table>
<thead>
<tr>
<th>Study Site</th>
<th># Patients</th>
<th>% of Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltimore, MD¹</td>
<td>129</td>
<td>52%</td>
</tr>
<tr>
<td>Chicago, IL²</td>
<td>39</td>
<td>64%</td>
</tr>
<tr>
<td>Nashville, TN³</td>
<td>55</td>
<td>50-70%</td>
</tr>
<tr>
<td>Cleveland, OH⁷</td>
<td>59</td>
<td>50%</td>
</tr>
</tbody>
</table>

*Methods of nutrition goal determination varied amongst studies

<table>
<thead>
<tr>
<th>Study Site</th>
<th># Patients</th>
<th>% Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palo Alto, CA⁴</td>
<td>60</td>
<td>32%</td>
</tr>
<tr>
<td>Cleveland, OH⁵</td>
<td>360</td>
<td>14%</td>
</tr>
<tr>
<td>Kansas City, KS⁶</td>
<td>77</td>
<td>44-50%</td>
</tr>
</tbody>
</table>

*Methods of nutrition goal determination varied amongst studies

EN Patients Often Receive Fewer Calories Than Prescribed

- Prospective, observational study of 59 ICU patients fed with EN
- EN feed interrupted 27.3% of the time
- Prolonged interruptions: Small-bore feeding tubes (25.6%), ↑ Residual volumes (13.3%), Weaning (11.7%), Other (22.8%)
- EN patients received 50% prescribed caloric needs

Factors Involved in Incomplete Delivery of Prescribed EN

- Admission
  - 18.2 (26.9) hours
- Insertion of tube
- Confirmation of placement
- Total process time: 39.7 (36.3) hours
- Start of enteral nutrition
- Interruptions
  - Problems with small-bore feeding tube
  - Residual volumes
  - Weaning procedures
  - Radiology
  - Preparation for surgery
  - Shock
  - Bath
  - Other
- Changes in rate
- ≈ 50% of nutrition prescribed is delivered

Goal-Directed Nutrition Therapy

- Malnutrition in U.S. hospitals can exceed 50% depending on nutrition assessment methods
- Malnourished hospital patients have been associated with ↑ complication rates, ↑ LOS, ↑ costs, and ↑ mortality rates
- Nutritional status may deteriorate after hospital admission
- Feed interruption and GI intolerance is common with EN
- EN may not always provide sufficient calories to meet a patient’s nutritional goals
  - Consider supplementing with PN
Negative Energy Balance Has Been Correlated With Complications

- Prospective, observational study of 50 ICU patients
  - Criteria >96 h of mechanical ventilation
  - Indirect calorimetry (IC) used to assess daily energy balance
- Cumulative negative energy balance was 4,767 kcal for ICU stay
  - 22% had a negative caloric balance >10,000 kcal
  - 30% had a negative caloric balance of 4000-10,000 kcal
- Negative energy balance correlated with complications in the ICU ($P<0.01$)
  - ARDS, sepsis, renal failure, renal replacement therapy

Negative Energy Balance Has Been Associated With Longer ICU Stay

- Multi-center, prospective RCT to study the impact of energy balance in 67 ICU patients
  - Patients likely to require mechanical ventilation >72 hrs
  - Controls (n = 35) fed based on std needs
  - Exp. group (n = 32) fed based on daily measured energy expenditure (MEE)
- Negative energy balance: minus 10,000 kcal
- Controls were 2X as likely to have negative energy balance
- Large negative energy balance associated with ↑ ventilator and ICU days

Enteral + Parenteral Nutrition May Improve Patient Outcomes

Enteral Nutrition  →  Improved Energy Balance  →  Improved Patient Outcomes

Parenteral Nutrition

Negative Energy Balance Associated With Increased Infectious Complications

• Prospective, observational study of 48 surgical ICU patients (>5 days)
  
• Energy delivery from oral, EN, PN
  
  – EN+PN when deficit >5 days and cumulated deficit >8000 kcal

• Large energy debt created in 1st week
  
  – Likely from depressed GI activity; guidelines received delay of 5-7 days
  
  – Correlated to ↑ total, infectious complications ($P=0.048$, $P=0.0049$)

• EN+PN was efficient in overcoming energy deficits
  
  – EN+PN 98% of goal
  
  – EN 62% of goal

• Energy debt occurs early in ICU stay and is difficult to overcome

Improved Energy Balance Associated With Reduced Mortality

- RCT to assess ↑ energy balance on clinical outcomes in 50 ICU patients receiving EN+PN
  - Study: kcal based on energy need
  - Control: 25 kcal/kg/day
  - No difference in severity of illness, glucose <150 mg/dL
- ↑ Cumulative energy balance in study group
  - Study: +1888 kcal
  - Control: -2,904 kcal
  - Additional PN in study group
- No difference in ICU outcomes
- However, ↓ hospital LOS and ↓ mortality in study group

EN+PN Has Been Associated With Lower Hospital LOS

- RCT with 120 ICU patients
  - 60 EN+PN (Treatment)
  - 60 EN-placebo (Control)
  - No difference in severity of illness
- PN and placebo administered only during 1st 4-7 days
- Goal of 25 total kcal/kg/day
  - Use of commercially prepared PN adjusted to meet goal
- EN+PN met 98% goal vs. 57% for EN
  - Positive energy balance in first 3 days
- No difference in infections, ICU LOS, and mortality
- EN+PN associated with ↓ hospital LOS vs. EN (31.2 vs. 33.7 days; \(P=0.0022\))

**Comparison of Caloric Intake Day 1-7 of Feed**

![Graph showing comparison of caloric intake between EN+PN and EN over 7 days.](image)

Goal-Directed Nutrition Therapy

• Energy debt is a marker for nutritional risk and improved energy balance is associated with lower hospital LOS and mortality

• Energy debt is often built up during the first week of ICU stay

• Adopting strategies to increase caloric intake of EN patients is important

• EN+PN should be considered to meet daily energy requirements (eg, 25 kcal/kg/day) and avoid energy debt
Mortality Risk: Enteral vs Parenteral Nutrition
PN Associated With Decreased Risk of Complications in Malnourished Patients

- Meta-analysis of 26 RCTs, 2,211 surgical/critically ill patients
  - Surgery, pancreatitis, ICU, burn patients
- Compared PN with Standard Care (SC); oral diet + IV dextrose
  - EN patients excluded
- No difference in mortality (RR=1.03)
- PN complication rates trended lower vs SC in all patients (RR=0.84)
- Subgroup analysis of malnourished patients
  - PN had significantly lower rate of major complications than SC

PN Has Shown Comparable Survival Benefit vs EN

- Summary of major meta-analyses comparing EN vs PN show no mortality benefit for EN
- ↓ Infection rates in EN patients did not translate into ↓ mortality
- Meta-analysis of RCT’s comparing early EN with PN²
  - No mortality difference early EN vs PN
- Only Intention-to-Treat analysis showed mortality benefit for PN (OR 0.51, 95% CI 0.27-0.97, \(P=0.04\))³
  - Mortality benefit attributable to use of PN in patients that could not initiate EN <24 h (OR 0.29, 95% CI 0.12 - 0.70, \(P=0.006\))³

### Summary of Meta-Analyses Comparing Mortality in EN vs PN¹

<table>
<thead>
<tr>
<th>Year</th>
<th># Studies</th>
<th># Patients</th>
<th>Mortality Favor EN or PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>32</td>
<td>2,005+</td>
<td>No difference</td>
</tr>
<tr>
<td>2001</td>
<td>20</td>
<td>1,033</td>
<td>No difference</td>
</tr>
<tr>
<td>2004</td>
<td>13</td>
<td>856</td>
<td>No difference</td>
</tr>
<tr>
<td>2005</td>
<td>30</td>
<td>2,430</td>
<td>No difference</td>
</tr>
<tr>
<td>2005</td>
<td>9</td>
<td>559</td>
<td>Lower mortality in PN</td>
</tr>
</tbody>
</table>

Enteral vs Parenteral Nutrition After Major Abdominal Surgery

- RCT comparing post-op EN vs PN in 241 patients with elective abdominal surgery
  - 91.7% high-risk malnourished patients affected by cancer
  - Immediate feed post-op
- Supplemental PN in EN group to achieve same caloric intake during 1st 3 days
- Feed interruptions
  - EN: 14 patients switched to PN
  - PN: none
- No difference in total complications and mortality

Rates of Complications and Mortality in Comparing EN vs PN

- Incidence, %
  - EN (n = 119)
  - PN (n = 122)
  - Complications: 37.8% vs 39.3%
  - Mortality: 5.9% vs 2.5%

Patient survey of 199 patients to study preference of EN vs PN

- Oncology patients vs control (primary care outpatient)
  - Demographic variables of the 2 groups comparable

- Most patients preferred PN over EN
  - Perceived ↑ comfort with PN
  - Cost and provider decision not a factor

- Given EN not necessarily superior to PN, patient choice of nutrition method should be considered

**Preferred Feeding Method (%)**

- Oncology Patients (n = 101)
- Outpatient Controls (n = 98)

Mortality Risk: Enteral vs Parenteral Nutrition

• In large meta-analyses PN has not been associated with excess mortality and may even be associated with improved survival

• Lower infection rates in EN patients have not demonstrated reduced mortality and are subject to biases
  – Comparable severity of infections unknown
  – Length of ICU stay was not comparable
  – Infections may be caused by inferior hygiene

• Rates of EN non-septic morbidity and feed complications have been shown to be more frequent than PN

• Given lack of superiority between EN and PN, patient preference for PN should be considered
Improved Parenteral Nutrition Safety
Proper Catheter Care Improves Parenteral Nutrition Safety

• It is imperative that the preparation of PN solution and the placement and care of catheters be accomplished under controlled aseptic conditions
  – Contaminated Infusate is the cause of most epidemic intravascular device-related infections
  – Catheter care effectively reduces PN-related infections\(^2\)

• Misunderstood risks should not deter clinicians from using PN\(^2\)

Potential Sources of Infection

- **Contaminated Catheter hub**
  - Endogenous Skin flora
  - Extrinsic HCW hands
  - Contaminated disinfectant

- **Contaminated Infusate**
  - Extrinsic Fluid
  - Medication
  - Intrinsic Manufacturer

- **Skin organisms**
  - Endogenous Skin flora
  - Extrinsic HCW hands
  - Contaminated disinfectant

- **Fibrin sheath, thrombus**

- **Hematogenous**
  From distant infection

Latest Parenteral Nutrition Preparation Methods

**Pharmacy Compounded Bag**
- Customized combining, mixing, or altering of ingredients
- State-regulated
- Laws vary from State to State
- Follow USP 797 compounding standards
- No final sterilization or on-going batch testing required

**Commercially Prepared Drug for IV Nutrition**
- Products produced by pharmaceutical companies
- FDA-approved and regulated
- Commercially manufactured
  - Follows Good Manufacturing Practices (GMPs)
  - Terminally Sterilized (final) in a sealed container
- Expiration dating extends beyond pharmacy compounded dating
- In some incidences, the addition of additives might be needed

Source: A.S.P.E.N. *Definition of Terms Approved by Board of Directors and Clinical Practice Committee*. 2010.
Errors Related to Compounding:¹

- 2 patients died when they received total nutrition admixtures (TNA) thought to contain calcium phosphate.
- 4 children infected, 2 of whom die due to *Enterobacter cloacae*.
  - Cultured in tubing from compounding equipment.
- 1 infant was overdose with dextrose when the PN was prepared with AA and 2 bags of 50% dextrose instead of 1 bag of 50% dextrose and 1 bag of sterile water.
- 1 infant was underdosed with dextrose while receiving a 1.75% final concentration of dextrose solution rather than a 17.5% concentration.
- 1 neonate received PN with no dextrose resulting in irreversible brain damage.
- 2 premature infants develop extreme magnesium toxicity.
  - Compounder malfunction.

PN-Related Ordering and Compounding Errors Are Common

- A.S.P.E.N. survey on PN ordering and compounding (n = 651)\(^1\)
  - 88% use standardized PN order forms
- Almost 2/3 observed 1-5 errors/month related to PN\(^1\)
  - PN electrolytes 71% of errors
- 46% reported AE’s related to PN
  - 35% required increase monitoring, 25% resulted in harm, 3.3% near death, 1.5% death

Standardized PN Prescribing Can Help Reduces Medication Errors

- 2004 MEDMARX report showed patient harm resulted in 4.4% of reported PN errors (n = 2,519)
  - Compared to 2.5% harm rate for all MEDMARX error reports
  - 71% errors prescribing, transcribing, administration
- Medication Error Reporting (MER) show PN harm rate 18% (vs 14% overall)
  - Dispensing problems with automated compounding devices and labeling
- 2008 MEDMARX report shows 60% of injection compounding errors (n = 70) involved PN
- Suggestions for improved PN safety
  - Standardized order forms
  - Validate hospital compounding
  - Policies for outsourcing
  - Visually inspect bags
  - Catheter care policy

Types of All Compounded Drug Preparation Errors (2008)

<table>
<thead>
<tr>
<th>Type of Error</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescribing error</td>
<td>23</td>
</tr>
<tr>
<td>Omission</td>
<td>21</td>
</tr>
<tr>
<td>Improper dose/quantity</td>
<td>21</td>
</tr>
<tr>
<td>Unauthorized/wrong drug</td>
<td>12</td>
</tr>
<tr>
<td>Drug prepared incorrectly</td>
<td>9</td>
</tr>
<tr>
<td>Wrong time</td>
<td>6</td>
</tr>
<tr>
<td>Extra dose</td>
<td>3</td>
</tr>
<tr>
<td>Wrong patient</td>
<td>3</td>
</tr>
<tr>
<td>Wrong administration technique</td>
<td>2</td>
</tr>
<tr>
<td>Mislabeling</td>
<td>1</td>
</tr>
<tr>
<td>Deteriorated product</td>
<td>1</td>
</tr>
<tr>
<td>Wrong route</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Standardized PN Has Shown Comparable Electrolyte Management vs Customized

• Prospective study at academic hospital of 4 standard formulations
  – Peripheral, central, high stress, fluid restricted
  – Patient acuity not controlled
• Compare metabolic parameters
  – Standard 76%
  – Customized 24%
• Laboratory electrolytes (Na, K, CO₂, Mg, PO₄, Cl)
  – WNL = % normal
  – ABN = % abnormal
• Significantly less electrolyte abnormalities with the standardized PN

PN-Related Ordering and Compounding Errors Are Common

- Standardization for PN must be explored to improve patient safety, clinical appropriateness
  - Includes commercial PN products (eg, multi-chamber bags)
- Questionnaire sent by University Health Systems Consortium (UHC) to their pharmacy directors showed most often used standard formulas are 4.25% and 5% amino acid concentration (1998)

### Available Commercially Prepared Products in the U.S.

<table>
<thead>
<tr>
<th>Formula % Dextrose</th>
<th>% Amino Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.75</td>
</tr>
<tr>
<td>5</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>X</td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>X</td>
</tr>
<tr>
<td>25</td>
<td>X</td>
</tr>
<tr>
<td>Glycerol</td>
<td></td>
</tr>
</tbody>
</table>

Commercially Prepared PN May Reduce Number of PN Compounding Errors

- Compounding errors in 1,679 IV doses at 5 large U.S. acute care hospitals
  - Considered “progressive” hospitals
  - Academic, not-for-profit, for-profit
- Mean compounding error rate 9%
- PN compounding errors highest (26%) of all products
- Ready-to-use products (0.3% error rate) may reduce PN errors by decreasing
  - # preparation steps
  - Dose calculations

### Type of Errors Observed in Compounded IV Admixtures

<table>
<thead>
<tr>
<th>Error Category</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong dose</td>
<td>69%</td>
</tr>
<tr>
<td>Wrong base solution</td>
<td>16%</td>
</tr>
<tr>
<td>Unauthorized drug</td>
<td>7%</td>
</tr>
<tr>
<td>Wrong preparation technique</td>
<td>5%</td>
</tr>
<tr>
<td>Omission</td>
<td>3%</td>
</tr>
</tbody>
</table>

Commercially Prepared Bag PN Formulations Are Widely Used in Europe

- Hospital pharmacy survey of MCB use in 3 European countries
- Adult PN represented the main type of prescription
- >80% use of MCB in Switzerland and France
  - MCB includes 2- and 3-chamber bags
  - 3-chamber bag not available in the US
- Limiting the use of customized PN formulas to decrease compounding error rates

Improved Parenteral Nutrition Safety

• Standard PN prescribing reduces medication errors.

• Commercially prepared PN may lower risk of infection related to contamination compared to compounded solutions

• Standardized commercially prepared PN may reduce errors associated with prescribing and transcription

• Commercially prepared drugs for IV Nutrition are FDA approved and regulated.
Bibliography

- ASPEN Guidelines. JPEN. 2002;26:1SA-138SA.
- ASPEN. Definition of Terms, Style, and Conventions. 2010.