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POCKET GUIDE TO

Parenteral Nutrition

SECOND EDITION

Editor

Pamela Charney

PhD, RD

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Academy of Nutrition and Dietetics
Chicago, IL

Academy of Nutrition and Dietetics
120 S. Riverside Plaza, Suite 2190
Chicago, IL 60606

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Frequently Used Terms/Abbreviations

AAC	acute acalculous cholecystitis
AHRQ	Agency for Healthcare Research and Quality
AMA	American Medical Association
ASPEN	American Society for Parenteral and Enteral Nutrition
ASHP	American Society of Health-System Pharmacists
AA	amino acid
AAA	aromatic amino acid
ACD	automated compounding device
BMTs	bone marrow transplants
BCAA	branched chain amino acid

CRBSI	catheter-related blood stream infection
CDC	Centers for Disease Control and Prevention
CMS	Centers for Medicare and Medicaid Services
CVC	central venous catheter
CMN	Certificate of Medical Necessity
CKD	chronic kidney disease
CBC	complete blood count
CII	continuous insulin infusion
D10W	dextrose
DME	direct medical equipment
eNCPT	electronic Nutrition Care Process Terminology
EN	enteral nutrition
EFAD	essential fatty acid deficiency
ESPEN	European Society for Clinical Nutrition and Metabolism
EAL	Evidence Analysis Library
EBP	evidence-based practice
FDA	US Food and Drug Administration

GI	gastrointestinal
GIR	glucose infusion rate
GRADE	Grading of Recommendations, Assessment, Development and Evaluation
HPN	home parenteral nutrition
ICU	intensive care unit
IDPN	intradialytic parenteral nutrition
IV	intravenous
IVFE	intravenous fat emulsion
ILE	intravenous lipid emulsion
MST	Malnutrition Screening Tool
MCT	medium chain triglyceride
MBD	metabolic bone disease
NPO	nil per os
NCP	Nutrition Care Process
NFPE	nutrition-focused physical examination
NST	nutrition support team
PN	parenteral nutrition

PNALD	parenteral nutrition–associated liver disease
PICC	peripherally inserted central catheters
PPN	peripheral parenteral nutrition
PES	problem, etiology, and signs and symptoms
POC	point of care
PVC	polyvinyl chloride
RDN	registered dietitian nutritionist
RN	registered nurse
smof	Smoflipid
SCCM	Society of Critical Care Medicine
SQ	subcutaneous
SVC	superior vena cava
TNA	total nutrient admixture
VAD	vascular access device

Contributors

Editor

Pamela Charney, PhD, RD
Associate Professor, University of North Georgia
Dahlonega, GA

Contributors

Therese Berry, MS, RD, LD, CNSC
Nutrition Support Dietitian, Coram CVS/Specialty Infusion
Solon, OH

Ainsley Malone, MS, RDN, LD, CNSC, FAND, FASPEN
Nutrition Support Team, Mt. Carmel West Hospital
Columbus, OH
Clinical Practice Specialist, The American Society for Parenteral and Enteral Nutrition
Silver Spring, MD

Mary Marian, DCN, RDN, CSO, FAND
Assistant Professor of Practice
Director, Didactic Program in Dietetics, University of Arizona
Tucson, AZ

Susan Roberts, MS, RDN, LD, CNSC
Area Director of Clinical Nutrition, Baylor Scott & White Health
Dietetic Internship Director, Baylor University Medical Center
Dallas, TX

Reviewers

Mara Lee Beebe, MS, RD, LD, CNSC
Clinical Dietitian, The Ohio State University Wexner Medical Center
Columbus, OH

Jennifer R. Bridenbaugh, MS, RDN, CNSC
Assistant Professor
Clinical Coordinator, Rutgers School of Health Professions
Newark, NJ

Mandy L. Corrigan, MPH, RD, CNSC, FAND
Manager, Home Nutrition Support Service for Gut Rehabilitation and Transplantation, The Cleveland Clinic
Cleveland, OH

Jennifer Lefton, MS, RDN, CNSC, FAND
Clinical Nutrition Specialist, Medstar Washington Hospital
Washington, DC

Jay M. Mirtallo, MS, RPh, BCNSP, FASHP, FASPEN
Professor of Clinical Pharmacy
Director, MS in Health System Pharmacy, The Ohio State University
Columbus, OH

Michelle M. Romano, MS, RDN, CNSC
Manager, Parenteral Nutrition, Clinical Nutrition Medical Affairs, Fresenius Kabi, USA
Lake Zurich, IL

Laura Williams, MS, RD, LD, CNSC
Registered Dietitian, The Cleveland Clinic
Cleveland, OH

Preface

The year 2018 marks the 52nd anniversary of the first use of parenteral nutrition (PN) in humans. Since its introduction, thousands of patients have benefited from this life-saving therapy. As members of interdisciplinary healthcare teams caring for patients receiving PN, registered dietitian nutritionists (RDNs) are often responsible for determining the need for PN, ordering nutrient solutions, monitoring patient response to therapy, and coordinating care with patients, caregivers, and other members of the healthcare team.

Since publication of the first edition of the *ADA Pocket Guide to Parenteral Nutrition* in 2007, there have been many changes in how PN is ordered, compounded, and infused. Ten years ago, amino acids were limited to only three or four concentrations, and there was only one lipid solution. Now clinicians can select from multiple amino acid concentrations and several new types of lipid solutions designed to prevent PN associated liver disease. While PN was ordered using paper forms in the past, most now use electronic ordering systems that

have built-in tools that provide information and decision support at the point of care.

Ordering PN remains one of the highest risk activities for even experienced RDNs. As RDNs take responsibility for ordering PN, it is incumbent on them to demonstrate competency to practice in this area.

The text begins with a review of the Nutrition Care Process as it relates to PN and evidence-based practice, proceeds with guidelines for patient selection, and continues through all of the steps required for safe use of PN therapy. In addition to chapters covering ordering, implementation, and monitoring of PN, there are chapters that will be useful for RDNs working in home care and patient education.

This Pocket Guide provides easy-to-understand, step-by-step guidance to serve as a quick reference for RDNs and other members of the nutrition support team. The text is written in a way that will be useful at all levels of practice, including students, novice, and more experienced RDNs.

Acknowledgments

I would be remiss if I did not offer my sincere thanks and appreciation to my coeditor of the first edition of the *ADA Pocket Guide to Parenteral Nutrition*, Ainsley Malone, MS, RD, LD, CNSC, FADA. Without her knowledge and patience, the first edition would not have been possible. Not only did we collaborate on this Pocket Guide, but we also became great friends. I would also like to thank our authors and reviewers, who shared their expertise in making this edition possible, as well as the multidisciplinary team members at Baylor Scott and White Health in Dallas, TX, for their involvement in the development of the order sets adapted for Chapter 5. Additionally, I owe a significant debt of gratitude to the publications staff at the Academy of Nutrition and Dietetics, who shepherded this publication from start to finish!

CHAPTER 1

The Nutrition Care Process and Evidence-Based Practice

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] In clinical practice, the NCP serves as a mechanism to ensure that nutrition care is provided for the right patient/client/population, at the right time, by the right professional. The following presents

a review of the NCP, with additional information as it applies to parenteral nutrition.

The objectives of the NCP are[1]:

- to provide a standardized process of care
- to support and promote individualized and population care
- to support and encourage use of critical thinking skills, and
- to serve as a structure to validate nutrition care and show that the care provided met the intended purpose.

Nutrition and dietetics terminology published in the electronic Nutrition Care Process Terminology (eNCPT) provides a mechanism to generate qualitative and quantitative data that can be analyzed and interpreted.[2]

The NCP provides a framework to standardize and facilitate the delivery of nutrition care and serve as the basis to document a rigorous approach to assessment of nutritional status, diagnosis of nutrition problems, determination of appropriate treatment, and evaluation of nutrition care.[3] The four steps of the NCP are:

1. Nutrition Assessment
2. Nutrition Diagnosis
3. Nutrition Intervention
4. Nutrition Monitoring and Evaluation

The eNCPT includes standardized terms used to describe each step of the NCP.[2]

Nutrition Screening

Because nutrition screening may be completed by individuals who are not registered dietitian nutritionists (RDNs), it is considered an entry system and not a step in the NCP.[1] The NCP, however, does rely on screening to identify patients who may have a nutrition diagnosis that would be treated by an appropriate nutrition intervention, including parenteral nutrition (PN). Therefore, accurate nutrition risk screening is a key antecedent activity in the overall process.

The nutrition risk screening process should be designed to quickly and accurately identify patients who may have a nutrition diagnosis or may be at risk for development of nutrition-related complication.

Whenever possible, a validated nutrition risk screen should be utilized. There are several nutrition risk screens that have been validated, including the Malnutrition Screening Tool (MST), which has been recommended for use in acute care settings.[4,5]

Nutrition Assessment

If risk is identified through the nutrition screening process, a comprehensive nutrition assessment should be performed to diagnose nutrition problems and determine the best mechanism to treat those nutrition diagnoses. While PN can be a life-saving therapy, inappropriate use of PN carries significant risks. Because

PN should only be initiated when the patient cannot or should not consume adequate nutrients via the oral or enteral route, nutrition assessment should include careful evaluation of the gastrointestinal (GI) system along with current nutrient intake.

The NCP provides RDNs with a framework for completing nutrition assessments. A comprehensive nutrition assessment includes evaluation of the following[1]:

- food- and nutrition-related history
- anthropometric measurements
- biochemical data, medical tests, and procedures
- nutrition-focused physical findings
- client history

Once all pertinent information is gathered, RDNs are responsible for diagnosing nutrition problems. RDNs utilize critical thinking skills to carefully evaluate and prioritize information that will support the correct nutrition diagnosis. If the RDN does not have reasonable certainty that a nutrition diagnosis is present, additional assessment information must be gathered until there is certainty that there is no nutrition diagnosis or that the correct nutrition problem has been diagnosed.

Nutrition Diagnosis

RDNs are responsible for evaluating information gathered during the nutrition assessment in order to

correctly diagnose nutrition problems. In addition to determining the best intervention to treat the nutrition diagnosis, RDNs must be able to clearly and effectively communicate the nutrition diagnosis to other members of the health care team, patients/clients, and caregivers. Terms from the nutrition diagnosis section of the eNCPT can be used to document nutrition diagnoses in a way that allows other RDNs and health care providers to clearly understand what was diagnosed.[2]

Many RDNs communicate and document nutrition diagnoses using the PES (problem, etiology, and signs and symptoms) format. A complete review of the PES format is beyond the scope of this guide. Readers are referred to the online eNCPT reference (subscription based; www.ncpro.org) for more information on the nutrition diagnosis statement or PES statement.[2]

PN is typically initiated in patients who cannot or should not meet their nutrient requirements by oral or enteral nutrition. Nutrition diagnoses that may be associated with the need for PN include (but are not limited to) the following[2]:

- inadequate energy intake
- inadequate oral intake
- inadequate enteral nutrition infusion
- inadequate protein-energy intake
- altered GI function

Note that Reference Sheets of these and other eNCPT terms provide a full profile of the term that includes a definition, assessment indicators, use examples, and criteria for evaluation.[2]

Because patients who require PN tend to have very complex health histories, it is not uncommon to see multiple nutrition diagnoses. Identification of all nutrition diagnoses is important. A complete nutrition diagnosis includes the etiology (as part of the PES statement of nutrition diagnosis), which drives the intervention. For example, if the patient has "inadequate energy intake" related to "altered GI function," the justification of PN as an intervention can be supported.

Nutrition Intervention

Nutrition interventions are actions that RDNs are responsible for taking in order to resolve or improve nutrition diagnoses.[1] Nutrition interventions include actions related to food and nutrient delivery, nutrition education, nutrition counseling, and coordination of care. Identification of the most appropriate nutrition intervention is driven by etiology in the PES statement of the nutrition diagnosis. The intervention must directly focus on alleviating or managing the etiology. For example, if the nutrition diagnosis is "parenteral nutrition composition inconsistent with needs," and the identified etiology is "excessive dextrose delivery (calculated at 9 mg/kg/min)," the intervention may be

to reduce dextrose delivery rate. If the nutrition diagnosis is an "imbalance of nutrients" related to etiology "insufficient phosphorus to support metabolism of carbohydrate from infusion of PN," the intervention may be to increase phosphorus provision. Hence, identifying the "why" (etiology) of a nutrition problem is key to provide the optimal "solution" (intervention).

Most of the nutrition interventions directly related to PN fall in the Food and/or Nutrient Delivery Domain, in ND-2 (Enteral and Parenteral Nutrition) of the eNCPT.[2] Interventions may include the following:

- Initiate PN. (There is no term for initiation of PN; instead, initiation of PN would fall under "Coordination of Nutrition Care by a Nutrition Professional.")
- Modify the rate, concentration, composition, schedule, and duration of the feeding.
- Provide parenteral nutrition site care.

An exception to this would be the provision of education to patients or caregivers, which would fall under Nutrition Education (E).[2]

When considering appropriate nutrition interventions, other considerations include end-of-life issues, ethical considerations, patient rights, family/caregiver issues, availability of and access to a qualified practitioner for follow-up and monitoring, and economic constraints that limit the availability of PN.

Monitoring and Evaluation

The monitoring and evaluation step of the NCP offers the clinician the opportunity to review the progress of PN support and to set goals that may include a trial of enteral nutrition (EN) or an oral diet. Monitoring and evaluation must be done at regular intervals, and the RDN must appropriately document progress toward goals set. Monitoring and evaluation should continue until the nutrition diagnosis has been successfully treated or there is a change in the patient's status that requires a change in the intervention.

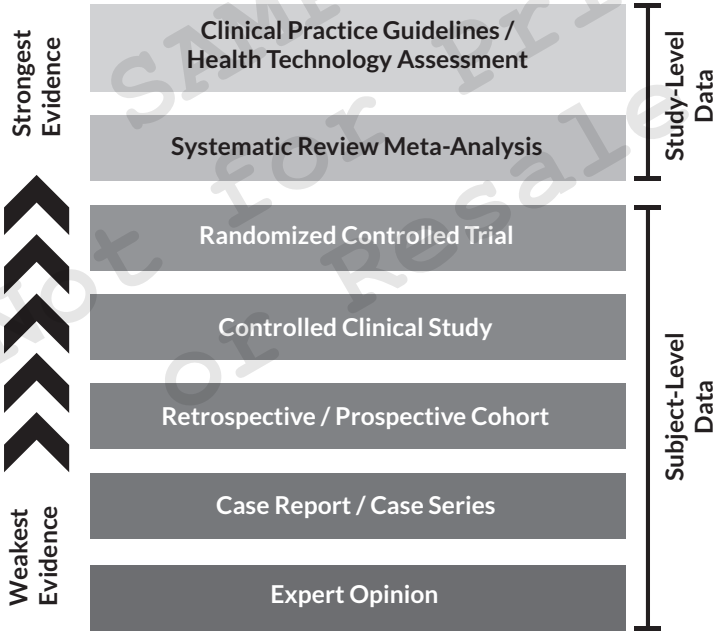
Evidence for Parenteral Nutrition

Evidence-based practice (EBP) has been defined as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients."[6,7]

Guidelines and recommendations have been developed to assist RDNs in determining if there is sufficient evidence to support the use of PN in a given situation.[8] However, RDNs must evaluate each guideline or recommendation prior to application in clinical practice in order to determine if the guideline applies to the current patient or if the guideline has sufficient strength.

How Are Guidelines Created?

Regulatory agencies and third-party payers may require the use of EBP as a condition for reimbursement. In developing guidelines, clinicians will systematically search the literature for studies to answer clinical questions. However, not all evidence sources and studies are created equal. Systematic reviews of the literature with meta-analysis are considered by most to be the highest level of evidence, while expert review or consensus is considered to be the lowest level of evidence.



From weakest to strongest, the levels of evidence are:

- expert opinion/consensus—weakest
- case study and case-controlled studies
- cohort studies
- randomized controlled trials
- evidence synthesis
- systematic review with meta-analysis—strongest

How to Find Guidelines

Many health care professional organizations provide guidelines that are focused on a given specialty area or answer a specific clinical question. The Academy of Nutrition and Dietetics offers the Evidence Analysis Library (EAL), which is a series of systematic reviews and evidence-based nutrition practice guidelines.[9,10] Access to the EAL is free for Academy of Nutrition and Dietetics members.

The Agency for Healthcare Research and Quality (AHRQ) sponsors the National Guideline Clearinghouse, a free resource available through the AHRQ website (www.guidelines.gov).[11] The website is host to a database containing hundreds of guidelines that can be searched by the clinical condition or by the society that provided the guideline.

The Cochrane Library includes the Cochrane Database of Systematic Reviews, which were created by a dedicated group of volunteers working with an editorial

team. There are over 9,000 systematic reviews included in the Cochrane Library. Each review was created using stringent guidelines for the entire process.[12]

How to Evaluate Guidelines

There are several different questions the practitioner can ask when examining new guidelines, such as:

- Are there clear objectives for the review or guideline?
- Are the methods for the literature search clearly described?
- Are inclusion and exclusion criteria clearly defined?
- Were primary studies evaluated using predefined, explicit criteria?
- Was the quality of each study determined?
- Were results reported along with meta-analysis (if appropriate)?
- Were the results interpreted in terms of implications for clinical practice?[13]

Guidelines and Recommendations Related to Parenteral Nutrition

In 2016 the Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral

Nutrition (ASPEN) collaborated on the development of guidelines for the use of nutrition support in critically ill adult patients.[8] While these guidelines are frequently used as a basis for decision making in patient care, practitioners must remember that the guidelines are based on expert consensus. Although published in 2016, the guidelines do not include studies published after 2013.

The SCCM/ASPEN guidelines utilized the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) process for determining the strength of each recommendation. Using this process of grading, four levels of strength for an individual study can be determined[14]:

- High—A great deal of confidence in the results
- Moderate—A chance that the true effect is different from the study results
- Low—Limited confidence in the results
- Very low—Very low confidence in the results

Review of Guidelines

In general, EN rather than PN should be considered when nutrition support is indicated, particularly if the GI tract is even partially functional. The only condition that would be an absolute indication for PN would be when the GI tract is completely nonfunctional. However, when PN is indicated or being considered, RDNs must understand how PN is utilized in different clinical

situations. A review of selected guidelines that discuss which intervention to use—PN or EN—in specific disease states follows.

Oncology

The impact of cancer on nutritional status depends on tumor type, stage, location, and treatment.[15] Many contributing factors, including poor intake, alterations in taste and smell, alterations in intermediary metabolism, and side effects from antineoplastic therapies, are thought to be associated with poor voluntary intake resulting in deterioration in nutritional status. While routine use of PN in patients undergoing cancer treatment is discouraged,[16,17] there may be some benefit to the use of PN in patients who are receiving bone marrow transplants (BMTs). However, a systematic review found a moderate level of support for the use of EN over PN in patients receiving allogeneic BMT.[18]

Critical Illness

Guidelines published in 2016 recommend initiation of PN when it is anticipated that previously well-nourished critically ill patients will not meet their nutritional needs via oral or enteral feeding for more than 7 days, although evidence to support this recommendation was weak.[8] Additionally, PN should be considered as soon as possible after intensive care unit (ICU) admission for patients

who are already malnourished.[8] PN should also be considered as a supplement to EN if EN cannot be advanced to at least 60% of caloric goals within 7 to 10 days.[8]

Gastrointestinal Disease

Malnutrition is often associated with GI conditions, such as Crohn's disease and ulcerative colitis, and is generally thought to be caused by malabsorption of macro- and micronutrients. Weight loss, vitamin and mineral deficiencies, and anemia are commonly seen as a result of untreated malnutrition. A recent systematic review stated that PN should only be used in patients with inflammatory bowel disease when EN is not tolerated or feasible.[19]

Renal Failure

Acute and chronic renal disease is associated with an increased risk for deterioration in nutritional status due to hypermetabolism, the presence of a chronic inflammatory state, and poor intake related to alterations in taste, nausea, and anorexia. However, EN is always the first therapy of choice for patients with acute or chronic renal failure who are not able to meet their nutrient needs via voluntary oral intake.

Intradialytic parenteral nutrition (IDPN) involves infusing a small volume of PN during hemodialysis. There is little evidence that IDPN is associated with improved nutritional status. Practitioners should

remember that (1) IDPN only supplements other forms of nutrition therapy, (2) IDPN does not increase oral nutrition intake, and (3) IDPN is expensive and may not qualify for reimbursement.[20]

Peripheral Parenteral Nutrition

Peripheral parenteral nutrition (PPN) is defined as provision of a less concentrated form of PN via a peripheral vein. Most limit PPN to less than 10% final concentration of dextrose and less than 3% final concentration of amino acids. Lipids may or may not be included in PPN. In order for an individual to receive adequate energy, protein, and other nutrients via PPN, a large fluid volume would be required. PPN may be a useful temporary method to provide partial nutrition support in patients with mild to moderate malnutrition until oral or enteral nutrition is resumed or central PN access is obtained. One study showed no difference in outcomes between PPN and standard fluid therapy following colorectal surgery.[21] PPN tends to be poorly tolerated mainly due to limited suitable peripheral veins that make it difficult and time consuming to maintain access.

Conclusion

PN is considered life-saving therapy for patients who have a nonfunctioning GI tract. Patients with severe intestinal dysfunction, short bowel syndrome,

mechanical bowel obstruction, intractable diarrhea or vomiting, large output fistulas, severe abdominal distention, mesenteric vascular insufficiency, gut ischemia, or infarction are generally the best candidates. Administration of PN is associated with more severe complications and costs than administration of EN. Therefore, EN should be considered as the preferred modality when nutrition support is initiated. The risks and benefits associated with PN must be carefully weighed before support is initiated.

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Written and reviewed by parenteral nutrition experts, this fully updated and evidence-based guide can be used by the nutrition support team in hospitals, long-term care facilities, and home or hospice settings. Topics include:

- indications for parenteral nutrition;
- vascular access, delivery systems, and intravenous pumps;
- parenteral nutrients and formulations;
- initiation, advancement, and acute complications;
- metabolic complications of long-term parenteral nutrition; and
- parenteral nutrition in the home and alternate sites.

An expanded chapter on the Nutrition Care Process addresses nutrition assessment, diagnosis, intervention, and monitoring and evaluation as it applies to the delivery of parenteral nutrition. Appropriate for students to the advanced practitioner, this pocket guide is an indispensable resource.

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