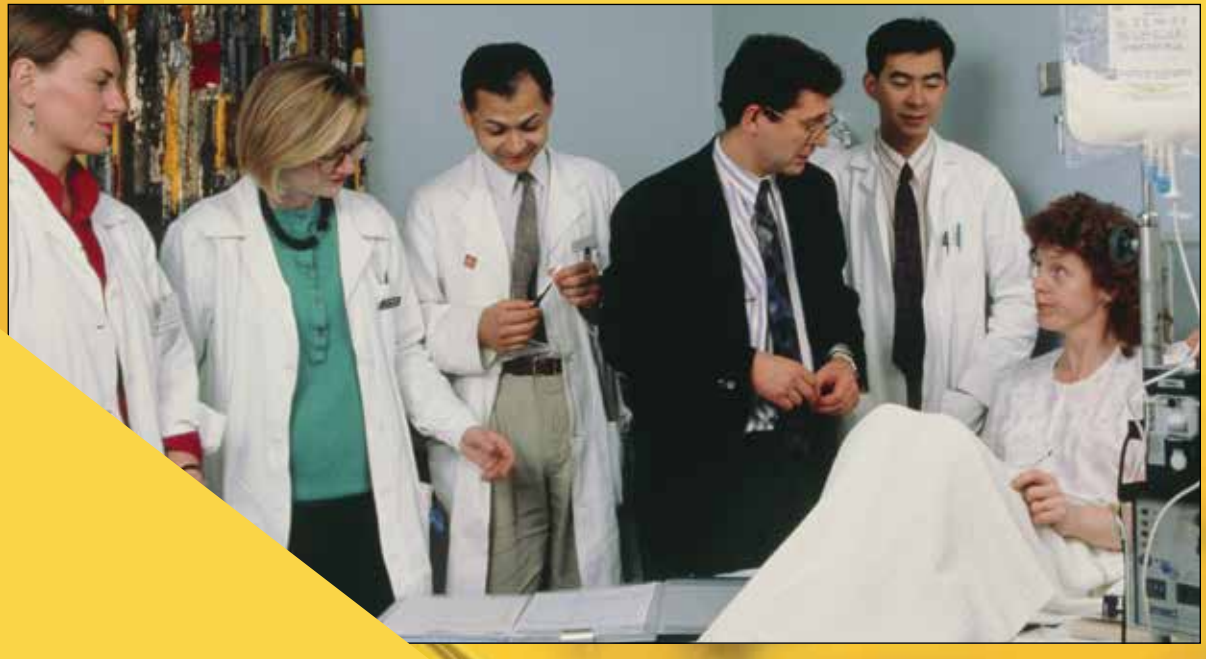
CME/CE Monograph

Addressing Malnutrition in Hospitalized Patients

FUNDAMENTALS FOR IMPROVING PATIENT OUTCOMES AND THE NEW ROLE OF PARENTERAL LIPIDS



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Estimated Time to Complete Activity: 1.25 hours

Target Audience
This activity has been designed to meet the educational needs of hospitalist physicians, physician assistants, and nurse practitioners.

Learning Objectives
Upon completion of this activity, participants will have improved their ability to:
1. Identify strategies to address malnutrition in hospitalized patients
2. Describe key elements related to lipids of guidelines for parenteral nutrition support
3. Evaluate the risks and benefits of different lipid emulsions used in parenteral nutrition
4. Collaborate with nutrition colleagues to provide appropriate nutrition with lipid emulsion for hospitalized patients on parenteral nutrition

Physician Continuing Medical Education
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Addressing Malnutrition in Hospitalized Patients

FUNDAMENTALS FOR IMPROVING PATIENT OUTCOMES AND THE NEW ROLE OF PARENTERAL LIPIDS

Introduction

Unrecognized malnutrition was described in 1974 by Charles E. Butterworth Jr, MD, as "the skeleton in the hospital closet."[1] More than 40 years later, it is still among the greatest silent epidemics facing hospitalized patients.[2]

Proper nutrition care for hospitalized patients who are malnourished hastens recovery from illness and injury and minimizes risk of a variety of complications.[3] In addition, accurate diagnosis and coding of malnutrition leads to higher direct hospital reimbursement and accurate adjustment of the case mix used for assessing quality of care.[3] Achieving these benefits for patients and hospitals depends on improved efforts to diagnose, document, intervene, and code for malnutrition.

Nutrition care in hospitalized patients requires a collaborative multidisciplinary effort, and as frontline care providers, hospitalists need to take a leadership role in developing initiatives for improving recognition and intervention for malnutrition.

This program aims to raise hospitalists' awareness about the prevalence and adverse consequences of malnutrition in hospitalized patients. Secondly, it presents ways to improve diagnosis and treatment of malnutrition, with a focus on parenteral nutrition (PN) and the latest advance in parenteral lipids.

Proper documentation of malnutrition to support appropriate coding that allows the hospital to receive reimbursement for the additional costs and resources used to care for patients with malnutrition is also reviewed.

The Problem of Malnutrition in Hospitalized Patients: Broad in Scope and Burdens

Malnutrition has a multifactorial etiology that includes a variety of socioeconomic, iatrogenic, and disease-related causes. It is therefore not surprising that malnutrition is common among hospitalized patients. Its reported prevalence depends on the population studied and the criteria used to define malnutrition.

Underserved populations and the elderly tend to be the most affected, but available research reports that 20% to 69% of all patients are malnourished on hospital admission, and the rate may be higher in some populations, such as in patients with gastrointestinal disease.[3-7]

Available data also indicate, however, that malnutrition in hospitalized patients is vastly underrecognized. An analysis from the University HealthSystem Consortium database encompassing 6 million admissions found the prevalence of malnutrition based on having a coded diagnosis was only 5%, with a range of 0.6% to 18.6% among the 105 institutions included.[8] Similarly, an analysis of discharge diagnosis data from the 2010 Healthcare Cost and Utilization Project indicated that only 3.2% of malnourished patients were recognized and diagnosed.[9]

Strikingly, even when recognized, malnutrition in hospitalized patients is often not treated. According to Healthcare Cost and Utilization Project data, among patients with a diagnosis of various types of malnutrition, only 1.2% to 28.7% received enteral nutrition or PN.[10] In addition, it has been estimated that up to two-thirds of patients who are malnourished at hospital admission experience worsening of their nutrition status during their stay, and more than one-third of patients who are not malnourished at admission become malnourished while in the hospital.[6,11]

Diagnosis of and intervention for malnutrition is critical for optimizing patient outcomes. Malnutrition impairs the body's ability to mount an immune response, impedes wound healing, and leads to loss of muscle mass, strength, and function.[3] Corresponding with these physiologic effects, there is abundant evidence to show that malnutrition adversely affects morbidity and mortality for hospitalized patients.[3,4,10,12,13] Patients diagnosed with malnutrition have a 4- to 5-fold higher mortality rate than their well-nourished counterparts.[9] The presence of preexisting malnutrition and/or weight loss has also been associated with a 2- to 3-fold increased risk of developing *Clostridium difficile* enterocolitis, surgical site infection, and postoperative pneumonia; a 4-fold higher risk of pressure ulcer development; and a > 5-fold increased risk of mediastinitis after coronary artery bypass grafting and catheter-associated urinary tract infection.[12]

On the basis of these data, it is not surprising that malnutrition is associated with longer hospital stays and higher readmission rates, and acts as a major driver of increased costs of care.[4,9,13-15] According to a study from the United Kingdom, the annual expenditure of managing patients at medium or high risk of disease-related malnutrition was €10.5 billion ($11.4 billion), and more than one-half of that cost was directly related to hospital care.[15]

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As a corollary, it is not surprising that focused nutrition screening and intervention programs have been shown to improve clinical outcomes and reduce costs. For example, 1 study found that earlier nutrition intervention for severely malnourished patients reduced the length of hospital stay by 3.2 days and translated into a savings of $1514 per patient.[6] Researchers at a community hospital reported that implementation of a comprehensive malnutrition clinical pathways program decreased the 30-day readmission rate from 16.5% to 7.1%.[16] All these data underscore the importance of improving recognition of malnutrition and of optimizing nutrition care.

Partners and Policies for Improving Malnutrition Screening and Diagnosis

The Joint Commission on Accreditation of Healthcare Organizations has a mandate that nutrition screening be performed on all patient admissions to an acute care center.

Identifying and treating malnutrition is a multidisciplinary process for which hospitals should have established protocols. The Joint Commission on Accreditation of Healthcare Organizations has a mandate that nutrition screening be performed on all patient admissions to an acute care center.[17] To facilitate the screening process and improve the detection of patients who may be malnourished, hospitals should operationalize a validated screening tool that a trained individual can use to identify patients needing a more detailed nutrition assessment.

The nutrition screen is usually performed by nurses during the admission assessment, but it can also be done by another member of the health care team, such as a dietetic technician or health care technician. A variety of instruments are available for screening; they have been validated in various patient populations to have high sensitivity and specificity for capturing people with malnutrition. Of these, the Malnutrition Screening Tool (MST) is simple to administer and commonly used **(Table 1)**.[18,19] Screening for malnutrition should not be limited to a 1-time evaluation on admission, but rather be done approximately every 5 to 7 days. Daily patient care by the health care team should include monitoring of weight, intake, and feeding/diet restrictions and intolerances. A repeat comprehensive nutrition assessment by the dietitian is usually performed every 5 to 10 days.

Table 1. The Malnutrition Screening Tool

Screening Questions	Score
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
Have you been eating poorly because of a decreased appetite?	
No	0
Yes	1
Total	

Score of 2 or more = patient at risk of malnutrition
Adapted from *Nutrition,* 15, Ferguson M, Capra S, Bauer J, Banks M, Development of a valid and reliable malnutrition screening tool for adult acute hospital patients, 458-464, Copyright 1999, with permission from Elsevier.

Any suspicion that a patient is malnourished or at risk of malnutrition needs to be communicated to the dietitian, who will conduct a comprehensive nutrition assessment for formal diagnosis. Hospitals should also have a protocol in place whereby communication with dietitians occurs on a daily basis either through use of the electronic medical record (EMR) system, at bedside rounds, via e-mail, or by paging.

Most dietitians are now using the Academy of Nutrition and Dietetics (Academy) and American Society for Parenteral and Enteral Nutrition (ASPEN) consensus characteristics to diagnose malnutrition **(Table 2)**.[20] The Academy/ASPEN approach considers the presence of inflammation and the etiology of malnutrition. Malnutrition can develop rapidly as a result of marked inflammation that occurs in response to acute disease or injury and can develop more slowly in the presence of mild-to-moderate inflammation that is associated with chronic disease. Malnutrition may also develop because of starvation associated with disorders such as anorexia nervosa or because of adverse socioeconomic status. The clinical characteristics considered for the diagnosis of malnutrition include evaluation of weight loss and dietary intake over time; physical examination of subcutaneous fat, muscle, and fluid accumulation; and functional status as measured by handgrip.

Table 2. Academy/ASPEN Clinical Characteristics to Support a Diagnosis of Malnutrition[20]

Because no single parameter is definitive for adult malnutrition, the identification of 2 or more of the following 6 characteristics is recommended for diagnosis:
• Insufficient energy intake
• Weight loss
• Loss of muscle mass
• Loss of subcutaneous fat
• Localized or generalized fluid accumulation that may sometimes mask weight loss
• Diminished functional status as measured by handgrip strength

Abbreviation: ASPEN, American Society for Parenteral and Enteral Nutrition.

The Subjective Global Assessment is another tool for assessing malnutrition.[21] It considers weight history; dietary intake; gastrointestinal symptoms; functional capacity; primary diagnosis, including metabolic demand or stress level; physical features such as the loss of subcutaneous fat and muscle; and presence of ankle edema, sacral edema, or ascites.

It is important to note that the interpretation of visceral proteins (serum albumin, prealbumin) to diagnose malnutrition must be used with caution because they lack specificity and sensitivity as indicators of nutrition status.[22] Visceral proteins are frequently reduced in the systemic response to injury, disease, or inflammation and patients so affected may or may not be malnourished. By measuring C-reactive protein (CRP), a positive acute-phase reactant, when shown to be elevated along with a low albumin or prealbumin level, inflammation is considered to be contributing to the reduced prealbumin and/or albumin level. Further, these blood-based markers will not reflect adequacy of nutrition delivery in the face of an elevated CRP level.

Any suspicion that a patient is malnourished or at risk of malnutrition needs to be communicated to the dietitian, who will conduct a comprehensive nutrition assessment for formal diagnosis.

Using the Academy/ASPEN consensus characteristics, the most common finding that leads to a diagnosis of malnutrition is unintentional weight loss over time.[20] This is often defined as a 10% decrease in weight over 6 months, although the Academy/ASPEN consensus characteristics include assessing malnutrition based on weight loss over shorter time periods, even just 1 week in the context of acute illness or injury, recognizing that rapid weight loss in the latter setting can be as devastating as more gradual weight loss over a longer period of time.[20]

Clinical nutrition departments should have a policy in place defining how the clinical dietitians diagnose malnutrition and its severity in order to provide a standard of care and practice in their facilities. Once a patient is diagnosed with malnutrition, there needs to be a notification system to alert the caring provider and initiate collaboration among the health care team to implement the intervention. Only a documented diagnosis of malnutrition, along with the nutrition care plan by the provider, can be used by clinical documentation specialists to assign the appropriate ICD (International Classification of Disease[s])-10 code for malnutrition that will determine reimbursement **(see Sidebar: Coding and Reimbursement).** Information on the degree of malnutrition and the care plan can be found in the dietitian's medical record documentation. The dietitian or health care provider's documentation on the nutrition care being delivered to treat malnutrition needs to be included in the daily progress note assessment.

Coding and Reimbursement

The Centers for Medicare & Medicaid Services payment system provides a fixed payment amount to the hospital for each patient that is determined by the individual's Medicare Severity–Diagnostic Related Group (MS-DRG). The hospital receives additional reimbursement if the patient has a secondary condition that the Centers for Medicare & Medicaid Services considers a complication or comorbid condition (CC), and an even higher reimbursement if the additional condition is considered a major complication or comorbid condition (MCC).

The more malnourished a patient is, the more resources are needed for providing care. Mild protein-calorie malnutrition and moderate protein-calorie malnutrition (ICD-10 code E44.1 and E44.0, respectively) fall under the CC category, and severe protein-calorie malnutrition (ICD-10 code E43) is considered an MCC.[1] An MS-DRG associated with mild, moderate, or severe protein-calorie malnutrition can increase reimbursement received for a patient.[2] A study from the West Virginia University School of Medicine found that appropriate documentation of malnutrition could have resulted in an average additional reimbursement of $10,000 per case, and over a 9-month period, proper malnutrition documentation for patients with consultation or high-risk notification in their charts could have potentially brought millions of dollars of additional reimbursement to the hospital.[3] Because the reimbursement for the assigned MS-DRG can only be increased by 1 CC or MCC, a diagnosis of malnutrition may not change the reimbursement for a patient who has other CC or MCC conditions.[2]

Obtaining reimbursement for malnutrition that is commensurate with the acuity of the patient depends on proper documentation and coding. The following are some important considerations:

- Provider documentation should be consistent with the dietitian's documented nutrition assessment and avoid conflicting descriptions, especially regarding physical appearance. Collaboration between the provider and the dietitian is essential! To be part of the patient's record for coding, the diagnosis and degree of malnutrition (mild, moderate, or severe protein-calorie malnutrition) and the intervention plan must be documented by the provider
  - Clinical documentation specialists should query the physician if malnutrition does not appear in the provider's documentation for a patient who was documented by the dietitian as having malnutrition
  - Lack of specificity, ie, documenting the diagnosis simply as "malnutrition," can potentially negate reimbursement or result in the improper use of codes for kwashiorkor or nutritional marasmus, which may prompt an audit of the code assignment by the Office of the Inspector General because these conditions are almost never encountered in the United States
  - Accurate documentation of malnutrition also allows for fair evaluations of quality of care because the malnutrition codes are used in determining the Case Mix Index and, therefore, hospital scores for Severity of Injury and Risk of Mortality. As a case in point, it has been the observation of 1 author of this monograph (P.E.W.) that specialties in hospitals

that care for high acuity patients (ie, hematology/oncology) can see a significant drop in their *US News & World Report* rankings and other quality metrics because of a higher than expected risk-adjusted mortality rate. Review of patient records in these hospitals always reveals that codes for severe malnutrition are frequently missing. This leads to an underrepresentation of the hospital's actual acuity of illness and mortality risk. Thus, proper documentation and coding of malnutrition can significantly modify these departments' risk-adjusted mortality rate and rankings

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Intervention for Malnutrition: Improved Safety and Benefits of Modern Parenteral Nutrition

Results of 3 large randomized controlled trials . . . clearly demonstrated that PN is no longer associated with any increased risk of infection compared with enteral therapy alone.

Oral or enteral nutrition should be considered as a first-line intervention for patients needing nutrition support, but these routes may be poorly tolerated, contraindicated, or inadequate to meet nutritional goals. Data from an observational cohort study examining nutrition practices in intensive care units (ICUs) at 167 centers worldwide showed patients were receiving only approximately 60% of prescribed calories and protein.[23] Considering the heightened attention given to patients in the ICU, it seems reasonable to assume that nutritional deficits may be even worse for patients on other hospital units.

Parenteral nutrition can assure better delivery of nutritional requirements than can enteral nutrition. Although some clinicians have been reluctant to use PN, considering reports that it increases infection risk, such concerns can be set aside according to the results of 3 large randomized controlled trials which clearly demonstrated that PN is no longer associated with any increased risk of infection compared with enteral therapy alone.[24-26]

The safety of modern PN in terms of infection risk can be attributed to several factors, including better attention to central venous catheter care, such as use of a central line insertion checklist.[24,25] In addition, many of the older studies showing increased infection risk with PN used a much higher-calorie delivery PN strategy (hyperalimentation), which is no longer practiced, and they did not provide modern glycemic control measures.[25,27,28] In fact, 12 of 18 trials included in a meta-analysis by Elke and colleagues that found increased infection risk with PN were conducted prior to publication of the landmark paper on intensive insulin therapy for glucose control in critically ill patients.[27,28] Finally, older trials associating PN with increased infection trials used traditional soybean oil–only lipid injectable emulsions (eg, IntraLipid, 20%), which, as discussed below, are believed to inherently carry infection risk. (Note: Lipid injectable emulsions are also known as "intravenous lipid emulsions" and "intravenous fat emulsions." Lipid injectable emulsion or the abbreviation ILE will be the term used herein.)

Lipid Injectable Emulsion Update: Rationale for the 4-Oil Formulation

Among the 4 ILEs that are available in the United States, the SMOF ILE uniquely provides EPA and DHA, is the only one with a balance of omega-6 to omega-3 fatty acids that is considered optimal by experts, and has the lowest phytosterol content.

As a source for energy and essential fatty acids, ILE is considered an integral component of PN.[29] A soybean oil product was the only ILE option available for many years, but with its use, concerns about safety emerged, related to the relatively high content of omega-6 fatty acids, particularly linoleic acid, and phytosterols in soybean oil. Omega-6 fatty acids are metabolized in the body to eicosanoids (prostaglandins, leukotrienes, and thromboxanes), which are generally proinflammatory and cause immunosuppression and blood coagulation **(Figure 1).**[29-31] Phytosterols have been implicated along with omega-6 fatty acids in the development of cholestasis and liver injury.[32-34] Infants and children are particularly at risk for hepatobiliary complications, but PN-associated liver disease (PNALD) has been reported in 15% to 40% of adults on prolonged PN.[35,36]

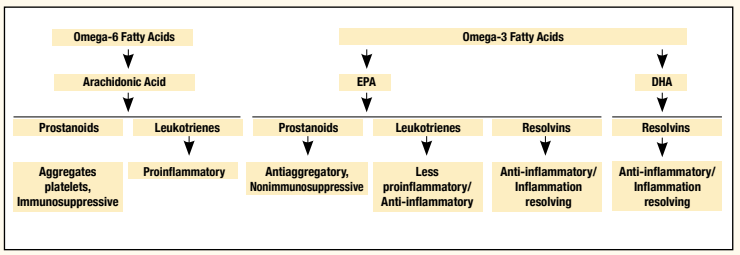

Figure 1. Biologic activity of omega-6 and omega-3 fatty acid metabolites[29-31]
Abbreviations: DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid.

Recognition of the potential risks of soybean oil ILE provided impetus for the formulation of alternative ILEs using other oil sources.[37] The development of products containing fish oil represents the most important advance in this product category because fish oil provides omega-3 fatty acids—eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)—that are precursors for less proinflammatory eicosanoids and for proresolving mediators (maresins, protectins, and resolvins) that are thought to actively promote resolution of inflammation **(Figure 1)**.[31,38] Compared with soybean oil, fish oil also contains a much lower level of phytosterols.[34]

A fish oil–containing ILE became available in the United States in 2016 when the 4-oil emulsion, SMOF, composed of 30% soybean oil, 30% medium-chain triglycerides (MCTs), 25% olive oil, and 15% fish oil, was approved by the US Food and Drug Administration for PN use in adults. Among the 4 ILEs that are available in the United States, the SMOF ILE uniquely provides EPA and DHA, is the only one with a balance of omega-6 to omega-3 fatty acids that is considered optimal by experts, and has the lowest phytosterol content **(Table 2)**.[29,39-45]

Table 2. Composition of Lipid Injectable Emulsions in the US Market

Trade Name	Intralipid[39]	Nutrilipid[40]	Clinolipid[41]	SMOFlipid[42]
Oil source	Soy (100%)	Soy (100%)	Olive (80%) Soy (20%)	Soy (30%) MCT (30%) Olive (25%) Fish (15%)
Fatty Composition (mean % by weight)				
Omega-6 fatty acid				
Linoleic	44-62	48-58	13.8-22.0	14-25
Omega-3 fatty acid				
Eicosapentaenoic acid	0	0	0	1.0-3.5
Docosahexaenoic acid	0	0	0	1.0-3.5
Omega-9 fatty acid				
Oleic	19-30	17-30	44.3-79.5	23-35
Ratio of Omega-6 to Omega-3 Fatty Acids[29]*				
	~7:1	~7:1	9:1	2.5:1
Phytosterol Content (mean, µg/mL)[29,45]				
	343-439	N/A	226-327	48-207

* Recommended goal is 2:1 to 4:1[43,44]

Abbreviations: MCT, medium-chain triglyceride; N/A, not available.

Evidence Base for Benefits of Fish Oil–Containing Lipid Injectable Emulsions

Although soybean oil– and fish oil–containing ILEs provide essential fatty acids and are similar with respect to osmolarity and energy delivery, because of differences in their balance of omega-6 to omega-3 fatty acids and their phytosterol content, they would be predicted to vary in their effects on immune function, inflammation, antioxidant and nutrition status, liver injury risk, and, therefore, clinical outcomes. The 4-oil ILE and other fish oil–containing ILEs have been available outside the United States for many years, and results from clinical trials evaluating these products in various patient populations provide evidence that the fish oil–containing ILEs are safe and have potential benefits compared with use of a soybean oil product **(Table 3)**.[30,46-50] On the basis of the available evidence, Canadian Critical Care Practice Guidelines, guidelines for intensive care and surgical patients from the European Society for Clinical Nutrition and Metabolism, and those from the Society of Critical Care Medicine/ASPEN for critically ill adult patients all support the use of ILEs that reduce exposure to soybean oil.[51-54]

Table 3. Summary of Outcomes in Studies Comparing Fish Oil–Containing and Soybean Oil ILEs

Study	Patient Population	End Points Favoring Fish Oil–Containing ILEs
Palmer et al.[46]	ICU	Decreased hospital stay
Manzanares et al.[47]	Critically ill	Decreased risk of infection; decreased hospital stay
Chen et al.[48]	Major abdominal surgery	Decreased hospital stay, ICU stay, and infection rate; decreased AST, ALT, and alpha-tocopherol blood levels; increased leukotriene B5 in leukocytes
Pradelli et al.[49]	ICU and elective surgery	Improved infection rate, hospital stay, ICU stay (ICU subgroup), antioxidant status, oxygenation index, markers of inflammation, liver function tests, and plasma phospholipid fatty acid composition
Tian et al.[50]	Postoperative	Compared with soybean oil–based and a soybean/olive oil–based ILE, SMOF was associated with lower levels of hepatic enzymes Compared with soybean oil–based ILE, SMOF had lower changes in low-density lipoprotein triglyceride and C-reactive protein levels
Klek et al.[30]	Stable intestinal failure	Better liver function tests

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; ICU, intensive care unit; ILE, lipid injectable emulsion; SMOF, soybean/medium-chain triglycerides/olive/fish oil.

Palmer and colleagues conducted a meta-analysis of randomized controlled trials enrolling critically ill patients who received PN with or without omega-3 fatty acid.[46] They identified 8 studies including 391 participants and found a statistically significant reduction in hospital length of stay in the omega-3 fatty acid group (-9.49 days; $P = .008$). There were no statistically significant differences between the study groups in mortality, infection risk, or length of ICU stay.

Manzanares and colleagues conducted a meta-analysis of 10 randomized controlled trials enrolling 733 critically ill patients receiving enteral or parenteral nutrition.[47] They reported that the administration of a fish oil–containing ILE was associated with a significantly lower risk of infections (-36%; $P = .02$). Considering data from only high-quality trials, these investigators also showed a significant benefit for shorter hospital length of stay (-7.42 days; $P = .001$) among patients receiving a fish oil–containing ILE. In addition, the group receiving the fish oil–containing ILE had a trend for fewer days on mechanical ventilation (-1.14 days; $P = .14$).

Chen and colleagues undertook a meta-analysis of 13 randomized controlled trials investigating fish oil–enriched PN regimens in patients who had undergone major abdominal surgery.[48] The analysis included 892 patients and found that the fish oil–enriched ILE was associated with statistically significant reductions in length of hospital stay, length of ICU stay, and postoperative infection rate **(Table 4)**. In addition, there were statistically significant differences favoring the group receiving the fish oil–enriched PN in laboratory analyses of aspartate aminotransferase, alanine aminotransferase, alpha-tocopherol, EPA, DHA, and leukotriene B5:leukotriene B4.

Table 4. Treatment Effects of Fish Oil–Enriched Parenteral Nutrition in a Meta-Analysis of 13 Studies of Patients Undergoing Major Abdominal Surgery[48]

Clinical Outcome	Effect	95% CI	*P* Value
Mortality	OR 1.43	0.53 to 3.80	.48
Hospital LOS	WMD -2.98 days	-4.65 to -1.31	< .001
ICU LOS	WMD -1.80 days	-3.04 to -0.56	.004
Postoperative infection rate	OR 0.56	0.32 to 0.98	.04
Postoperative cardiac complication rate	OR 0.62	0.20 to 1.94	.42

Abbreviations: CI, confidence interval; ICU, intensive care unit; LOS, length of stay; OR, odds ratio; WMD, weighted mean difference.

Another meta-analysis by Pradelli and colleagues, including data for approximately 1500 patients enrolled in 23 trials, showed that for a variety of clinical outcomes, use of omega-3–enriched ILEs had statistically significant benefits compared with use of standard ILEs containing soybean oil, MCTs/long-chain triglycerides, or olive oil/soybean oil.[49] The population in this meta-analysis was approximately equally represented by ICU and surgical patients, and analyses were performed for all patients and for each of the 2 subgroups. In these analyses, the omega-3–enriched ILEs were associated with statistically significant reductions in infection rate in the overall population (-39%; $P = .002$) and in the surgical patients (-47%; $P = .004$). Length of ICU stay was also significantly reduced in patients receiving the omega-3–enriched ILEs (-1.92 days; $P < .005$), as was hospital length of stay for the overall population (-3.29 days; $P < .0005$) and in both the ICU (-5.17 days; $P = .001$) and surgical subgroups (-1.86 days; $P = .0005$). Overall and in both the ICU and

surgical subgroups, statistically significant differences were also found in analyses of inflammatory markers, lung gas exchange (only analyzed for total population), liver function tests, antioxidant status, and fatty acid composition of plasma phospholipids.

Reports focusing on the SMOF ILE include a meta-analysis of 6 randomized controlled trials evaluating its safety and efficacy in postoperative patients.[50] Compared with a soybean oil–based ILE, the SMOF product was associated with lower levels of liver enzymes **(Table 5)**. There was no difference between the 2 PN protocols for length of stay or CRP level.

Table 5. Treatment Effects of SMOF Lipid Injectable Emulsion vs Soybean Oil Lipid Injectable Emulsion in a Meta-Analysis of 6 Studies of Surgical Patients[50]

Outcome	Effect (Mean Difference)	*P* Value	Evidence Quality
LOS	-2.10 days	.15	Moderate
AST	-5.25 U/L	.002	Moderate
ALT	-8.92 U/L	.001	Moderate
GGT	-23.46 U/L	.006	Moderate
AP	-19.56 U/L	.0002	Moderate
CRP	-3.47 mg/L	.76	Low

Abbreviations: ALT, alanine aminotransferase; AP, alkaline phosphatase; AST, aspartate aminotransferase; CRP, C-reactive protein; GGT, gamma-glutamyl transferase; LOS, length of stay; SMOF, soybean/medium-chain triglycerides/olive/fish oil.

Evidence that SMOF ILE is associated with less liver toxicity than soybean oil–based ILE is also available from results of a multicenter randomized controlled trial conducted by Klek and colleagues that enrolled 73 patients with stable intestinal failure.[30] Mean aspartate transaminase, alanine aminotransferase, and total bilirubin decreased in the SMOF-based ILE group and increased in the soybean oil–based ILE group **(Figure 2)**. The mean values for these liver function tests were significantly lower in the SMOF ILE group at the end of the 4-week study than in the soybean oil–based ILE group.

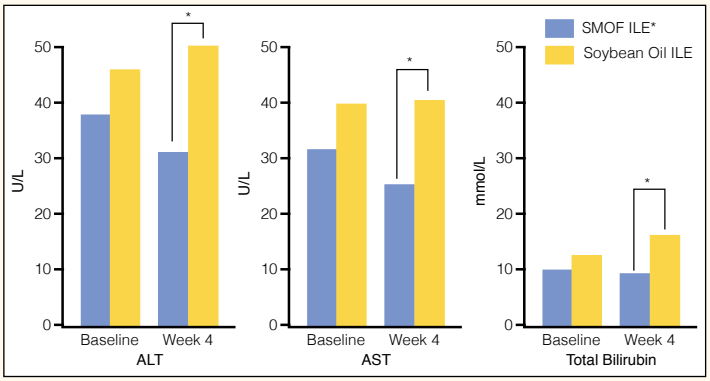

Figure 2. Parameters of liver function at baseline and at week 4[30]

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferas; ILE, lipid injectable emulsion; SMOF, soybean/medium-chain triglycerides/olive/fish oil.

* Statistically significant difference between groups at week 4 ($P < .05$)

In addition, clinical studies show benefits of using a fish oil–containing ILE to treat PNALD that developed in infants receiving a soybean oil ILE or as a preventive strategy.[32,33] Studies have also been conducted comparing the pure fish oil ILE to the SMOF product with variable results; some showed that the 2 formulations are similar in their benefits for decreasing PNALD and others suggested the superiority of one over the other.

Improving Nutrition Care Quality for Hospitalized Patients: Expert Insights and Practical Approaches

Optimizing Diagnosis of Malnutrition and Reimbursement

Dr Wischmeyer: What has been done at the Cleveland Clinic hospitals to optimize recognition of malnutrition?

Ms Hamilton: For the initial screen on admission, we standardized the use of a validated nutrition screening tool, the MST, across our health care system. It is used by the admitting nurse and is built into the EMR; the dietitian is automatically notified when a patient is identified as being at risk for malnutrition. The dietitian performs a comprehensive nutrition assessment using the Academy/ASPEN characteristics, and if the patient is malnourished, the dietitian develops and implements a treatment plan.

In April 2016, a policy change was implemented that allowed dietitians to place a diagnosis of malnutrition onto the active problem list in the EMR. As a consequence of that action, providers increased their documentation of malnutrition, and within a 6-month period, we saw a sizeable increase in our malnutrition capture rate as part of the patient's hospital bill from 12% to approximately 19%. This new policy also led to a substantial increase in reimbursement.

Whether or not dietitians at other facilities will be able to get approval to make entries onto the active problem list will depend on the particular hospital's EMR functionality and its bylaws. The argument used to support this change at Cleveland Clinic was based on the idea that the problem list belongs to the patient and not to any particular health care provider.

Because electronic charting seems to make it more difficult for providers to find the dietitian's documentation of malnutrition or because providers do not use the active problem list, we are also working to allow for the dietitian's diagnosis of malnutrition to auto-populate into the provider's note so that it becomes a medical diagnosis. We feel that building the EMR in this way creates an opportunity to improve capture of malnutrition while making things more efficient for the physician provider. The provider still has to agree to accept the dietitian's assessment and diagnosis of malnutrition and has the option to disagree. We have found, however, that physicians agree with dietitians' diagnosis of malnutrition more than 95% of the time.

Dr Deckelbaum: When working to create new policies that will improve capture and treatment for malnutrition, it is important to educate hospital administrators, personnel in finance, and those involved in budgeting on the benefits for improving patient outcomes and increasing hospital revenue.

Ms. Hamilton: When we first approached hospital administration with our ideas for new policies and changes to the EMR, we found it difficult to get anyone's attention. The situation changed, however, after working with the Health Information Management Department, Clinical Documentation Specialists, and Finance Department, when it became obvious that not only could we improve documentation and affect our quality scores, we could also receive reimbursement

for the enhanced services provided at our institution. Optimizing recognition of malnutrition in our hospitalized patients has become an important initiative with top level leadership support.

Dr Wischmeyer: Our experience at Duke has been similar: having the opportunity to work with forward-thinking and patient-focused administrators was essential to improving the identification of malnutrition in hospitalized patients. As front-line physicians who are often the first to encounter the malnourished patient and as caregivers, hospitalists play an essential role for stimulating and establishing system changes. Hospitalists should lead the charge for implementing use of basic malnutrition screening tools, such as the MST, and for collaborating with their dietitian colleagues to incorporate malnutrition diagnosis, coding, and treatment into their EMR and progress notes. This key information can all be brought in from the dietitian's notes, with very minimal additional work by the hospitalists.

Adopting SMOF Lipid Injectable Emulsion

Dr Wischmeyer: At Duke, the cost difference between the SMOF ILE and soybean ILE was minimal, and on the basis of the evidence, we strongly felt that the SMOF ILE was a safer product and would be cost effective because of its benefits for providing better nutrition and reducing infection rate, length of stay, and risk of liver injury and cholestasis. We presented the information to our Pharmacy & Therapeutics Committee and were successful in getting the SMOF ILE approved as the sole ILE for use in adults on PN.

For hospitalists, other physicians, and all individuals involved in nutrition support, I think it is important to be aware that adoption of the SMOF ILE is a unique opportunity for improving patient outcomes, and I encourage hospitalists to work with the other stakeholders to introduce it for Pharmacy & Therapeutics Committee review in their hospitals.

Even if the SMOF ILE can be approved only for use in select patient populations, it is a major step forward, and I think critically ill patients and major surgical patients are key groups that can particularly benefit from availability of the SMOF ILE. Because of the proinflammatory characteristics of the omega-6 fatty acids in soybean oil, the Society of Critical Care Medicine/ASPEN guidelines recommends withholding soybean oil–based lipids from PN given during the first week to patients in the ICU.[53] The guidelines, which were published before the US Food and Drug Administration approved the SMOF ILE, also states that when alternative ILEs become available, their use should be considered in a critically ill patient who is an appropriate candidate for PN.

Are there other subgroups of hospitalized patients that you think would benefit most from receiving PN with the SMOF ILE instead of a soybean oil product?

Dr Deckelbaum: I think PN with the SMOF ILE can provide a particular benefit for patients susceptible to cholestatic and hepatic problems, such as adults on long-term PN and low-birth-weight infants, although pediatric use of the SMOF ILE is off-label. Restricting the daily dose of soybean oil ILE is 1 of the major strategies advocated to decrease PN-related liver disease in the pediatric population.[33] That approach, however, exposes the child to a higher carbohydrate load and its risks. I think a lipid replacement strategy using an omega-3–enriched ILE allows these children to safely receive a more balanced energy supply.

Because of the proinflammatory effects of omega-6 fatty acids, I also suggest that an omega-3–enriched ILE has benefits for surgical patients needing PN, critically ill patients who are in a hyperdynamic state, and any patients with conditions associated with high levels of inflammation.

Dr Wischmeyer: At hospitals at which the SMOF ILE is not available, I would recommend continuing to use a soybean oil ILE until more modern balanced lipids like SMOF can be approved. In critically ill patients with ongoing infection or high acuity of ICU illness, I would limit use of a soybean oil ILE to 2 to 3 times a week. A pure soybean oil ILE should also be appropriately limited in any patient with cholestasis, elevated bilirubin, or ongoing liver injury.

Take-Home Messages

Malnutrition is perhaps the most pressing "silent" epidemic in hospitalized patients today.

- It is a much more common problem than many physicians realize, given what they were taught (or not taught) during their medical education
- It unquestionably adversely affects patient outcomes and ongoing quality of life, but, currently, malnutrition is severely underdiagnosed and undertreated

The Joint Commission on Accreditation of Healthcare Organizations has a mandate for performing nutrition risk screening of all inpatient admissions.

Recognition and care of malnutrition involves the efforts of multiple clinical disciplines.

- Policies and protocols are needed to optimize communication among the involved professionals and should consider leveraging of the EMR system
- Hospitalists need to reach out and work with hospital administration and nutrition support teams, and understand the documentation required to support coding and reimbursement for malnutrition

Parenteral nutrition is now known to be safe and indicated to meet the nutritional goals for malnourished patients when enteral nutrition is contraindicated, inadequate, or not tolerated.

SMOF ILE, containing soybean oil, MCTs, olive oil, and fish oil, is now available in the United States as an alternative to soybean oil ILE.

- Accumulating clinical trial evidence indicates that, compared with soybean oil ILE, PN with SMOF ILE or other omega-3–containing ILEs has benefits for improving clinical outcomes and indices of inflammation, immune function, oxidative stress, nutrition status, and liver function
- Guidelines on PN for various patient populations support the use of alternative ILEs that reduce exposure to soybean oil

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Post-Test

To obtain *AMA PRA Category 1 Credit* ™ for this activity, complete the CME post-test and activity evaluation online at https://tinyurl.com/AddressingMalnutrition. Upon successful completion of the post-test and activity evaluation, you will be able to generate an instant certificate of credit.

See detailed instructions at **Method of Participation and Request for Credit** on page 2.

1. The Joint Commission on Accreditation of Healthcare Organizations has a mandate that nutrition risk screening be performed in the following patient groups.
   A. At-risk groups, including low socioeconomic status, age > 65 years, and a diagnosis of cancer
   B. A recent history of disease-related weight loss
   C. Admission to an intensive care or other critical care unit
   D. Admission to an acute care center

2. Nutrition screening and assessment for malnutrition should be repeated for patients who are:
   A. Hospitalized
   B. Expected to receive nothing by mouth for > 3 days
   C. Expected to stay > 3 days
   D. Critically ill

3. A diagnosis of protein-calorie malnutrition can increase reimbursement for a patient's assigned MS-DRG:
   A. Depending on the MS-DRG
   B. Depending on if the patient has other conditions considered complications, comorbidities/major complications, or comorbidities
   C. Only if the malnutrition diagnosis is coded as severe protein-calorie malnutrition
   D. Only if the malnutrition diagnosis is coded as nutritional marasmus or kwashiorkor

4. Which of the following is NOT considered a factor contributing to a reduced risk of infection with modern PN?
   A. Attention to central venous catheter care
   B. Avoidance of hyperalimentation protocols
   C. Increased reliance on peripheral venous access
   D. Use of an ILE as a dextrose-sparing energy source

5. Which ILE(s) contain(s) an omega-6 to omega-3 fatty acid ratio in the recommended range of 2:1 to 4:1?
   A. Olive oil/soybean oil emulsion
   B. Soybean oil emulsions
   C. 4-oil emulsion (soybean oil, MCTs, olive oil, fish oil)
   D. None of the above

6. In a meta-analysis by Pradelli and colleagues, in the subgroup of surgical patients, use of omega-3–enriched ILEs had statistically significant benefits compared with standard ILEs containing soybean oil, MCTs/long-chain triglycerides, or olive oil/soybean oil for improving all the following end points, EXCEPT:
   A. Infection rate
   B. Inflammatory markers
   C. Hospital length of stay
   D. Mortality

7. Which of the following statements is true about the liver function test (LFT) outcomes of a multicenter randomized controlled trial by Klek and colleagues comparing SMOF ILE and soybean oil ILE?
   A. LFTs worsened in both groups, but the change was significantly less with SMOF ILE
   B. LFTs improved in the SMOF ILE group and worsened with the soybean oil ILE, and the mean end of study values were significantly lower with SMOF ILE
   C. LFTs improved in both groups, but the mean end of study values was significantly lower with SMOF ILE
   D. LFTs improved in the SMOF ILE group and worsened with the soybean oil ILE, but the difference between the groups in the mean end of study values did not achieve statistical significance

8. Results from a meta-analysis by Chen and colleagues of 13 randomized controlled trials in patients who had undergone major abdominal surgery favored fish oil–containing ILEs over soybean oil ILEs for the following end points.
   A. Hospital stay, ICU stay, infection rate
   B. Hospital stay, infection rate, renal function tests
   C. Hospital stay, ICU stay, renal function tests
   D. ICU stay, infection rate, renal function tests

9. For a patient who is an appropriate candidate for PN, the current Society of Critical Care Medicine/ASPEN guidelines on nutrition support for critically ill adult patients recommend considering an alternative ILE:
   A. On the basis of cost
   B. For patients with a history of cholestatic or liver problems
   C. If the expected duration of PN is > 7 days
   D. When such a product is available

10. To improve systems for the diagnosis and management of malnutrition, hospitalists may work with personnel in the following areas.
    A. Administration, dietetics/nutrition, research
    B. Administration, dietetics/nutrition, finance
    C. Administration, research, finance
    D. Dietetics/nutrition, finance, research

Addressing Malnutrition in Hospitalized Patients

FUNDAMENTALS FOR IMPROVING PATIENT OUTCOMES AND THE NEW ROLE OF PARENTERAL LIPIDS