Inpatient Nutrition Support

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KEYWORDS

• Malnutrition • Specialized nutritional support • Enteral nutrition • Parenteral nutrition

HOSPITAL MEDICINE CLINICS CHECKLIST

1. Established criteria for malnutrition include at least 2 of the following features: insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid accumulation, and decreased functional status.
2. Specialized nutrition support includes oral nutrition supplements, enteral nutrition (EN), and parenteral nutrition (PN).
3. Malnutrition is common in hospitalized adults.
4. Hospitalized patients typically require 20 to 35 kilocalories per kilogram per day, and there are specialized formulas to estimate energy requirements in obese patients.
5. Protein requirements can vary greatly between states of health and critical illness.
6. The Joint Commission requires a nutrition screen for all patients admitted to an acute care hospital, and there are several nutrition screening tools available.
7. Various laboratory tests including albumin, prealbumin, and transferrin vary greatly depending on the illness, and do not consistently indicate the current nutritional status of many patients.
8. The literature supports the use of EN over PN with few exceptions.
9. Medical comorbidities may influence choice of access for EN, PN, and which type of EN formula to select.
10. Risks of EN and PN include refeeding syndrome, which can be ameliorated by initiating nutrition support at a slower rate in patients at greatest risk.

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DEFINITIONS

What is the definition of malnutrition?

Stedman's Concise Medical Dictionary defines malnutrition as "faulty nutrition resulting from malabsorption, poor diet, or overeating."[1] Published criteria for malnutrition include at least 2 of the following features: insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid accumulation, and decreased functional status.[2]

A published consensus statement also describes an etiology-based definition of malnutrition that includes whether or not and to what degree inflammation is present (**Table 1**).[3] For example, anorexia nervosa is a noninflammatory condition whereby a patient can still have severe malnutrition. By contrast, sepsis leads to an inflammatory cascade whereby severe malnutrition can rapidly develop. In the context of an acute illness such as trauma or sepsis, severe malnutrition is quantified by intake of 50% or less of the estimated energy requirement for 5 days or longer. In a patient with anorexia nervosa, severe malnutrition is defined as a patient with 75% or less of estimated energy requirement for at least 1 month. In addition to diminished energy intake, other measures such as weight loss, loss of body fat and muscle mass, impaired grip strength, and increased fluid accumulation stratify the severity of malnutrition.

Why is it important to identify and treat malnutrition?

Malnutrition, whether present on admission or acquired during hospitalization, is associated with adverse outcomes for patients and can also have negative financial consequences for an institution. Negative effects of malnutrition include decreased

Table 1
Clinical characteristics that the clinician can obtain and document to support a diagnosis of malnutrition

Clinical Characteristic	Acute Illness			
	Moderate		Severe	
Energy intake	<75% estimated energy requirement for >7 d		<50% estimated energy requirement for >5 d	
Interpretation of weight loss	% of body weight lost: 1–2 5 7.5	Time frame for loss of that % of body weight: 1 wk 1 mo 3 mo	% of body weight lost: >2 >5 >7.5	Time frame for loss of that % of body weight: 1 wk 1 mo 3 mo
Physical findings	Mild changes		Moderate changes	
Body fat	Mild losses		Moderate losses	
Muscle mass	Mild losses		Moderate losses	
Fluid accumulation	Mild increase		Moderate to severe increase	
Reduced grip strength	No change		Measurably reduced	

Adapted from White JV, Guenter P, Jenson G, et al. Consensus statement: Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition: characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). JPEN J Parenter Enteral Nutr 2012;36:3; with permission.

immune response, increased risk for pressure ulcers, impaired wound healing, longer length of stay (LOS), and increased mortality rates.[4]

Malnutrition is often associated with a loss of both muscle and fat mass, leaving more prominent bony features and increasing the risk for pressure ulcers.[4] Decreased wound healing capability, in addition to potential vitamin and mineral deficiencies (eg, zinc, vitamin C, vitamin A) impair the patient's ability to repair these ulcers. The loss of muscle mass can be associated with decreased respiratory and cardiac function as well as atrophy of visceral organs.[4]

Longer LOS in malnourished patients in comparison with their well-nourished counterparts has been reported in numerous studies, with increases ranging from 3 to 6 days.[5]

Given the multiple adverse effects that malnutrition can have on patients and a health care institution, early detection of malnourished and at-risk patients with subsequent treatment is hugely important.

What is the definition of specialized nutrition support (SNS)?

The Academy of Nutrition and Dietetics and the American Society for Parenteral and Enteral Nutrition (ASPEN) defines SNS as the provision of oral nutrition supplements, enteral nutrition (EN), or parenteral nutrition (PN). EN is the delivery of nutrients via feeding tube into a patient's gastrointestinal tract. PN refers to delivery of nutrients directly into the bloodstream.[3]

EPIDEMIOLOGY

What is the incidence of malnutrition in a general inpatient setting?

One-third of hospitalized patients present with malnutrition. In addition, up to one-third of well-nourished patients on admission later develop malnutrition during their hospitalization.[6]

What are normal nutritional requirements for adults?

National and international dietary guidelines describe that for average adults, approximately 60% of calories should be derived from carbohydrates, 10% to 20% of calories should be derived from protein, and less than 30% of calories should be derived from fat. For both generally healthy and acutely ill patients the expected number of kilocalories per day is estimated to be 20 to 35 kcal/kg/d. For example, a 70-kg male may require approximately 1400 to 2450 kcal per day. Young, healthy, and physically active adults may require even a greater number of calories. For example, a 29-year-old active 70-kg man may require 3050 kcal in comparison with a less active 60-year-old 70-kg man who would require only 2050 kcal. Protein requirements can depend greatly on the health status of patients, ranging between 0.8 g/kg/d in a healthy adult to 2 g/kg/d in patients with high metabolic demands, such as critical illness, trauma, or burns.[3]

How do nutritional requirements differ in obese patients?

In the absence of indirect calorimetry, the recommended technique is to use the Penn State University 2010 predictive equations to estimate the metabolic needs of obese patients.

In general, guidelines support hypocaloric (ie, <70% estimated caloric needs) and high protein nutrition for obese patients with acute illness.[7]

DIAGNOSIS

How can clinicians screen for malnutrition?

The Joint Commission requires nutrition screening to take place within 24 hours of admission to an acute care center. There are various screening tools for malnutrition. The Malnutrition Screening Tool (MST), which uses 2 simple questions, has high sensitivity and specificity (both 93%) in assessing if a patient is at risk for malnutrition. If the MST score is 2 or greater, the patient is considered at risk for malnutrition (**Table 2**).[8] The gold standard for diagnosing malnutrition is the Subjective Global Assessment (SGA), which requires additional physical examination and clinical assessment.[9] Findings such as peripheral edema, muscle wasting (eg, clavicular or temporal wasting), loss of subcutaneous fat, or ascites would be noted on the SGA to support a diagnosis of malnutrition. A detailed dietary history is also part of the SGA. The obese patient may have greater than ideal body weight, but may also have decreased muscle bulk and relative weight loss, supporting a diagnosis of malnutrition.

Which laboratory tests are helpful in diagnosing malnutrition?

Albumin, prealbumin, and transferrin have poor ability to diagnose malnutrition when used in isolation. These tests can be helpful when used as indicators of severity of illness, because low albumin is an independent risk factor for mortality in older adults, but does not accurately reflect nutritional status. Some clinicians may track the response to nutrition therapy by following serial prealbumin and C-reactive protein levels, but this practice is not well supported by current practice guidelines.[3]

Table 2
Malnutrition screening tool (MST)

1. Have you lost weight recently without trying?	
No	0
Unsure	2
If Yes, how much weight (kg) have you lost?	
1–5	1
6–10	2
11–15	3
>15	4
Unsure	2
Weight loss score	
2. Have you been eating poorly because of a decreased appetite?	
No	0
Yes	1
Appetite score	
Total MST score (Weight loss + Appetite scores)	

From Ferguson M, Capra S, Bauer J, et al. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. Nutrition 1999;15:6; with permission.

MANAGEMENT

Which patients should receive SNS?

SNS should be started in well-nourished patients who experience inadequate oral intake for 7 to 14 days or who are expected to have poor oral intake over a similar time frame.[10] It is reasonable to start SNS in malnourished patients who experience inadequate oral intake for 3 to 5 days or are expected to have poor intake over a similar time frame (**Fig. 1**[11]). The literature supports the use of EN over PN with few exceptions.[3]

What are the indications for EN?

Indications for EN include the following[12,13]:

- Existing severe malnutrition or risk of protein-calorie depletion because of persistent negative nitrogen balance
- Anorexia
- Fractures of head and neck or neurologic disorders preventing satisfactory oral feeding
- Coma or depressed mental state
- Serious medical or surgical illness (eg, burns) whereby metabolic requirements are very high

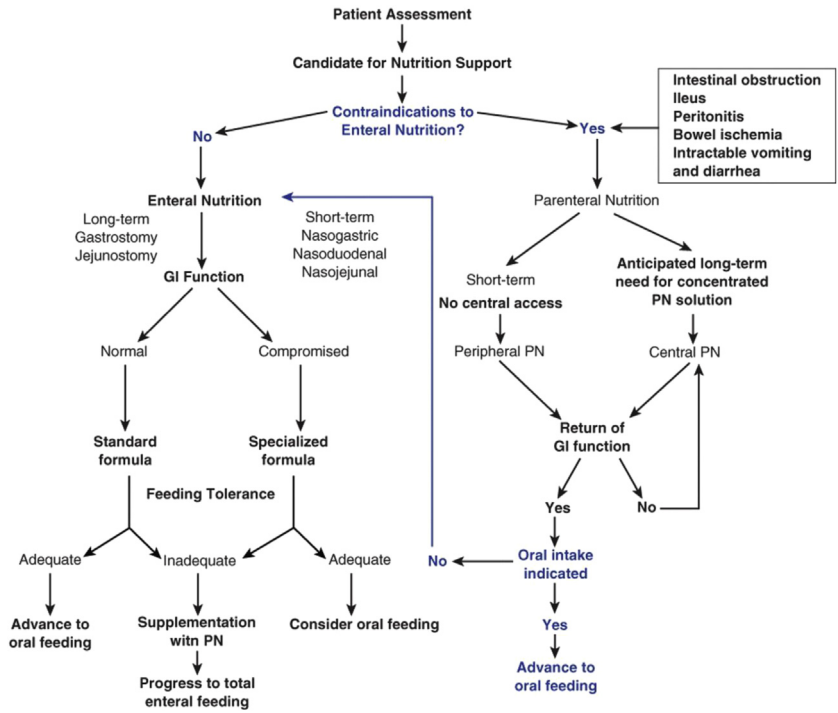

Fig. 1. Pathway for nutrition support. GI, gastrointestinal; PN, parental nutrition. (*From* Ukleja A, Freeman KL, Gilbert K, et al. Standards for nutrition support: adult hospitalized patients. Nutr Clin Pract 2010;25:4; with permission.)

- Other specific indications
  - Enterocutaneous fistula
  - Small bowel adaptation
  - Crohn disease of the small bowel
  - Severe acute pancreatitis

Enteral feeding should be started early (ie, <24–48 hours following admission) for critically ill patients who are unable to take oral nutrition because of mental status, mechanical ventilation, or other reasons. EN should be delayed until the patient is stabilized following initial resuscitation.

What are the features of various types of enteral access?

When deciding on route of administration, the hospitalist must first determine the expected duration of EN. When long-term (>30 days) EN is expected or if nasopharyngeal obstruction impairs placement of nasogastric tubes or nasojejunal tubes (NJTs), a tube enterostomy is indicated.[3] Gastric tubes can be placed surgically, or percutaneously with either endoscopic or fluoroscopic guidance. Second, the hospitalist must decide the site of delivery of EN. Anatomic considerations and motility disorders should be evaluated before feeding tubes are advanced to the small bowel. Examples of situations whereby small bowel access is indicated include gastroparesis, gastric outlet obstruction, or altered gastrointestinal anatomy from prior surgery. Although studies do not consistently show that small bowel feedings decrease the risk of aspiration, sometimes a gastric tube is advanced to the postpyloric position in the context of tracheal aspiration or reflux esophagitis.[3] Jejunal enteral nutrition cannot typically accommodate intermittent bolus feeding.

The use of NJTs is associated with several risks including nasopharyngeal ulcers, nasal septum necrosis, sinusitis, otitis, and vocal cord paralysis.[3] Tube enterostomies can lead to additional complications such as wound infection, hemorrhage, perforation, bowel obstruction or necrosis, and stomal leakage.[3]

How should EN be initiated?

Correct placement of the feeding tube needs to be confirmed radiographically before initiation of feeds. In the acute care setting, whether the eventual goal is continuous, cycled, or bolus feeds, feedings should start with full-strength formula at rates ranging from 10 mL/h to 50 mL/h, and increased by 10 to 25 mL every 4 to 24 hours depending on the patient situation. Patients warranting lower starting rates and slower advancement are those at risk for refeeding syndrome, those who have undergone recent gastrointestinal surgery, and those with a history of intolerance to enteral feeds.[12]

EN can be delivered with continuous, cyclic, or bolus feeding. Continuous feeding occurs with the assistance of a pump whereby the total volume of feeds is infused over 24 hours. Continuous feeding is best for critically ill patients, intubated patients, patients with poor glycemic control, patients with postpyloric or jejunal feeding tubes, or patients who have demonstrated intolerance to intermittent feeds or feeding at higher rates. Cyclic feeding occurs when the total volume is delivered over less than 24 hours, and is helpful in allowing patients to take oral nutrition. Cyclic feedings can also be used for patients with postpyloric or jejunal feeding tubes, and also allows patients to have time free from the pump equipment. Bolus feeding is best for patients who are awake and alert, and can aid in self-care bolus feeding, which allows the total volume of feeds to be delivered by pump, syringe, or gravity drip bag to occur at

specific intervals throughout the day over a short period of time, typically 15 minutes. Bolus feeding can help patients mimic the timing of oral meals, and can be used to supplement oral intake.[12]

How is EN tolerance monitored?

Gastric residual volumes are monitored to evaluate how much content could be potentially aspirated from feeding tubes entering the stomach. Residuals should be checked every 4 hours during the first 48 hours of feeding in gastrically fed patients. Depending on the institution, feeds are typically held for residuals ranging from 200 to 500 mL. The 2009 ASPEN guidelines suggest initiation of a promotility agent, such as metoclopramide, for 2 consecutive gastric residuals that are greater than or equal to 250 mL, and recommends holding feeds only for residuals greater than 500 mL. Gastric residual volume should be checked before feeding with bolus feedings.[14]

When the feeding tube is postpyloric, such as with an NJT, gastric residual volumes cannot be monitored. Other signs of feeding intolerance include increasing abdominal girth, distention, or tenderness.

When diarrhea develops while a patient is receiving tube feeds, a thorough evaluation for common causes such as antibiotics-associated diarrhea, *Clostridium difficile* infection, and liquid medications containing sorbitol should be pursued before attributing the diarrhea to tube feeds. If diarrhea persists and all other causes have been ruled out, the addition of soluble fiber may be beneficial. Changing the EN formula can also be considered. Clinicians may need to consider use of total PN (TPN), if stool output remains high (>1 L per day) and malabsorption of tube feeds is suspected.

What are available types of EN formula?

Typical EN formulas are presented in **Table 3**.

What are indications for PN?

Indications for PN include the following[14,15]:

- Documented severe malabsorption of nutrition from the gastrointestinal tract as in:
  - Massive small bowel resection (at least initially)
  - Intractable diarrhea
  - Radiation enteritis
  - Scleroderma of the bowel
- Complete bowel obstruction
- Inability to obtain enteral access for feeding for at least 7 to 10 days
- Persistent gastrointestinal bleeding
- High-output fistula (>500 mL) and inability to gain enteral access distal to fistula
- Diffuse peritonitis
- Bowel ischemia
- Perioperatively in severely malnourished patients without functioning gastrointestinal tract
- Severe acute pancreatitis with documented abdominal pain with jejunal enteral feeds

Table 3
Typical enteral nutrition formulas

Formula Type	Description	Indications	Examples
Standard/polymeric formula	Contains intact nutrients and may or may not have fiber	Patient with normal gastrointestinal tract that can tolerate higher volumes	Replete Promote Osmolyte Jevity 1.0
Restricted volume polymeric formula	Calorically dense formula that contains intact nutrients and may or may not contain fiber	States of volume overload such as: congestive heart failure, renal failure, and hepatic failure	Probalance Jevity 1.5 Fibersource Isosource 1.5 TwoCal HN
Semielemental formula	Contains partially hydrolyzed nutrients (protein) and altered fats	Gastrointestinal intolerance to standard formulas, persistent diarrhea, malabsorption disorders	Peptamen Vital
Elemental formulas	Contain completely hydrolyzed protein and altered/minimal fats	Chylothorax, short gut syndrome, intolerance to semielemental formula	Vivanex
Disease-specific formulas	Targeted for organ dysfunction or specific metabolic conditions	Conditions such as renal failure (potassium and phosphorous restricted), respiratory failure (use of decreased ratio of carbohydrates), diabetes (lower carbohydrates) when unable to use polymeric formulas	Pulmocare Nepro Glucerna

Even when EN intake provides insufficient energy intake for critically ill patients, the use of PN to supplement energy intake should typically be started only after 7 days.

Data from 2 randomized controlled trials have shown that PN is not consistently beneficial when started early in the course of critical illness. Casaer and colleagues[16] demonstrated a significant increase in the likelihood of being discharged alive earlier from the intensive care unit (ICU) (hazard ratio 1.06, 95% confidence interval 1.00–1.13) and a significant decrease in ICU infections (22.8% vs 26.2%, $P = .008$) in patients randomized to a delayed start of PN. Doig and colleagues[17] showed that there was no change in 60-day mortality in critically ill patients with relative contraindications to early EN, who were randomized to early PN (ie, 5 days) versus usual care.

What are access options for delivery of PN?

Most often PN is synonymous with TPN. Peripheral veins cannot safely tolerate infusions of PN, owing to the high concentration of nutrients delivered with PN. Thus, PN is delivered through central venous catheters, including peripherally inserted central catheters with the tip sitting in the cavoatrial junction.[3] The expected duration of TPN, vascular anatomy, and acuity of illness may affect the choice of central venous access being a temporary central venous catheter, a tunneled percutaneous catheter,

or an implanted subcutaneous infusion port. For multilumen catheters, TPN should be administered via a dedicated lumen.[3] Peripheral parenteral nutrition (PPN) can administer limited quantities of nutrition via peripheral intravenous catheter. The use of PPN should be limited to rare instances, such as when a patient is anticipated to need TPN but is awaiting placement of central venous access or awaiting placement of a feeding tube. PPN cannot meet the nutritional needs of most patients and requires large volumes, which many patients cannot tolerate.

How is PN typically initiated?

PN should be initiated at a low caloric dose (eg, 100–150 g dextrose per day), at a low total volume (approximately 1000 mL), with a moderate amount of protein (eg, 50–70 g) and without lipids over 24 hours. PN can be advanced in patients with normal serum phosphorus and potassium, and glucose concentrations between 100 and 200 mg/dL. Dextrose is usually advanced by 50 to 100 g/d based on glucose tolerance, to goals of anywhere between 100 and 600 g/d. Lipids can be added once a triglyceride level has been checked and is lower than 400 mg/dL. Cycling of PN should only be done once a patient has reached his or her dextrose goal and has acceptable glucose levels.[15]

How is PN monitored?

When PN is first started, fluids, electrolytes, and renal function should be monitored daily. Once these levels are stable and the PN order is being minimally adjusted, the frequency can be decreased over time to once per week. Blood sugars should also be monitored closely until glucose level is stable and PN is at goal. Triglyceride levels should be checked at baseline and monitored weekly. Liver function tests should also be checked at baseline, then weekly until the patient is stable, at which time they can be checked monthly.[15]

What are the risks of EN and PN?

Both EN and PN can lead to the refeeding syndrome, which manifests as a combination of hypophosphatemia, hypokalemia, hypomagnesaemia, and fluid retention and is the result of aggressive administration of carbohydrates in the malnourished patient. This alteration in electrolyte and fluid status can lead to hypotension, edema, hemolysis, arrhythmia, or respiratory changes. Nutrition support should be started at a slow rate and gradually increased in patients at risk (eg, patients with chronic anorexia nervosa, patients with significant weight loss, or patients with a history of alcohol abuse for refeeding syndrome) with approximately 25% of estimated goal needs provided on day 1. Treatment of refeeding syndrome includes aggressive electrolyte repletion and supportive care while nutrition support is held and then gradually reintroduced.[18]

Additional complications of EN and PN are listed in **Table 4**.

What are guidelines for feeding around the time of invasive procedures?

The American Society for Anesthesiology 2011 guidelines recommend “a minimum duration for fasting of 2 hours following ingestion of clear fluids, 6 hours following a light meal, and >8 hours post-ingestion of a fatty meal prior to undergoing general, regional anesthesia, or sedation for elective procedures.”[19] Multiple studies show that early postsurgical EN (within 24 hours) enteral feeding reduces mortality and morbidity.[19]

Table 4
Complications of nutrition support

	Route of SNS	
	Enteral	**Parenteral**
Complications	Refeeding syndrome Hyperglycemia Gastroesophageal reflux Pulmonary aspiration Diarrhea	Refeeding syndrome Hyperglycemia Sepsis from infection of vascular access sites Steatosis (early and reversible with discontinuation of PN) Cholestasis (chronic and irreversible) Metabolic bone disease Hypertriglyceridemia

Abbreviations: PN, parenteral nutrition; SNS, specialized nutrition support.
Data from ASPEN Board of Directors and the Clinical Guidelines Task Force. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. JPEN J Parenter Enteral Nutr 2002;26:(1 Suppl):1SA–138SA.

PERFORMANCE IMPROVEMENT

How can hospitalists effect positive change on nutrition-related outcomes in their hospitals?

Hospitalists are often key participants for hospital-wide efforts in quality improvement. Improving nutrition for hospitalized patients is closely aligned with the skills and goals that many hospitalists possess. The interdisciplinary nature of such a quality improvement endeavor is not unique to the daily work that hospitalists participate in. With this in mind, representation from the Society of Hospital Medicine joined an alliance including the Academy of Medical-Surgical Nurses, the Academy of Nutrition and Dietetics, ASPEN, and Abbott Nutrition to recognize the important role nutrition has in improving the quality of care. The key principles proposed for advancing patient nutrition are shown in **Box 1**.

CLINICAL GUIDELINES

Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. JPEN J Parenter Enteral Nutr 2002;26:1SA–138SA.

American Society for Parenteral and Enteral Nutrition clinical guidelines: nutrition screening, assessment, and intervention in adults. JPEN J Parenter Enteral Nutr 2011;35:1.

Box 1
Key principles for advancing patient nutrition

1. Create institutional culture
2. Redefine clinician's roles to include nutrition
3. Recognize and diagnose all patients at risk for malnutrition
4. Rapidly implement interventions and continued monitoring
5. Communicate nutrition care plans
6. Develop discharge nutrition care and education plan

Adapted from Tappenden KA, Quatrara B, Parkhurst ML, et al. Critical role of nutrition in improving quality of care: an interdisciplinary call to action to address adult hospital malnutrition. JPEN J Parenter Enteral Nutr 2013;37:4; with permission.

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