



Parenteral Nutrition: New Clinical Guidance for Patient Selection and Management

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Disclosure

All planners, presenters, and reviewers of this session report no financial relationships relevant to this activity.

Learning Objectives

- Describe the challenges for identifying evidence-based indications for parenteral nutrition therapy.
- Given a patient scenario, apply clinical factors that should be considered when assessing appropriateness for parenteral nutrition.
- Given a patient scenario, apply practical strategies for the appropriate use of parenteral nutrition.
- Given a patient scenario, develop a parenteral nutrition monitoring plan to assess progress toward therapeutic goals, the need to adjust the prescription, and when to wean or discontinue therapy.

Introduction to Consensus Recommendations, “When is Parenteral Nutrition Appropriate?”

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Background

- Parenteral nutrition (PN) represents one of the most notable achievements of modern medicine.
- PN can serve as a therapeutic modality for all age groups across the healthcare continuum.
- PN offers a life-sustaining option when intestinal failure prevents adequate oral or enteral nutrition.
- However, providing nutrients intravenously (IV) is an expensive form of nutrition support, and serious adverse events can occur.

Purpose of the Document

- **Goal:**
 - To develop consensus recommendations regarding appropriate PN use to promote clinical benefits while minimizing the associated risks

Process

- 11-member task force convened by the American Society for Parenteral and Enteral Nutrition (ASPEN)
- Authors included pharmacists, dietitians, nurses, physicians with various practice settings and specialty areas
- 14-guiding questions and areas for future research
- Recommendations also designed to inform decisions made by stakeholders (e.g., policy makers and third-party payers) by providing current perspectives regarding the use of PN in a variety of healthcare settings

Consensus Recommendations

Consensus Recommendation



When Is Parenteral Nutrition Appropriate?

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Appropriate PN Use

Identifying Candidates for PN

- Question of PN use based on diagnostic categories
- Clinical indications for PN administration
- Evaluating GI function: continuum of intestinal failure
- Timing

PN Use in a Variety of Clinical Situations

- Selecting vascular access device
- Peripheral PN, intradialytic PN, perioperative PN
- PN in palliative care
- Home PN

Promoting Optimal PN Outcomes

- Strategies to reduce complications
- Assessing progress toward goals
- Managing transitions, weaning PN
- Tracking/monitoring PN

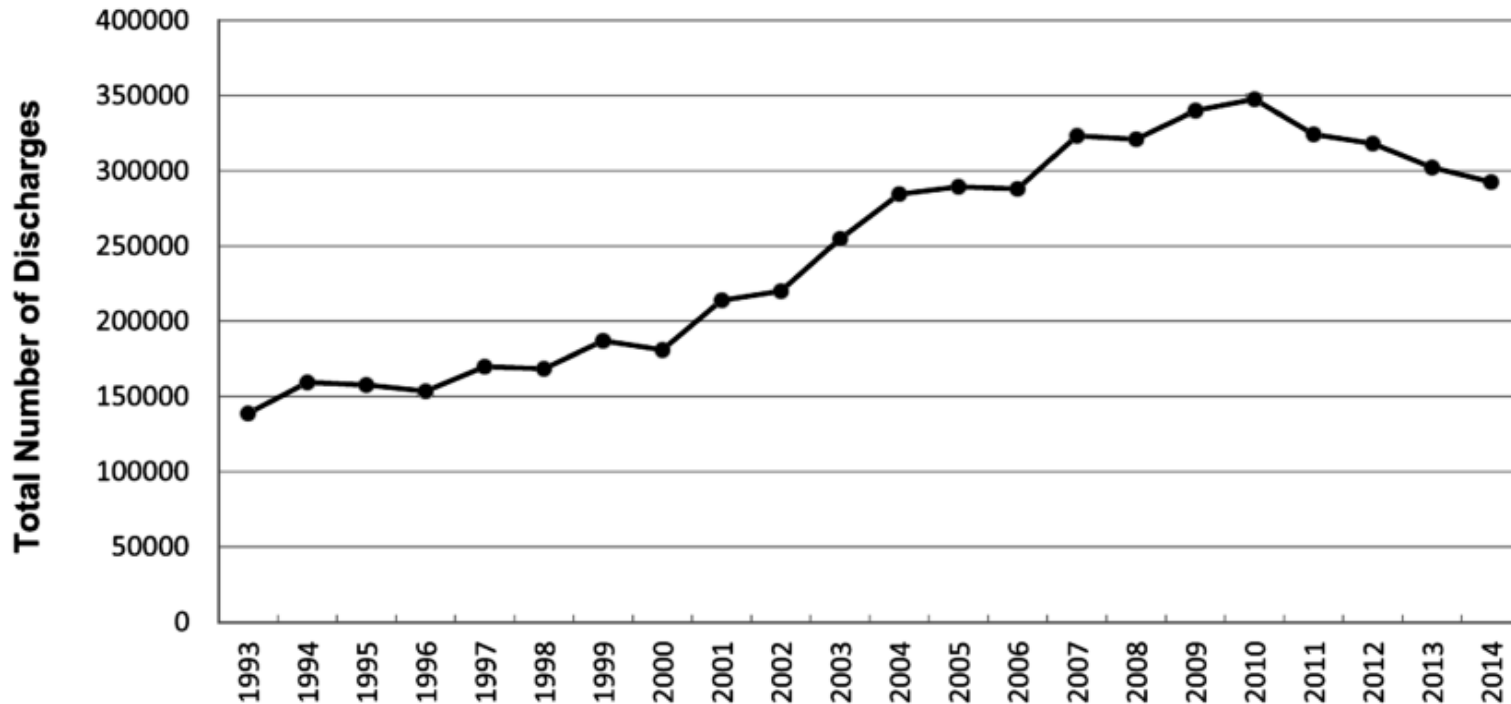
Research

- Questions requiring further study

**Challenge to Delineating Evidence-
Based Indications for PN
and
Clinical Factors to Consider When
Identifying Appropriate Candidates**

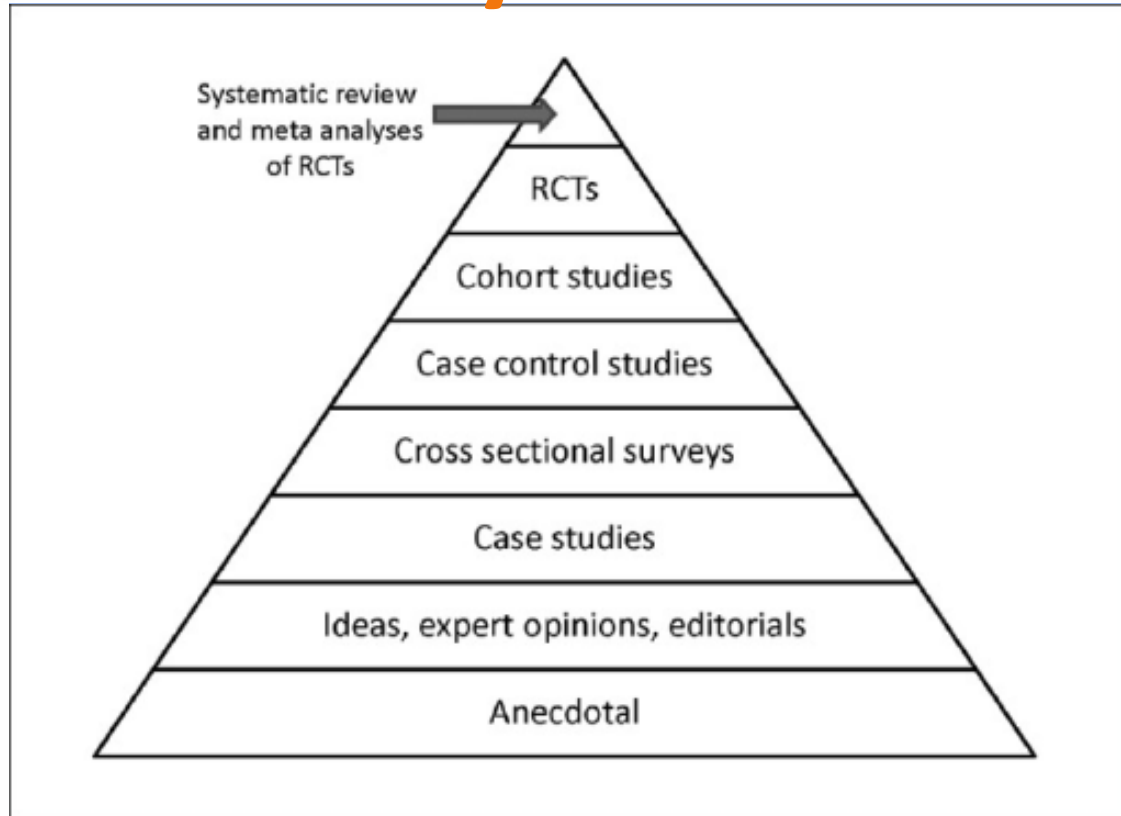
Hospital Discharges Linked to ICD-9 Code 99.15

Parenteral Infusion of Concentrated Nutritional Substances



Data from National Inpatient Sample of the Healthcare Cost and Utilization Project from the Agency for Healthcare Research and Quality. <http://hcupnet.ahrq.gov/>. Accessed September 27, 2017.

Hierarchy of Evidence



Identifying Evidence-Based Indications PN Therapy: Challenges

- Some data are “old”
- Data have been generalized based on narrowly selected cohorts in some cases
- Data are extremely limited with newer products
- Well-designed RCTs, especially in specific populations, are very limited
- Some of the practices have changed over time
- Insufficient data in assessing competency and outcomes

Consensus Recommendations

- Developed in the absence of high-quality, grade level evidence
- Designed to provide guidance in clinical decisions
 - Identify best practices
 - Reduce variations in practice
 - Enhance patient safety
 - Provide day-to-day guidance for clinical decisions
- Not intended to supersede the judgment of the healthcare professional

Ashley's Case

- **37 year-old Caucasian female**
 - Presents to the ED with fever, vomiting, and abdominal pain:
 - 1 day history of fever, malaise, and abdominal pain which progressed to two vomiting episodes in 6 hrs
 - No diarrhea
 - Subsequent work-up confirms acute pancreatitis

Ashley's Case

- **Past medical history:**
 - Short bowel syndrome (SBS) due to Crohn's disease (285 cm of functional small intestine and an intact colon)
 - Chronic diarrhea usually controlled by loperamide
 - Generalized anxiety disorder
 - Chronic anemia

Ashley's Case

- **Diet:**
 - Generally oral diet with oral supplements and vitamins
- **Current medications:**
 - Azathioprine
 - Escitalopram
 - Loperamide
 - Clonidine
 - Prenatal vitamin
 - Cyanocobalamin
 - Iron sucrose
- **NKDA**

Ashley's Case

- **Vitals:**
 - RR: 18/min
 - Pulse: 98-104 bpm, sinus tachycardia
 - BP: 106/65 mm Hg
 - Temp: 101.5°F
- **Weight:** 62.5 kg (decreased 0.8 kg from baseline)
- **Height:** 5'7" (170.2 cm)
- **Body mass index:** 21.5 kg/m²

Question #1: Is PN indicated upon admission for Ashley?

- A. Yes; because of SBS and/or Crohn's disease
- B. Yes; because of acute pancreatitis
- C. Yes; because of abdominal pain and vomiting
- D. No; because she was on oral diet prior to admission

PN Initiation

- Do not use based solely on medical diagnosis or disease state
- Use PN in patients who are malnourished or at risk for malnutrition when a contraindication to EN exists; **OR** the patient cannot tolerate adequate EN; **OR** lacks sufficient bowel function to maintain or restore nutrition status due to GI dysfunction
- Evaluate clinical factors from history, physical examination, and diagnostic evaluations in determining if EN is contraindicated

(Recommendations 1-3)

Worthington P. *JPEN J Parenter Enteral Nutr.* 2017;41:324-377.

Clinical Factors Assessed for EN versus PN Eligibility

- Function status of GI tract
 - Evidence of history, physical, diagnostic studies
- Failed EN trials
- Hemodynamic instability
- Failure to achieve/maintain enteral access
- Contraindications for enteral access
 - Active GI bleeding
 - Uncontrolled peritonitis
 - Ischemic bowel
- Intractable vomiting or diarrhea

Note: Absence of bowel sounds does not, per se, constitute a reason to delay or interrupt EN

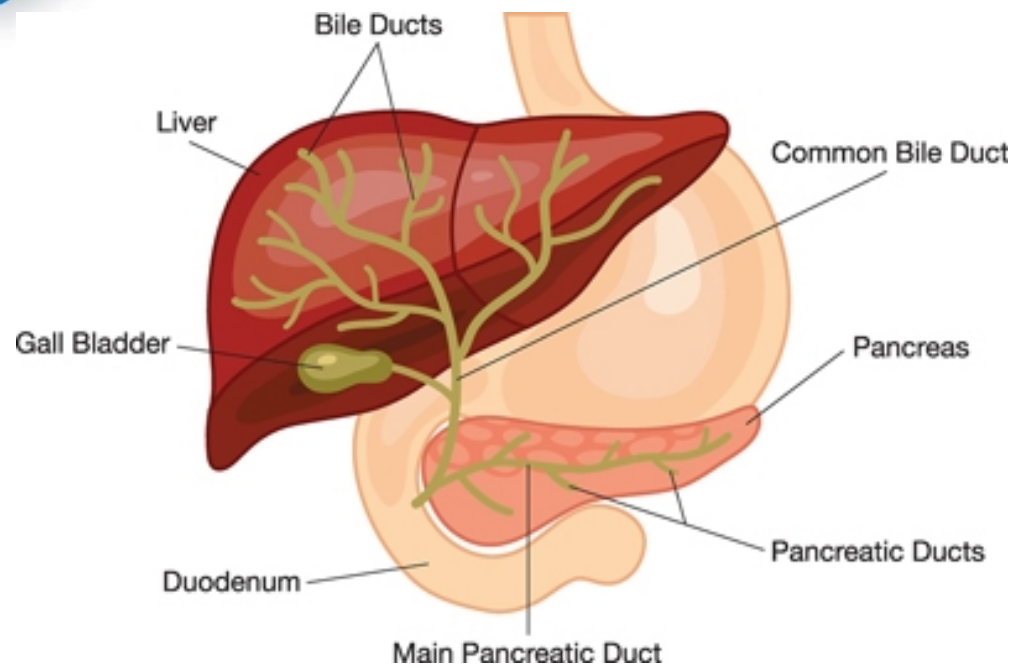
Ashley's Case Continues

- Oral diet not feasible
- No absolute or relative contraindication to EN
- What is her malnutrition risk?
 - Weight change
 - Pre-admission intake
 - Comorbidities

Ashley's Case Continues

- Admitted to the medical ICU, started on IV fluid for dehydration
- Anti-emetics (ondansetron + diphenhydramine) for nausea and vomiting
- Blood culture sent, result pending
- Pain management
- Post-pyloric feeding tube placed (past the ligament of Treitz)
- EN (polymeric formula) to be started once BP stable and heart rate < 100 bpm

Ashley's Clinical Course:



<https://www.niddk.nih.gov/health-information/diagnostic-tests/endoscopic-retrograde-cholangiopancreatography>.

Accessed September, 27, 2017.

Question #2: Which presentation would make Ashley a suitable candidate for PN?

- A. Unable to reach goal for EN feeding after 24 hours
- B. Unable to reach goal for EN feeding after 3 days
- C. Unable to reach goal for EN feeding after 7 days
- D. Blood glucose consistently >180 mg/dL while receiving EN

Switching to PN

- Initiate PN after 7 days for well-nourished, stable adult patients who have been unable to receive significant (50% or more of estimated requirements) oral or enteral nutrients
- Initiate PN within 3–5 days in those who are nutritionally at-risk and unlikely to achieve desired oral intake or EN
- Initiate PN as soon as is feasible for patients with baseline moderate or severe malnutrition in whom oral intake or EN is not possible or sufficient
- Delay the initiation of PN in a patient with severe metabolic instability until the patient's condition has improved
- [\(Recommendation 4\)](#)

Indications for PN

- **Non-functional GI tract (Failed/inadequate EN)**
 - **Impaired absorption of nutrients**
 - Short bowel syndrome, fistula, absorptive capacity
 - **Mechanical bowel obstruction**
 - Peritoneal carcinomatosis, severe adhesive disease
 - **Motility disorders**
 - Pseudo-obstruction, prolonged ileus
 - **Need for “bowel rest”**
 - Ischemic bowel, neutropenic colitis, severe pancreatitis
 - **Inability to achieve enteral access**

Clinical Conditions Warranting Cautious Initiation of PN in Adults

Conditions	Suggested Criteria
Hyperglycemia	Glucose > 180 mg/dL
Azotemia	Blood urea nitrogen > 100 mg/dL
Hypertriglyceridemia	Serum triglycerides > 200 mg/dL
Hypo-/ hypernatremia	Serum sodium < 130 mEq/L or > 150 mEq/L
Hypokalemia	Serum potassium < 3 mEq/L
Hypomagnesemia	Serum magnesium < 1.3 mEq/L
Hypocalcemia	Ionized calcium < 4.5 mg/dL
Hypophosphatemia	Serum phosphorus < 2 mg/dL

Reprinted from Worthington P, et al. *JPEN J Parenter Enteral Nutr.* 2017;41:324-377 with permission from the American Society for Parenteral and Enteral Nutrition (ASPEN).

Solomon D. *Nutr Clin Pract.* 2017;32(3):400-406.

Strategies for Appropriate Use of PN in a Variety of Clinical Situations and Settings

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Ashley's Case Continues

- Standard polymeric EN formulation initiated at 20 mL/hr, with the plan to advance by 20 mL/hr every 8 hours as tolerated until goal (90 mL/hr)
- On day 2 of EN, at an infusion rate of 60 mL/hr, she developed severe abdominal pain again (pain score: 7/10)

Question #3: Which of the following is the best assessment and action?

- A. Possible pancreatic stimulation; check enteral feeding tube location
- B. EN nutrient intolerance; switch to semi-elemental product
- C. Unable to reach goal; start PN
- D. Part of the presentation of pancreatitis; give IV analgesic and continue current management

Ashley's Case Continues

- Experiences several episodes of hypotension requiring vasopressor support
- Abdominal pain did not resolve and her abdomen becomes distended with no bowel sounds
- Surgical evaluation reveals ischemic bowel
- Another 75 cm of small intestine removed
- EN discontinued; PN is to be initiated

Question #4: Which strategy can reduce complications related to central venous catheters (CVC)?

- A. Insert a new central venous access device for PN administration
- B. Select the smallest device with the fewest lumens necessary to meet the patient's needs
- C. Replace central venous access devices at regularly scheduled intervals
- D. Preferentially place peripherally inserted central catheters for long-term PN

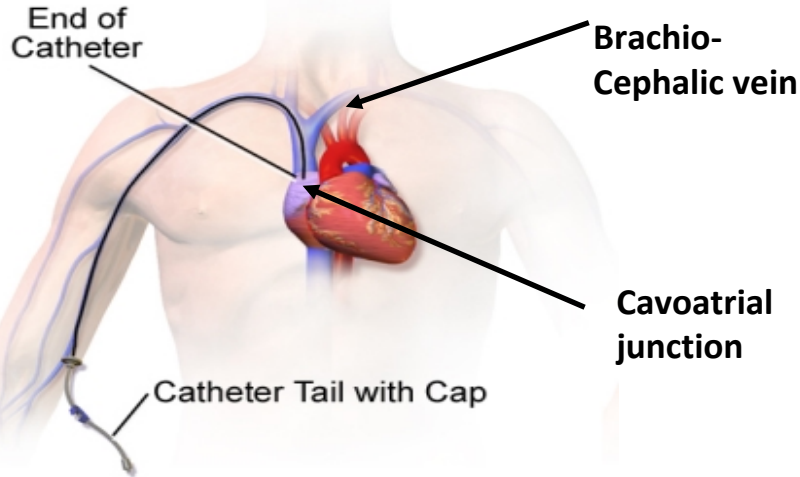
Ashley's Case:

Is the Vascular Access OK?

- X-ray report states that the tip of her line rests in the brachiocephalic vein
- PN is a risk factor for central line blood stream infection and deep vein thrombosis

Individualize selection based on:

- Healthcare setting
- Risks versus benefits
- Clinical factors (renal failure)
- Anticipated duration of PN
- Complexity of care
- Patient's views

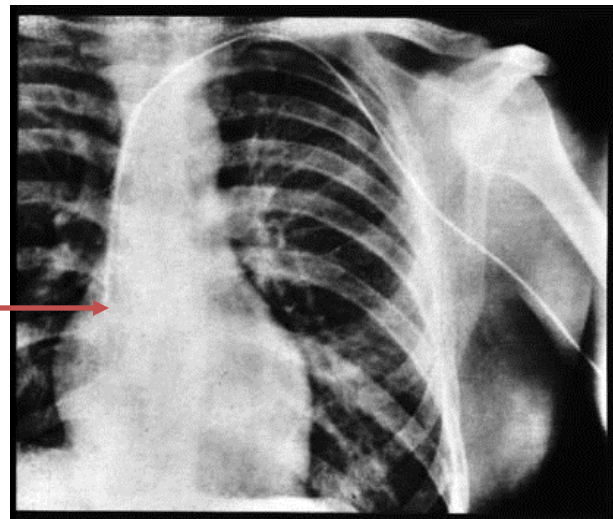


Worthington P. *JPEN J Parenter Enteral Nutr.* 2017;41:324-377.

https://commons.wikimedia.org/wiki/File:PICC_vs._Midline_Catheter.png. Accessed September 27, 2017.

Vascular Access for PN

- Choose the smallest device with the fewest number of lumens
- Optimal position: Distal SVC/cavoatrial junction to reduce infectious and thrombotic complications
- Dedicate one lumen for PN administration when possible
- No recommendation regarding need to insert a new line for PN



(Recommendation 5)

Question #5: Is Ashley a good candidate for peripheral PN?

- A. Yes. Her nutrient needs can be easily managed by PN with osmolarity compatible with a peripheral vein.
- B. Yes. PN support is expected to be required for a short duration (<2 weeks).
- C. No. She already has a central catheter in place.
- D. No. Peripheral PN is associated with lower risks for infections.

Peripheral PN (PPN)

- Use PPN only for short-term purposes, no more than 10–14 days, as supplemental PN or as a bridge therapy during transition periods, where oral intake or EN is suboptimal or clinical circumstances do not justify placing a CVC
- Estimate the osmolarity of peripheral PN formulations
- Maintain an **upper limit of 900 mOsm/L** for PPN
- In well-nourished pediatric patients, use PPN for short-term purposes until oral intake or EN can be established or to serve as a bridge to central PN

(Recommendation 6)

When is PPN a Reasonable Choice?

- Use as supplemental PN or a bridge therapy:
 - Oral intake or EN is suboptimal
 - Can avoid CVC placement
 - Maximum duration of 10-14 days
- Better nutrient provision with increase in osmolality limits from 600 to 900 mOsm/L limits

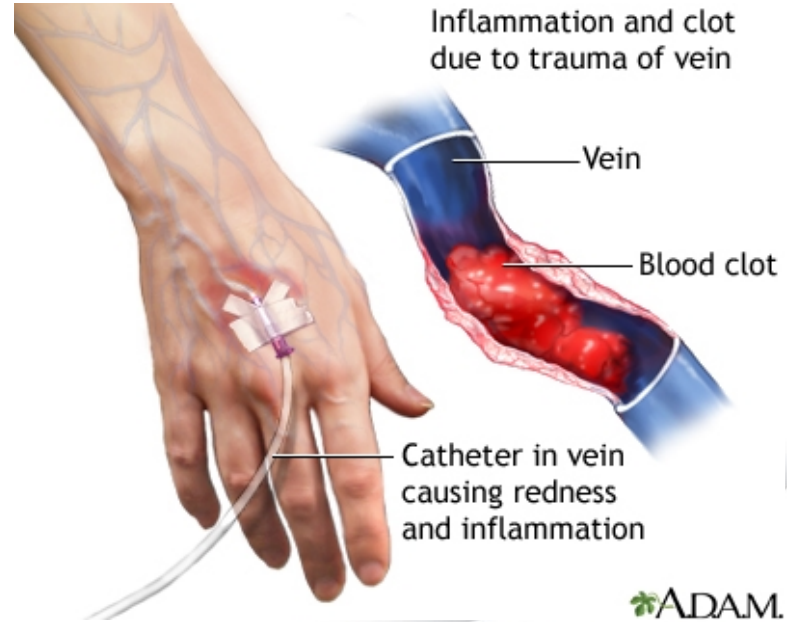
Vascular Access for PPN

- Avoids risks of central venous access
- Maximum osmolarity = 900 mOsm/L
- Assess risk factors for difficult IV access:
 - Obesity
 - Extremes in age (neonates and elderly)
 - History of multiple venous cannulations
 - History of IV drug use
- Extravasation of nutrient admixtures can lead to tissue injury and necrosis
- Associated with **increased rates of phlebitis**

Question #6: What are the primary signs and symptoms to be frequently monitored for when PPN is utilized?

What is Phlebitis?

- Inflammation of vein (typically endothelial wall)
- Most common causes:
 - High osmolarity of IV solution
 - Traumatic IV placement
 - Prolonged use of IV site



Signs of Phlebitis

- Redness of the vein
- Swelling over the vein
- Tenderness or pain over the vein
- Red streaks
- Palpable, hard “cord”
- Site warm to touch
- Sluggish infusion rate/ flow of infusate

Question #7: Should perioperative PN be given to Ashley prior to surgery?

- A. Yes
- B. No

Perioperative PN

- Malnutrition may negatively impact surgical outcomes
- Malnutrition in perioperative surgical patients is evaluated through a combination of parameters
- PN may have some impact in both the preoperative and postoperative periods, but **the exact timing and duration of perioperative PN is not fully defined**
- Preoperatively, PN is less preferred than EN
- Perioperative PN data is **based on elective/non-urgent surgery**; not applicable to patients requiring urgent surgery

Perioperative PN

- Preoperative PN use in **SEVERELY** malnourished patients may decrease overall complications but does not seem to affect mortality
- Benefits may be more significant for severely malnourished patients undergoing GI tract surgery
- Established, higher quality studies show that PN must be provided for 7–10 days to improve outcomes
- In infants undergoing cardiac surgery, one study suggests that perioperative PN may also decrease length of stay

Role of Perioperative PN in Elective/Non-urgent Surgery

- **Preoperatively:**
 - Severely malnourished patients unable to tolerate oral intake or EN
- **Postoperatively:**
 - Severely malnourished patients unable to tolerate oral intake or EN for more than 7 days unless initiated preoperatively

(Recommendation 8)

Role of Perioperative PN in Elective/Non-urgent Surgery

- Malnourished surgery patients have an increased risk for negative outcomes:
 - Infection
 - Bacterial overgrowth in the GI tract
 - Poor wound healing
- May decrease overall complications
- No impact on mortality

**Question #8: Intradialytic PN (IDPN)
may be administered during
hemodialysis. If Ashley requires
intermittent hemodialysis
postoperatively, is she a candidate for
IDPN?**

When is IDPN a Reasonable Choice?

- Do not use as a sole source of nutrition in malnourished patients with chronic kidney disease (CKD)
- Typically provides 500-1000 kcal and 50-100 g of amino acids in less than 1 liter of volume per dialysis treatment
- Consider for adult and pediatric malnourished patients with CKD:
 - Adjuvant to oral/enteral nutrition limited by anorexia and fluid restrictions
 - Must meet strict guidelines for third-party payers
 - Used to promote catch-up growth in pediatric and neonatal patients

(Recommendation 7)

2017 versus 2010

ASPEN Recommendations

- Cano 2007: RCT; concluded that IDPN does not improve survival over a 2-year period
 - Note: 92/93 patients in the control group received EN or oral supplementation
- Marsen 2015: German IDPN-Trial Group Study showed that IDPN is associated with improved prealbumin versus nutrition counseling alone
- Prognosis of malnutrition in CKD is poor
- **IDPN, if used carefully, may be a better option than no intervention in CKD patients/high risk of malnutrition**

Cano NJ. *J Am Soc Nephrol.* 2007;18:2583-2591.

Marsen TA. *Clinical Nutrition.* 2015;36(1):107-117.

Making the Transition: Identifying Candidates for Home PN (HPN)

- Patients with intestinal dysfunction who are clinically stable
- Able to receive therapy outside an acute care setting
- Evaluate medical and psychosocial factors that influence suitability for HPN
- Address financial considerations and insurance coverage
- Address patient responsibilities with the patient and caregiver
- Pediatrics: Discharge to the care of a pediatric home care team and infusion provider with pediatric experience

(Recommendation 10)

Safely Initiating PN at Home

- Establish organizational policies that delineate circumstances in which HPN initiation can occur outside the acute care setting
- Delineate patient-centered eligibility criteria for initiating PN safely in the home setting
- Develop strict protocols and procedures for initiating PN in the home setting, monitoring response to therapy, and documenting outcomes

(Recommendation 11)

Safely Initiating PN at Home

- Conduct a comprehensive medical, clinical, and psychosocial assessment of HPN candidates to assess risks for adverse events related to initiating PN
- Consider initiating PN therapy at home only when assessment confirms that the benefits greatly outweigh the risks
- Do not initiate PN in the home setting for children

(Recommendation 11)

When Is Initiating PN at Home Not Recommended?

- Inability to obtain necessary laboratory monitoring
- Significant risk for refeeding syndrome
- Presence of comorbidities associated with PN complications
- Risk of Wernicke encephalopathy
- Severe risk for fluid and/or electrolyte imbalances
- Poor performance status
- Lack of supportive care partner

Final Chapter: PN in Palliative Care

Barbara's Case

- Barbara is a 47 year-old woman with a history of ovarian cancer
- Presents with a small bowel obstruction and diagnosed with peritoneal carcinomatosis
- Palliative Care service is consulted
- Barbara wishes to go home
- Strong family support

Question #8: Is Barbara a suitable candidate for HPN?

PN for Patients in Palliative Care

- Do not use PN solely to treat poor oral intake and/or cachexia associated with advanced malignancy
- Limit to patients with an expected survival of 2-3 months
- Evaluate clinical factors and performance status (Karnofsky Score)
- Involve patients and caregivers in dialogue regarding realistic goals and risks/burdens of therapy
- Define criteria for discontinuing PN at the onset of therapy
- Stop PN when the risks and burdens outweigh the benefits
- Set realistic expectations of the benefits

(Recommendation 9)

Monitoring Parameters to Promote Optimal PN Therapy

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Strategies to Reduce Risk of Complications Associated with PN

- Employ standardized processes for managing PN
- Incorporate measures to reduce the risk of complications into organizational policies and procedures for administering PN
- Use an interprofessional team of clinicians with expertise in nutrition support to manage PN
- Educate PN prescribers and demonstrate prescribing competencies for all clinicians writing PN orders

(Recommendation 12)

Standardized Processes for PN Management

- ASPEN recommends standardized processes to avoid complications associated with PN
- Impact of standardized processes:
 - Kaminski 1974: PN practices deviated from standards of care: Electrolyte abnormalities (28%); Glucosuria (42%)
 - Skoutakis 1975: Detailed protocol and PN team implemented: Electrolyte abnormalities (2.7%); Glucosuria (5%)

Kochevar M. *JPEN J Parenter Enteral Nutr.* 2007; 31:441-448.

Kaminski MV. *Am J Hosp Pharm.* 1974; 31:228-253.

Skoutakis VA. *Am J Hosp Pharm.* 1975; 32:693:697.

Policies and Procedures May Reduce Risk of PN Complications

- Potential benefits:
 - Promote glycemic control
 - Avoid overfeeding
 - Provide meticulous management of venous access devices
- Brown 1977: Implementation of PN procedures for catheter insertion and care, nursing care plan, and metabolic flow sheet
 - Sepsis: 12.5% to 5.1% after intervention

Kochevar M. *JPEN J Parenter Enteral Nutr.* 2007; 31:441-448.

Brown RS. *Crit Care Med.* 1977;5(5):241-244.

Interprofessional Approach to PN

- Literature supports PN management by interdisciplinary team with expertise in nutrition support
- Collaboration reduces the risk of complications:
 - Interdisciplinary team managed PN patients (n=211)
 - Electrolyte imbalance: 3%
 - No glucosuria or death
 - Physician managed PN patients (n=164)
 - Electrolyte imbalance: 36%
 - 10 patients died from complications of glucose imbalance

PN Competency Demonstration

- To optimize nutrition provision and reduce the risk of complications:
 - Educate prescribers
 - Prescribers should demonstrate PN competency
 - Certification as nutrition support clinician
 - Board certification
 - ASPEN model for competency demonstration if not certified

Guenter P. *Nutr Clin Pract.* 2015; 30(4):570-576.

Boullata JI. *Nutr Clin Prac* 2016; 31(4):548-555.

Monitoring PN

- Provide interprofessional monitoring of clinical status and response to PN therapy by clinicians
- Modify the PN prescription as indicated based on ongoing evaluation of gastrointestinal function, nutrition status, and, for pediatric patients, growth

(Recommendation 13)

Clinical Monitoring During PN: Hospitalized Patients (Adult)		
Parameter	Approach	Frequency
Physical exam	Including a nutrition-focused approach: <ul style="list-style-type: none"> - micronutrient abnormalities - muscle and fat stores - fluid accumulation - functional/developmental status 	On initial exam, then according to individual hospital nutrition reassessment policy
Evaluate weight and height	Weight scales used in a consistent manner; patients should not wear shoes or heavy garments	On initial exam, then weights daily until stable 2-3 x week for stable patient
Determine energy and macronutrient needs	Use of appropriate predictive equations, indirect calorimetry, or nitrogen balance	On initial exam, then when changes in medical condition or activity level occur
Evaluate intake and output records	Oral or enteral intake, IV fluids and medications, blood products, urine, stool/ostomy/fistula output, other relevant wound/drain output	On initial exam, then daily until stable

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Clinical Monitoring During PN: Hospitalized Patients (Adult)		
Parameter	Approach	Frequency
Review vital signs	BP, RR, HR, temperature	Initially, then daily until stable
Blood glucose monitoring	Capillary glucose levels, correctional dose insulin requirements, ancillary orders for appropriate intervention for hypoglycemia	Every 1-24 hrs depending on clinical status
Evaluation of micronutrient status	Serum levels of vitamins, minerals, trace elements	When history, physical, and/or clinical evidence suggests abnormality
Examination of vascular access device (VAD)	Inspection and palpation to assess for redness, tenderness or rash under dressing or along subcutaneous tunnel; Observe for upper extremity edema; Review position on chest x-ray	Daily assessment; x-ray confirmation at VAD placement; when admitted with VAD

Clinical Monitoring During PN: Hospitalized Patients (Adult)		
Parameter	Approach	Frequency
Reassess continued need for PN therapy	Intake and output records, nutrition adequacy assessment, physical exam, radiological evaluation	Daily, or with signs indicating return of bowel function, or with change in pertinent clinical condition
General response to therapy	Wound healing, stamina, functional status, progress toward weight or growth goals	Ongoing throughout the course off therapy

Question #9: Which parameter is least useful to determine Ashley's general response to PN therapy?

- A. Functional status
- B. Post-surgical healing
- C. Prealbumin
- D. Stamina

Monitoring Ashley's General Response to PN Therapy

- Optimal parameters:
 - Functional status
 - Post-surgical healing
 - Stamina
- Visceral protein concentrations such as prealbumin are unreliable markers of nutrition status especially in the setting of inflammation

Question #10: Ashley's triglyceride concentration was normal at the time of PN initiation. While stable on PN, how often should Ashley's triglyceride concentration be reevaluated?

- A.** Daily
- B.** Every 3 days
- C.** Every 7 days
- D.** Every 2 weeks

Triglyceride Monitoring with PN

- Optimal monitoring:
 - Baseline prior to administration of lipid in PN
 - Weekly
 - Pediatric: daily until stable and then weekly
- Frequency of monitoring adjusted per the acuity of illness and clinical stability of the patient
- Acceptable triglyceride concentrations: <400 mg/dL

Laboratory Monitoring During PN (Adult and Pediatric)

	Acute Care PN			Long-Term PN			
Parameter	Baseline	Days 1-7	Ongoing, stable	Initial, post discharge	Weeks 1-4	At 3 months	Ongoing, stable
Glucose, BUN, creatinine, electrolytes	√	Daily x 3 or until stable	1-2 x/week or as indicated	√	√		Monthly
CBC with differential	√	Daily x 3 or until stable	1-2 x/week	√	√		Monthly
Total bilirubin, direct bilirubin, AP, AST, ALT,	√		Weekly	√			Monthly
PTT, PT, INR	√		Weekly				Monthly
Triglyceride level	√	Pediatric: daily until stable	Weekly	√			Monthly

Laboratory Monitoring During PN (Adult and Pediatric)

Parameter	Acute Care PN			Long-Term PN			
	Baseline	Days 1-7	Ongoing, stable	Initial, post discharge	Weeks 1-4	At 3 months	Ongoing, stable
Serum proteins	√		Weekly	√			Monthly
Iron indices			As clinically indicated			√	Every 3-6 months
Trace elements			As clinically indicated			√	Every 3-6 months
Vitamin A, OH-25 vitamin D, vitamin E			As clinically indicated			√	Every 12 months
Vitamin B ₁₂ and folate			As clinically indicated			√	Every 6-12 months
TSH				As indicated			Every 12 months
Carnitine						√ Pediatric	Every 3-12 months

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Question #11: Ashley's GI function has improved. She is transitioning to an oral diet. Which of the following is an acceptable minimum percentage of oral diet she must tolerate to wean PN?

- A. 30%
- B. 60%
- C. 90%

Weaning PN

- Wean PN when oral intake and/or EN achieves 50%-75% of requirements for energy, protein, and micronutrients, unless impaired GI function precludes 100% absorption of nutrient needs
- Consider using a weaning protocol during the transition from PN to EN

(Recommendation 13)

Weaning Long-Term PN

- Routinely assess GI function for readiness to begin or advance oral or enteral intake
- Verify metabolic and clinical stability on current PN regimen
- Establish clear goals with patient
- Optimize pharmacologic management of GI symptoms
- Provide nutrition counseling and dietary guidance as indicated
- Monitor weight and hydration status closely
- Consider increasing the frequency of weight and laboratory monitoring during the transition

Weaning Long-Term PN

- Assess the need to provide oral vitamin and mineral supplementation
- Eliminate 1 or 2 non-consecutive infusions per week; in children consider weaning by a small percentage every week
- Adjust PN during the transition to avoid overfeeding
- Consider further reductions if nutrition and hydration stable
- Evaluate the need for electrolyte supplementation
- Make a nutrition-monitoring plan after PN is stopped to ensure safe transition to full oral or enteral nutrition

Organizational Monitoring: PN Appropriateness

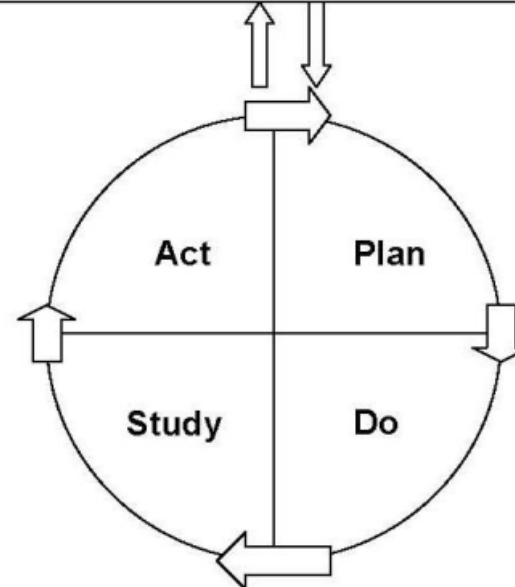
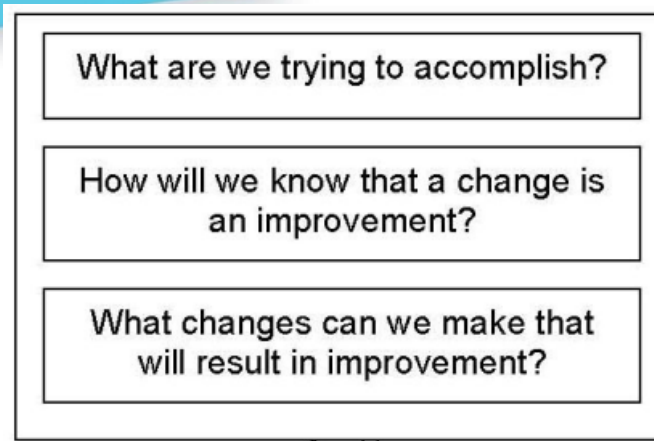
- Conduct a clinical review for each patient to assess PN appropriateness prior to compounding the PN admixture
- Implement a quality improvement process [eg, clinical audit, plan-do-study-act (PDSA) cycle, medication-use evaluation (MUE)] to ensure appropriate use of PN based on the best available evidence

(Recommendation 14)

Question #12: The Plan-Do-Study-Act cycle could be accomplished by developing a plan to test the change, completing the test, analyzing the data to determine if the change addressed the quality issue, and then more broadly implementing the change or revising based on results from the test.

- A. True
- B. False

Plan-Do-Study-Act Cycle



Monitoring Indicators of PN Appropriateness

- Gastrointestinal function
- Patient selection
- Utilization trends
- Timing of initiation
- Duration of therapy
- Vascular access (type and location)
- Adequacy/efficacy of PN formulation
- Safety
 - Compliance with guidelines
 - Readmission rates for patients discharged on PN
 - Reason for readmission: PN-related?

Key Takeaways

- Judicious selection of candidates for PN is essential for this high alert medication
- Use clinical assessment, rather than medical diagnosis, to identify candidates for PN, as well as situations in which PN is not likely to be of benefit
- Establish protocols for monitoring the response to therapy that are based on clinical stability and healthcare setting in which PN is administered
- Implement PN specific Quality Improvement programs to ensure safety and efficacy of PN therapy