# Pocket Guide to Parenteral Nutrition

THIRD EDITION



**Editors**
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**and Renee Walker, MS, RD, LD, CNSC, FAND, FASPEN**

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# Frequently Used Terms/Abbreviations

| | |
|---|---|
| **AA** | Amino acids |
| **AAA** | Aromatic amino acids |
| **AAC** | Acute acalculous cholecystitis |
| **ACD** | Automated compounding device |
| **AMA** | American Medical Association |
| **ASHP** | American Society of Health-System Pharmacists |
| **ASPEN** | American Society for Parenteral and Enteral Nutrition |
| **BCAA** | Branched chain amino acids |
| **CII** | Continuous insulin infusion |
| **CKD** | Chronic kidney disease |
| **CMN** | Certificate of Medical Necessity |
| **CRBSI** | Catheter-related blood stream infections |
| **CT** | Computed tomography |
| **CVAD** | Central vascular access device |
| **DME** | Durable medical equipment |
| **DXA** | Dual energy x-ray absorptiometry |
| **EFAD** | Essential fatty acid deficiency |
| **EN** | Enteral nutrition |
| **FDA** | Food and Drug Administration |
| **GIR** | Glucose infusion rate |
| **HPN** | Home parenteral nutrition |
| **ILE** | Intravenous lipid emulsion |

| | |
|---|---|
| **INR** | International normalized ratio |
| **LCD** | Local Coverage Determination |
| **MBD** | Metabolic bone disease |
| **NCP** | Nutrition Care Process |
| **NFPE** | Nutrition-focused physical examination |
| **NPO** | Nil per os |
| **NST** | Nutrition support team |
| **PICC** | Peripherally inserted central catheter |
| **PN** | Parenteral nutrition |
| **PNALD** | PN-associated liver disease |
| **PPN** | Peripheral parenteral nutrition |
| **QOL** | Quality of life |
| **RDN** | Registered dietitian nutritionist |
| **RN** | Registered nurse |
| **SCCM** | Society of Critical Care Medicine |
| **SVC** | Superior vena cava |
| **TNA** | Total nutrient admixtures |
| **USP** | United States Pharmacopeia |
| **VAD** | Vascular access device |

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# Preface

Since the 1960s, parenteral nutrition (PN) has been used to provide intravenous nutrition support for individuals with altered gastrointestinal function. Due to the complexity of compounding PN and the numerous components involved, PN is considered a high-risk medication with potential for errors. It is crucial for practitioners involved in recommending, prescribing, and ordering PN to understand how to deliver appropriate and effective nutrition support to achieve optimal outcomes.

This is the third edition of the Academy of Nutrition and Dietetics *Pocket Guide to Parenteral Nutrition*. This guide explores who should start on PN, appropriate vascular access devices, differences among PN nutrients and formulations, and the process of initiating and advancing a PN regimen. It also offers strategies for managing complications in both acute and long-term patients on PN. In addition, it provides guidance for patients receiving PN at home and in alternative care settings.

Since the publication of the previous edition in 2019, tables and charts have been updated, simplified, and clarified to reflect current research, practice guidelines, and consensus recommendations. Additional updates include the inclusion of refeeding syndrome consensus statement recommendations, adjustments to account for additional intravenous lipid availability, updated Medicare criteria for PN, and specific guidance on electrolyte repletion.

Many thanks to our subject matter experts for the countless hours spent revising the pocket guide. We hope that you find this third edition of the *Pocket Guide to Parenteral Nutrition* a beneficial and invaluable tool for your PN practice.

# Acknowledgments

We wish to thank the authors and reviewers for contributing their time and expertise to the third edition of the *Pocket Guide to Parenteral Nutrition*. The field of nutrition is constantly evolving, and updating these pocket guides on an ongoing basis is crucial to ensure that practices remain evidence-based, effective, and aligned with the most current knowledge. We also wish to thank the Academy of Nutrition and Dietetics' publications team for their guidance and support in bringing this publication to life. We thank the workgroups from previous editions of this pocket guide for their contributions and vision. Finally, we would like to thank the Dietitians in Nutrition Support Dietetic Practice Group for providing support and a group of clinicians with a priceless depth of knowledge.

This book is dedicated to our families, who make our lives fuller, louder, and infinitely more interesting; and to our patients, who are the driving force of our work, and whose journeys continue to inspire us.

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# 1

# Assessment for Parenteral Nutrition in Adults

*Beth Peterson, MS, RD, CSO, LDN, CNSC*



Patients who are not able to digest, absorb, or metabolize nutrients via the gastrointestinal (GI) tract may be candidates for parenteral nutrition (PN). PN provides nutrients via infusion into the venous system, thus bypassing the GI tract. PN is a life-sustaining modality but has potential for significant risks and complications. To promote patient safety and facilitate best outcomes, clinicians should understand and implement the recommendations for PN provided in best-practice documents, clinical practice guidelines, and consensus statements, in addition to using well-developed clinical judgment.

## The Nutrition Care Process

The Nutrition Care Process (NCP) was developed by the Academy of Nutrition and Dietetics as a mechanism to provide nutrition and dietetics professionals with a framework for critical thinking and decision making in all practice settings.[1] The four steps of the NCP, and how they relate to PN, include[1,2]:

- **Nutrition assessment** of the patient on PN, which is covered in detail in this chapter.
- **Nutrition diagnosis**, which is a standardized approach to stating the nutrition-related problem, its etiology, and signs and symptoms. Common problem statements that may be associated with the need for PN include (but are not limited to):
  - inadequate energy intake
  - inadequate oral intake
  - inadequate enteral nutrition (EN) infusion
  - inadequate protein-energy intake
  - altered GI function
  - impaired nutrient utilization
- **Nutrition interventions** directly related to PN, which may include:
  - Initiating PN
  - Modifying the rate, concentration, composition, schedule, and duration of the feeding
  - Providing PN site care
  - Transitioning feeding modalities
  - Coordinating home PN care
- **Nutrition monitoring and evaluation** of PN, which generally encompasses adequacy of nutrient provision, anthropometrics, laboratory measures, and other relevant clinical parameters. This is covered in detail in Chapters 4 and 5.



## Assessment

When determining whether PN is appropriate, the clinician should first complete a comprehensive nutrition assessment and formulate a diagnosis of nutrition problems that preclude oral or enteral feeding. A comprehensive assessment includes evaluation of the patient's clinical status, functional capacity of the GI tract, and the ability to access the GI tract. Information gathered from a thorough review of the patient's clinical condition (eg, renal function, hydration, glucose tolerance, electrolyte homeostasis) and medical history (eg, history of congestive heart failure, diabetes, pulmonary dysfunction) guides the development of a

comprehensive nutrition care plan. Confirmation of seriously altered or absent GI tract function may be obtained from intake and output reports, results of an EN trial, radiology (computed tomography [CT] scan or X-ray) or surgery reports, and GI studies, such as endoscopy.

Per the NCP, information from five categories gathered during the nutrition assessment can be used to diagnose nutrition problems and guide selection of the appropriate nutrition interventions. Box 1.1 provides examples of findings from the nutrition assessment that may be associated with appropriate selection of PN as a nutrition intervention.[2]

**BOX 1.1 Nutrition Assessment Information Pertinent to Use of Parenteral Nutrition**[2]

| Category | Findings pertinent to parenteral nutrition |
|---|---|
| Anthropometric measurements | ▪ Weight loss<br>▪ Poor weight gain |
| Food/nutrition related history | ▪ Inability to tolerate oral or enteral nutrition despite adjustments to diet or enteral formula |
| Biochemical data, medical tests, and procedures | ▪ Endoscopy results<br>▪ Diagnostic imaging (computed tomography, magnetic resonance imaging, ultrasound)<br>▪ Surgical reports |
| Physical exam findings | ▪ Subcutaneous fat loss<br>▪ Muscle wasting<br>▪ Presence of edema |
| Client history | ▪ Significant history of gastrointestinal disorders |



## Patient Selection and Consideration of Risks

Appropriate patient selection for PN is critical, as PN carries higher risks compared to oral feeding or EN.[3] Before deciding to initiate PN, the clinician must carefully evaluate the patient's nutrition needs and clinical status and determine whether EN alone is appropriate.

### EXPERT INSIGHT

*Ordering, compounding, administering, and evaluating PN is a complex, high-risk procedure; therefore, it is vital that all clinicians who are caring for patients receiving PN demonstrate competency.*[4,5]

Worthington et al noted that the broad variety of health care settings in which PN is used, along with the decline in the number of dedicated nutrition support teams, "raises the potential for gaps to exist in the expertise of clinicians initiating and managing PN therapy."[6]

Considering its inherent risks and cost, PN should not be used as a substitute for EN if either standard care (defined as "little or no nutrition intervention," ie, oral diet as tolerated with intravenous hydration) or EN is feasible.[3] In a meta-analysis published in 2001, EN and standard care were generally associated with a lower risk of infection compared with PN.[3] More recently, several randomized clinical trials have evaluated the effectiveness of EN vs PN in patients who are critically ill and concluded that there is no significant difference in mortality risk associated with the use of parenteral or enteral routes of administration in adult patients who are critically ill.[7,8] However, evidence does continue to support the use of early EN when feasible to reduce infectious and other clinical complications associated with complete bowel rest.[9]

### EXPERT INSIGHT

*If EN alone is not feasible, the clinician must determine whether PN (alone or in a supplemental role) is appropriate to fully meet nutritional needs, as well as to ideally maintain or improve nutritional status. Identifying appropriate patient populations and optimizing glucose control, central venous catheter care, and macronutrient and micronutrient intake may positively affect the response to PN.*[10,11]

# Appropriate Use of Parenteral Nutrition

In 2014, the Board of Directors of the American Society for Parenteral and Enteral Nutrition (ASPEN) convened an interprofessional task force to review questions surrounding PN use. According to the report generated by the task force, the group decided against a paper that "narrowly focused on *indications* for PN" in favor of a document that guides the reader to the "*appropriate use* of PN therapy in a variety of clinical circumstances."[6] This document reflects consensus recommendations, largely due to the lack of published research of sufficient quality to create evidence-based guidelines. The recommendations are intended to help clinicians identify best practices, guide decisions (if possible), eliminate variations in practice, and, above all, improve patient safety.[6]

Although PN is a life-sustaining medical intervention for some patients, the task force recommended that PN should not be prescribed solely based on a specific medical diagnosis, clinical condition, or disease state, as PN has not been shown to be an effective treatment modality except in the case of malnutrition.[6] Clinical practice guidelines and consensus recommendations suggest that PN be used in patients who are[6,12,13]:

- already malnourished or at high risk for becoming malnourished;
- not candidates for EN;
- unable to meet their needs with EN alone;
- without sufficient bowel length and/or function to maintain or restore nutritional status; or
- likely to need PN therapy for weeks, months, or years.

Box 1.2 provides examples of conditions likely to require PN across the lifecycle.[6]

**BOX 1.2 Examples of Conditions Likely to Require Parenteral Nutrition**[6]

| Category | Example | Clinical features |
|---|---|---|
| *Impaired absorption or loss of nutrients* | Short bowel syndrome (both mechanical and functional), complications of bariatric surgery, volvulus, mesenteric thrombosis, trauma | Bowel length (adults): 60 cm with colon in continuity, 120 cm without colon in continuity<br>Weight loss, failure to thrive, fluid and electrolyte disturbances |
| | High output intestinal fistula (more than 500 mL/d) | Bypasses significant absorptive mucosal area; location precludes enteral access or results in high-volume output with enteral nutrition (EN) |
| | Neutropenic colitis | Opportunistic infection in an immune-compromised patient |
| | Small bowel mucosal disease:<br>▪ Radiation or chemotherapy related enteritis<br>▪ Congenital diseases (microvillus inclusion disease, tufting enteropathy)<br>▪ Autoimmune enteropathy | Intractable diarrhea, weight loss, failure to thrive, unresponsive to medical management |
| *Mechanical bowel obstruction* | Intrinsic or extrinsic blockage of intestinal lumen:<br>▪ Stenosis or strictures<br>▪ Inflammatory disease<br>▪ Peritoneal carcinomatosis<br>▪ Severe adhesive disease<br>▪ Severe superior mesenteric artery syndrome | Recurrent or intractable vomiting, limited oral intake<br>Unamenable to medical, surgical, or interventional treatment (placement of stent or enteral access device) |

| | | |
|---|---|---|
| *Need to restrict oral or enteral intake: bowel rest* | Ischemic bowel | Mesenteric artery stenosis, intestinal angina, abdominal compartment syndrome, or low flow states |
| | Severe pancreatitis | Increased pain or serum lipase levels with EN, infected pancreatic phlegmon or pseudocyst, complex pancreatic fistula, abdominal compartment syndrome |
| | Chylous fistula | Increased output with low-fat diet or elemental formula |
| | Perioperative status | Severely malnourished adults with nonfunctional gastrointestinal tract for 7–10 days prior to surgery |
| *Motility disorders* | Prolonged ileus | Diffuse peritonitis related to medical treatment or other disease state<br>Time to intervention varies per nutrition and clinical status |
| | Pseudo-obstruction, scleroderma, visceral organ myopathy, very long segment Hirschsprung's disease | Failure to tolerate adequate oral intake or EN |
| | Severe adhesive disease | "Frozen abdomen"a with chronic obstructive symptoms and malnutrition |
| *Inability to achieve or maintain enteral access* | Varies with clinical circumstances | Hemodynamic instability, active gastrointestinal bleeding, severe neutropenic fever,or inability to place tube due to mechanical reasons |

[a] A condition where the abdominal organs and compartmental structures lose their natural space, causing tissues to stick together with loss of functionality. Often characterized by abdominal pain, infection, and impaired intestinal transit.

Adapted with permission from reference 6: Worthington P, Balint J, Bechtold M, et al. When is parenteral nutrition appropriate? *JPEN J Parenter Enteral Nutr*. 2017;41(3):324-377. doi:10.1177/0148607117695251

## Timing of Parenteral Nutrition

Evidence-based recommendations suggest the following guidance regarding the timing of PN initiation[6,13,14]:

- Initiate PN after 7 days in adult patients who are stable and well-nourished, and who have been unable to receive significant (50% or more of estimated requirements) oral or enteral nutrients.
- Initiate PN within 3 to 5 days in those who are nutritionally at risk and unlikely to achieve desired oral intake or EN, including patients who are critically ill.
- Initiate PN as soon as feasible for patients with baseline moderate or severe malnutrition when oral intake or EN is not possible or sufficient.
- Delay initiation in a patient with severe metabolic instability until the patient's condition has improved. Refer to Box 1.3.[6,14]

**BOX 1.3** Clinical Conditions Warranting Cautious Initiation of Parenteral Nutrition in Adults[6,14]

| Conditions | Suggested criteria |
|---|---|
| **Hyperglycemia** | Glucose >300 mg/dL |
| **Azotemia** | Blood urea nitrogen >100 mg/dL |
| **Hypernatremia** | Serum sodium >150 mEq/L |
| **Hypokalemia** | Serum potassium <3 mEq/L |
| **Hypomagnesemia** | Serum magnesium <1.3 mg/dL |
| **Hypophosphatemia** | Serum phosphorus <2 mg/dL |



## Recommendations for Supplemental Parenteral Nutrition

Clinical practice guidelines recommend that supplemental PN should be considered after 7 to 10 days for patients who are critically ill and at either low or high nutrition risk and unable to meet more than 60% of their calorie and protein requirements via EN alone.[13] Guidelines published in 2022 recommend against using supplemental PN prior to day 7 of intensive care unit admission.[15] However, when used as the primary

feeding modality, either EN or PN is acceptable in the first week of critical illness.[14,15]

## Use of Peripheral Parenteral Nutrition

The ASPEN task force developed the following consensus recommendations regarding the use of peripheral parenteral nutrition (PPN)[6]:

- Use PPN only for short-term purposes (no more than 10 to 14 days), as supplemental PN or as a bridge therapy during transition periods, or when a central venous catheter cannot be placed.
- Maintain an upper limit of 900 mOsm/L for PPN formulations.

Contraindications for use of PPN include significant malnutrition, severe metabolic stress (eg, hypercatabolism), large nutrient or electrolyte needs, fluid restriction, need for prolonged PN (>2 weeks), and renal or liver compromise.[14]

## Other Clinical Situations for Parenteral Nutrition Use

Appropriate PN use has also been evaluated in specific clinical situations. Consensus recommendations, as well as other considerations, follow.

### *Intradialytic Parenteral Nutrition*

Intradialytic parenteral nutrition (IDPN) should not be used as the primary nutrition intervention in patients who are malnourished and have chronic kidney disease (CKD).[6] Because IDPN typically only provides 500-1000 kcal per dialysis treatment, and intermittent dialysis treatments are provided 2-3 times per week for most patients, IDPN can only play a supplemental role for patients with CKD who are malnourished and unable to tolerate adequate oral or enteral intake. Existing data suggest IDPN is safe for selected patients, but the risks, complications, and financial costs have not been thoroughly studied.[6,16]

### *Perioperative Parenteral Nutrition*

EN is generally preferred in the preoperative period, but preoperative PN may be considered for patients who are severely malnourished and unable to tolerate adequate oral intake or EN.[6] Postoperatively, PN may be appropriate for patients who are severely malnourished and unable to tolerate EN for more than 7 days.[6]

## *Palliative Care*

PN should not be used solely to treat poor oral intake or cachexia associated with advanced malignancy. Clinicians must consider the risk-to-benefit ratio when evaluating the use of PN in palliative care.[6] Recommendations state to "limit the use of PN in palliative care to carefully selected candidates, with an expected survival of at least 2 to 3 months, for whom oral intake or EN is not feasible and for whom quality of life and the potential burden of long-term PN has been assessed and discussed."[6,17] A time-limited trial of PN may be appropriate for patients whose prognosis is uncertain or whose nutritional decline may be reversible.

## *Home Parenteral Nutrition*

Common indications for home parenteral nutrition (HPN) include[6]:

- short bowel syndrome
- Crohn's disease
- intestinal motility disorders
- chronic bowel obstruction due to benign adhesions or strictures
- radiation enteritis
- malabsorptive disorders
- intestinal and pancreatic fistula
- GI malignancy
- malignant bowel obstruction, carcinomatosis
- complications of bariatric surgery
- gastroschisis
- long-segment Hirschsprung's disease

HPN may be considered for patients who have gastrointestinal failure (as demonstrated by one of the above indications), are clinically stable, and can safely receive therapy outside of an acute-care setting.[6] Clinicians must thoroughly evaluate medical and psychosocial factors that influence suitability for HPN, as well as address financial considerations and patient responsibilities with the patient and caregiver.[6] Refer to Chapter 6 for more information on HPN.

## Contraindications for Enteral Nutrition: Indications for Parenteral Nutrition?

Some relative or absolute contraindications to feeding tube placement may require initiation of PN.[6] The registered dietitian nutritionist should carefully evaluate each patient individually.

- Overall contraindications to obtaining EN access that may necessitate PN initiation include mechanical obstruction of the GI tract, uncontrolled peritonitis, uncorrected coagulopathy or thrombocytopenia, GI bleeding, or bowel ischemia.
- Contraindications for nasal feeding tube placement may include basilar skull fracture; recent transsphenoidal surgery; facial, sinus, or nasal trauma; or significant esophageal disease (including recent variceal banding).
- Contraindications for abdominal feeding tube placement may include massive ascites, hemodynamic instability, morbid obesity, or short duration of therapy (<4 weeks).



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