Pocket Guide to Parenteral Nutrition

THIRD EDITION

Dietitians in Nutrition Support Dietetic Practice Group

EDITORS

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Frequently Used Terms and Abbreviations

AA	amino acid
AAA	aromatic amino acid
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 acid
CDC	Centers for Disease Control and Prevention
CII	continuous insulin infusion
CKD	chronic kidney disease
CMN	certificate of medical necessity
CRBSI	catheter-related blood stream infection
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	US Food and Drug Administration
GIR	glucose infusion rate
HPN	home parenteral nutrition

IDPN	interdialytic parenteral nutrition
ILE	intravenous lipid emulsion
INR	international normalized ratio
LCD	local coverage determination
MBD	metabolic bone disease
MCB	multichamber bag
NCP	Nutrition Care Process
NFPE	nutrition-focused physical examination
NST	nutrition support team
PICC	peripherally inserted central catheter
PN	parenteral nutrition
PNALD	parenteral nutrition–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 admixture
USP	United States Pharmacopeia
VAD	vascular access device

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Preface

Since the 1960s, parenteral nutrition (PN) has been used to provide IV 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 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 patients receiving acute PN or long-term PN. In addition, it provides guidance for patients receiving PN at home and in alternative care settings.

The tables and figures in this edition have been updated, simplified, and clarified to reflect current research, practice guidelines, and consensus recommendations. Additional updates include discussion of refeeding syndrome consensus statement recommendations, adjustments to account for additional IV lipid availability, updated Medicare criteria for PN, and specific guidance on electrolyte repletion.

We extend 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 *Academy of Nutrition and Dietetics 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 *Academy of Nutrition and Dietetics 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 , particularly past editors Pamela Charney, PhD, RDN, LDN, FAND, and Ainsley Malone, MS, RDN, LD, CNSC, FAND, FASPEN. 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.

Emily Schwartz, DCN, RD, CNSC, editor
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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 4 steps of the NCP, and how they relate to PN, are as follows[2]:

- **Nutrition assessment** of the patient receiving 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) the following:
  - 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; or
  - coordinating home PN care.
- **Nutrition monitoring and evaluation** of PN, which generally encompasses adequacy of nutrient provision, anthropometrics, laboratory measurements, and other relevant clinical parameters. This step 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, the 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, or electrolyte homeostasis) and medical history (eg, history of congestive heart failure, diabetes, or 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 (eg, CT scan or x-ray) or surgery reports, and GI studies (eg, endoscopy).

Per the NCP, information from 5 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 ▪ 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 ▪ Diagnostic imaging (CT, MRI, or ultrasound) ▪ Surgical reports
Physical examination findings	▪ Subcutaneous fat loss ▪ Muscle wasting ▪ 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 of adverse effects 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[6] 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."

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 IV 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 adult patients who are critically ill; researchers concluded that there is no significant difference in mortality risk associated with the use of parenteral or enteral routes of administration in these patients.[7,8] However, evidence continues 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 nutrition 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 an article 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." 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 on page 6 provides examples of conditions likely to require PN.[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, or trauma	Bowel length (adults): 60 cm with the colon in continuity, 120 cm without the colon in continuity Weight loss, failure to thrive, or fluid and electrolyte disturbances
	High-output intestinal fistula (more than 500 mL/d)	Bypasses a significant absorptive mucosal area; location precludes enteral access or results in high-volume output with enteral nutrition (EN)
	Neutropenic colitis	Opportunistic infection in an immunocompromised patient
	Small bowel mucosal disease: ▪ Radiation- or chemotherapy-related enteritis ▪ Congenital diseases (microvillus inclusion disease, or tufting enteropathy) ▪ Autoimmune enteropathy	Intractable diarrhea, weight loss, failure to thrive, or unresponsive to medical management
Mechanical bowel obstruction	Intrinsic or extrinsic blockage of the intestinal lumen: ▪ Stenosis or strictures ▪ Inflammatory disease ▪ Peritoneal carcinomatosis ▪ Severe adhesive disease ▪ Severe superior mesenteric artery syndrome	Recurrent or intractable vomiting, or limited oral intake 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, or abdominal compartment syndrome
	Chylous fistula	Increased output with low-fat diet or elemental formula
	Perioperative status	Severely malnourished adults with a nonfunctional gastrointestinal tract for 7 to 10 days prior to surgery
Motility disorders	Prolonged ileus	Diffuse peritonitis related to medical treatment or other disease state Time to intervention varies per nutrition and clinical status
	Pseudo-obstruction, scleroderma, visceral organ myopathy, or very long–segment Hirschsprung 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 in which 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 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 [6]

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% 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]

Condition	Suggested criterion
Hyperglycemia	Glucose greater than 300 mg/dL
Azotemia	Blood urea nitrogen greater than 100 mg/dL
Hypernatremia	Serum sodium greater than 150 mEq/L
Hypokalemia	Serum potassium less than 3 mEq/L
Hypomagnesemia	Serum magnesium less than 1.3 mg/dL
Hypophosphatemia	Serum phosphorus less than 2 mg/dL

Recommendations for Supplemental Parenteral Nutrition

Clinical practice guidelines recommend considering supplemental PN if enteral or oral feedings are unable to meet at least 60% of the patient's calorie and protein requirements for 7 to 10 days, whether the patient is at high or low nutrition risk.[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 PN (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 PN (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 to 1,000 kcal per dialysis treatment and intermittent dialysis treatments are provided 2 to 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 PN (HPN) include the following[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 disease

HPN may be considered for patients who have GI failure (as demonstrated by one of the aforementioned indications), are clinically stable, and can safely receive therapy outside of an acute care setting. 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 the 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 clinician 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 use (<4 weeks).

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