Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine and American Society for Parenteral and Enteral Nutrition: Executive Summary*

Robert G. Martindale, MD, PhD; Stephen A. McClave, MD; Vincent W. Vanek, MD; Mary McCarthy, RN, PhD; Pamela Roberts, MD; Beth Taylor, RD; Juan B. Ochoa, MD; Lena Napolitano, MD; Gail Cresci, RD; American College of Critical Care Medicine; and the A.S.P.E.N. Board of Directors

PRELIMINARY REMARKS

Guideline Limitations

Practice guidelines are not intended as absolute requirements. The use of the practice guidelines does not, in anyway, project or guarantee any specific benefit in outcome or survival.

The judgment of the healthcare professional based on individual circumstances of the patient must always take precedence over the recommendations in these guidelines.

The guidelines offer basic recommendations that are supported by review and analysis of the pertinent available current literature, by other national and international guidelines, and by the blend of expert opinion and clinical practicality. The "intensive care unit" (ICU) or "critically ill" patient is not a homogeneous population. Most studies in which the guidelines are based are limited by sample size, patient heterogeneity, variability in definition of disease state and severity of illness, lack of baseline nutritional status, and lack of statistical power for analysis. Whenever possible, these factors are taken into account and the grade of statement will reflect the power of the data. One of the major methodologic problems with any guideline is defining the exact population to be included.

Periodic Guideline Review and Update

The guidelines may be subject to periodic review and revision based on new peer-reviewed critical care nutrition literature and practice. The 307 references and 19 tables included are up to May 2008 when final form went to review.

Target Patient Population for Guidelines

The guidelines are intended for the adult medical and surgical critically ill patient populations expected to require an ICU stay of >2 or 3 days and are not intended for those patients in the ICU for temporary monitoring or those who have minimal metabolic or traumatic stress. The guidelines are based on populations, but like any other therapeutic treatment in an ICU patient, nutrition requirements and techniques of access should be tailored to the individual patient.

Target Audience

The intended use of the guidelines is for all individuals involved in the nutrition therapy of the critically ill, primarily physicians, nurses, dietitians, pharmacists, and respiratory and physical therapists where indicated.

Methodology

A list of guideline recommendations was compiled by experts on the Guidelines Committee for the two societies, each of which represented clinically applicable definitive statements of care or specific action statements. Prospective randomized controlled trials were used as the primary source to support guideline statements, with each study being evaluated and given a level of evidence. The overall grade for the recommendation was based on the number and level of investigative studies referable to that guideline. Large studies warranting level I evidence were defined as those with ≥100 patients or those which fulfilled end point criteria predetermined by power analysis. The level of evidence for uncontrolled studies was determined by whether they included contemporaneous controls (level III), historical controls (level IV), or no controls (level V, equal to expert opinion) (Table 1) (1). Review articles and consensus statements were considered expert opinion, and were designated the appropriate level of evidence. Meta-analyses were used to organize the information and to draw conclusions about an

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The American College of Critical Care Medicine (ACCM), which honors individuals for their achievements and contributions to multidisciplinary critical care medicine, is the consultative body of the Society of Critical Care Medicine (SCCM) that possesses recognized expertise in the practice of critical care. The College has developed administrative guidelines and clinical practice parameters for the critical care practitioner. New guidelines and practice parameters are continually developed, and currents ones are systematically reviewed and revised.

Speaker's bureaus, consultant fees, or research grants: Stephen A. McClave, MD (Nestle, Abbott, ACM Technologies, Kimberly-Clark, Microvasive Boston Scientific); Robert G. Martindale, MD (Nestle, Abbott, Merck, Novartis, Pfizer); Beth Taylor, RD (Nestle); Pamela Roberts, MD (Nestle and Abbott); and Juan Ochoa, MD (Nestle and Abbott). Direct financial interest—stock ($10,000 or more): none. Authors with no relationship to disclose: Vincent W. Vanek, MD; Gail Cresci, RD; Mary McCarthy, RN, PhD; and Lena M. Napolitano, MD.

For information regarding this article, E-mail: rmartind@mail.mcg.edu; martindr@ohsu.edu

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The full guidelines are available at www.sccm.org and are also being copublished by the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) in the *Journal of Parenteral and Enteral Nutrition* (*JPEN*), 2009, Vol. 33, No. 3.

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Table 1. Grading system used for these guidelines

Grade of recommendation
A. Supported by at least two level I investigations
B. Supported by one level I investigation
C. Supported by level II investigations only
D. Supported by at least two level III investigations
E. Supported by level IV or level V evidence
Level of evidence
I. Large, randomized trials with clearcut results; low risk of false-positive (alpha) error or false-negative (beta) error
II. Small, randomized trials with uncertain results; moderate to high risk of false-positive (alpha) and/or false-negative (beta) error
III. Nonrandomized, contemporaneous controls
IV. Nonrandomized, historical controls
V. Case series, uncontrolled studies, and expert opinion

Large studies warranting level I evidence were defined as those with ≥100 patients or those which fulfilled end point criteria predetermined by power analysis. Meta-analyses were used to organize information and to draw conclusions about overall treatment effect from multiple studies on a particular subject. The grade of recommendation, however, was based on the level of evidence of the individual studies.

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overall treatment effect from multiple studies on a particular subject. The grade of recommendation, however, was based on the level of evidence of the individual studies. An A or B grade recommendation required at least one or two large positive randomized trials supporting the claim, whereas a C grade recommendation required only one small supportive randomized investigation. The rationale for each guideline statement was used to clarify certain points from the studies, to identify controversies, and to provide clarity in the derivation of the final recommendation. Significant controversies in interpretation of the literature were resolved by consensus of opinion of the committee members, which in some cases led to a downgrade of the recommendation. After an extensive review process by external reviewers, the final guideline manuscript was reviewed and approved by the Boards for both the American Society for Parenteral and Enteral Nutrition and the Society of Critical Care Medicine.

INTRODUCTION

The significance of nutrition in the hospital setting cannot be overstated. This significance is particularly noted in the ICU. Critical illness is typically associated with a catabolic stress state in which patients commonly demonstrate a systemic inflammatory response. This response is coupled with complications of increased infectious morbidity, multiorgan dysfunction, prolonged hospitalization, and disproportionate mortality. Over the past three decades, the understanding of the molecular and biological effects of nutrients in maintaining homeostasis in the critically ill population has made exponential advances. Traditionally, nutrition *support* in the critically ill population was regarded as adjunctive care designed to provide exogenous fuels to support the patient during the stress response. This support had three main objectives: to preserve lean body mass, to maintain immune function, and to avert metabolic complications. Recently, these goals have become more focused on nutrition *therapy*, specifically attempting to attenuate the metabolic response to stress, prevent oxidative cellular injury, and favorably modulate the immune response. Nutritional modulation of the stress response to critical illness includes early enteral nutrition (EN), appropriate macronutrient and micronutrient delivery, and meticulous glycemic control. Delivering early nutrition support therapy, primarily using the enteral route, is seen as a proactive therapeutic strategy that may reduce disease severity, diminish complications, decrease length of stay in the ICU, and favorably impact patient outcome.

Initiate Enteral Feeding

1. Traditional nutrition assessment tools are not validated in critical care (albumin, prealbumin, and anthropometry). Before initiation of feedings, assessment should include evaluation of weight loss and previous nutrient intake before admission, level of disease severity, comorbid conditions, and function of the gastrointestinal tract (Grade E).
2. Nutrition support therapy in the form of EN should be initiated in the critically ill patient who is unable to maintain volitional intake (Grade C).
3. EN is the preferred route of feeding over parenteral nutrition (PN) for the critically ill patient who requires nutrition support therapy (Grade B).
4. Enteral feeding should be started early within the first 24–48 hours following admission (Grade C). The feedings should be advanced toward goal over the next 48–72 hours (Grade E).
5. In the setting of hemodynamic compromise (patients requiring significant hemodynamic support, including high-dose catecholamine agents, alone or in combination with large volume fluid or blood product resuscitation to maintain cellular perfusion), EN should be withheld until the patient is fully resuscitated and/or stable (Grade E).
6. In the ICU patient population, neither the presence nor the absence of bowel sounds and evidence of passage of flatus and stool is required for the initiation of enteral feeding (Grade B).
7. Either gastric or small bowel feeding is acceptable in the ICU setting. Critically ill patients should be fed via an enteral access tube placed in the small bowel if at high risk for aspiration or after showing intolerance to gastric feeding (Grade C). Withholding of enteral feeding for repeated high gastric residual volumes alone may be a sufficient reason to switch to small bowel feeding (the definition for high gastric residual volume is likely to vary from one hospital to the next, as determined by individual institutional protocol) (Grade E) (see No. 4 of Monitoring Tolerance and Adequacy of EN section for recommendations on gastric residual volumes, identifying high-risk patients, and reducing chances for aspiration).

When to Use PN

1. If early EN is not feasible or available over the first 7 days following admission to the ICU, no nutrition support therapy (standard therapy) should be provided (Grade C). In the patient who was previously healthy before critical illness with no evidence of protein-calorie malnutrition, use of PN should

be reserved and initiated only after the first 7 days of hospitalization (when EN is not available) (Grade E).

2. If there is evidence of protein-calorie malnutrition at admission and EN is not feasible, it is appropriate to initiate PN as soon as possible following admission and adequate resuscitation (Grade C).
3. If a patient is expected to undergo major upper gastrointestinal surgery and EN is not feasible, PN should be provided under very specific conditions:

   If the patient is malnourished, PN should be initiated 5–7 days preoperatively and continued into the postoperative period (Grade B).

   PN should not be initiated in the immediate postoperative period, but should be delayed for 5–7 days (should EN continue not to be feasible) (Grade B).

   PN therapy provided for a duration of <5–7 days would be expected to have no outcome effect and may result in increased risk to the patient. Thus, PN should be initiated only if the duration of therapy is anticipated to be ≥7 days (Grade B).

Dosing of Enteral Feeding

1. The target goal of EN (defined by energy requirements) should be determined and clearly identified at the time of initiation of nutrition support therapy (Grade C). Energy requirements may be calculated by predictive equations or measured by indirect calorimetry. Predictive equations should be used with caution, as they provide a less accurate measure of energy requirements than indirect calorimetry in the individual patient. In the obese patient, the predictive equations are even more problematic without availability of indirect calorimetry (Grade E).
2. Efforts to provide >50% to 65% of goal calories should be made to achieve the clinical benefit of EN over the first week of hospitalization (Grade C).
3. If unable to meet energy requirements (100% of target goal calories) after 7–10 days by the enteral route alone, consider initiating supplemental PN (Grade E). Initiating supplemental PN before this 7–10-day period in the patient already on EN does not improve outcome and may be detrimental to the patient (Grade C).
4. Ongoing assessment of adequacy of protein provision should be performed. The use of additional modular protein supplements is a common practice, as standard enteral formulations tend to have a high nonprotein calorie:nitrogen ratio. In patients with body mass index (BMI) <30, protein requirements should be in the range of 1.2–2.0 g/kg actual body weight per day, and may likely be even higher in patients with burn or multiple trauma (Grade E).
5. In the critically ill obese patient, permissive underfeeding or hypocaloric feeding with EN is recommended. For all classes of obesity where BMI is >30, the goal of the EN regimen should not exceed 60% to 70% of target energy requirements or 11–14 kcal/kg actual body weight/day (or 22–25 kcal/kg ideal body weight/day). Protein should be provided in a range ≥2.0 g/kg ideal body weight/day for class I and class II patients (BMI 30–40), ≥2.5 g/kg ideal body weight/day for class III (BMI ≥40). Determining energy requirements is discussed elsewhere (Grade D).

Monitoring Tolerance and Adequacy of EN

1. In the ICU setting, evidence of bowel motility (resolution of clinical ileus) is not required to initiate EN in the ICU (Grade E).
2. Patients should be monitored for tolerance of EN (determined by patient complaints of pain and/or distention, physical examination, passage of flatus and stool, abdominal radiographs) (Grade E). Inappropriate cessation of EN should be avoided (Grade E). Holding EN for gastric residual volumes <500 mL in the absence of other signs of intolerance should be avoided (Grade B). Making the patient *nil per os* surrounding the time of diagnostic tests or procedures should be minimized to prevent inadequate delivery of nutrients and prolonged periods of ileus. Ileus may be propagated by *nil per os* status (Grade C).
3. Use of enteral feeding protocols increases the overall percentage of goal calories provided and should be implemented (Grade C).
4. Patients placed on EN should be assessed for risk of aspiration (Grade E). Steps to reduce risk of aspiration should be used (Grade E).

   The following measures have been shown to reduce risk of aspiration:

   In all intubated ICU patients receiving EN, the head of the bed should be elevated 30°–45° (Grade C).

   For high-risk patients or those shown to be intolerant to gastric feeding, delivery of EN should be switched to continuous infusion (Grade D).

   Agents to promote motility, such as prokinetic drugs (metoclopramide and erythromycin) or narcotic antagonists (naloxone and alvimopan), should be initiated where clinically feasible (Grade C).

   Diverting the level of feeding by postpyloric tube placement should be considered (Grade C).

   Use of chlorhexidine mouthwash twice a day should be considered to reduce risk of ventilator-associated pneumonia (Grade C).

5. Blue food coloring and glucose oxidase strips, as surrogate markers for aspiration, should not be used in the critical care setting (Grade E).
6. Development of diarrhea associated with enteral tube feedings warrants further evaluation for etiology (Grade E).

Selection of Appropriate Enteral Formulation

1. Immune-modulating enteral formulations (supplemented with agents, such as arginine, glutamine, nucleic acid, omega-3 fatty acids, and antioxidants) should be used for the appropriate patient population (major elective surgery, trauma, burns, head and neck cancer, and critically ill patients on mechanical ventilation), being cautious in patients with severe sepsis (for surgical ICU patients Grade A) (for medical ICU patients Grade B). ICU patients not meeting criteria for immune-modulating formulations should receive standard enteral formulations (Grade B).
2. Patients with acute respiratory distress syndrome and severe acute lung injury should be placed on an enteral formulation characterized by an anti-inflammatory lipid profile (i.e., omega-3 fish oils, borage oil) and antioxidants (Grade A).
3. To receive optimal therapeutic benefit from the immune-modulating formulations, at least 50% to 65% of goal

energy requirements should be delivered (Grade C).
4. If there is evidence of diarrhea, soluble fiber-containing or small peptide formulations may be used (Grade E).

Adjunctive Therapy

1. Administration of probiotic agents has been shown to improve outcome (most consistently by decreasing infection) in specific critically ill patient populations involving transplantation, major abdominal surgery, and severe trauma (Grade C). No recommendation can currently be made for use of probiotics in the general ICU population because of a lack of consistent outcome effect. It seems that each species may have different effects and variable impact on patient outcome, making it difficult to make broad categorical recommendations. Similarly, no recommendation can currently be made for use of probiotics in patients with severe acute necrotizing pancreatitis, based on the disparity of evidence in the literature and the heterogeneity of the bacterial strains used.
2. A combination of antioxidant vitamins and trace minerals (specifically including selenium) should be provided to all critically ill patients receiving specialized nutrition therapy (Grade B).
3. The addition of enteral glutamine to an EN regimen (not already containing supplemental glutamine) should be considered in burn, trauma, and mixed ICU patients (Grade B).
4. Soluble fiber may be beneficial for the fully resuscitated, hemodynamically stable critically ill patient receiving EN who develops diarrhea. Insoluble fiber should be avoided in all critically ill patients. Both soluble and insoluble fiber should be avoided in patients at high risk for bowel ischemia or severe dysmotility (Grade C).

When Indicated, Maximize Efficacy of PN

1. If EN is not available or feasible, the need for PN therapy should be evaluated (see recommendations No. 1, 2, and 3 of When to Use PN section and No. 3 of Dosing of Enteral Feeding section) (Grade C). If the patient is deemed to be a candidate for PN, steps to maximize efficacy (regarding dose, content, monitoring, and choice of supplemental additives) should be used (Grade C).
2. In all ICU patients receiving PN, mild permissive underfeeding should be considered, at least initially. Once energy requirements are determined, 80% of these requirements should serve as the ultimate goal or dose of parenteral feeding (Grade C). Eventually, as the patient stabilizes, PN may be increased to meet energy requirements (Grade E). For obese patients (BMI $\geq$30), the dose of PN with regard to protein and caloric provision should follow the same recommendations given for EN in recommendation C5 (Grade D).
3. In the first week of hospitalization in the ICU, when PN is required and EN is not feasible, patients should be given a parenteral formulation without soy-based lipids (Grade D).
4. A protocol should be in place to promote moderately strict control of serum glucose when providing nutrition support therapy (Grade B). A range of 110–150 mg/dL may be most appropriate (Grade E).
5. When PN is used in the critical care setting, consideration should be given to supplementation with parenteral glutamine (Grade C).
6. In patients stabilized on PN, periodically repeat efforts should be made to initiate EN. As tolerance improves and the volume of EN calories delivered increases, the amount of PN calories supplied should be reduced. PN should not be terminated until $\geq$60% of target energy requirements are being delivered by the enteral route (Grade E).

Pulmonary Failure

1. Specialty high-lipid low-carbohydrate formulations designed to manipulate the respiratory quotient and reduce CO_2 production are not recommended for routine use in ICU patients with acute respiratory failure (Grade E) (this is not to be confused with the recommendation No. 2 of Selection of Appropriate Enteral Formulation section for acute respiratory distress syndrome/acute lung injury).
2. Fluid-restricted calorically dense formulations should be considered for patients with acute respiratory failure (Grade E).
3. Serum phosphate levels should be monitored closely, and replaced appropriately when needed (Grade E).

Renal Failure

1. ICU patients with acute renal failure or acute kidney injury should be placed on standard enteral formulations, and standard ICU recommendations for protein and calorie provision should be followed. If significant electrolyte abnormalities exits or develop, a specialty formulation designed for renal failure (with appropriate electrolyte profile) may be considered (Grade E).
2. Patients receiving hemodialysis or continuous renal replacement therapy should receive increased protein, up to a maximum of 2.5 g/kg/day. Protein should not be restricted in patients with renal insufficiency as a means to avoid or delay initiation of dialysis therapy (Grade C).

Hepatic Failure

1. Traditional assessment tools should be used with caution in patients with cirrhosis and hepatic failure, as these tools are less accurate and less reliable because of complications of ascites, intravascular volume depletion, edema, portal hypertension, and hypoalbuminemia (Grade E).
2. EN is the preferred route of nutrition therapy in ICU patients with acute and/or chronic liver disease. Nutrition regimens should avoid restricting protein in patients with liver failure (Grade E).
3. Standard enteral formulations should be used in ICU patients with acute and chronic liver disease. The branched chain amino acid formulations should be reserved for the rare encephalopathic patient who is refractory to standard therapy with luminal-acting antibiotics and lactulose (Grade C).

Acute Pancreatitis

1. At admission, patients with acute pancreatitis should be evaluated for disease severity (Grade E). Patients with severe acute pancreatitis should have a nasoenteric tube placed and EN initiated as soon as fluid volume resuscitation is complete (Grade C).
2. Patients with mild to moderate acute pancreatitis do not require nutrition support therapy (unless an unexpected complication develops or there is failure to advance to oral diet within 7 days) (Grade C).

3. Patients with severe acute pancreatitis may be fed enterally by the gastric or jejunal route (Grade C).
4. Tolerance to EN in patients with severe acute pancreatitis may be enhanced by the following measures:

   Minimizing the period of ileus after admission by early initiation of EN (Grade D).

   Displacing the level of infusion of EN more distally in the gastrointestinal tract (Grade C).

   Changing the content of the EN delivered from intact protein to small peptides, and long-chain fatty acids to medium-chain triglycerides or a nearly fat-free elemental formulation (Grade E).

   Switching from bolus to continuous infusion (Grade C).

5. For the patient with severe acute pancreatitis, when EN is not feasible, use of PN should be considered (Grade C). PN should not be initiated until after the first 5 days of hospitalization (Grade E).

Nutrition Therapy End-of-Life Situations

1. Specialized nutrition therapy is not obligatory in cases of futile care or end-of-life situations. The decision to provide nutrition therapy should be based on effective patient/family communication, realistic goals, and respect for patient autonomy (Grade E).

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The Canadian Clinical Practice Guidelines (2) served as an indispensable reference source and a valuable model for the organization of the topics included in this document. Many of the tables were adapted from the Canadian Clinical Practice Guidelines.

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