A Monograph on Nutrition in Healthcare

feed M.E malnutrition awareness & education

Feed Patients Right.
Feed Patients Now.

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feedM.E.: MALNUTRITION AWARENESS AND EDUCATION

The content of this monograph has been reviewed and endorsed by international nutrition experts and groups. Together we are committed to increasing awareness of nutrition in healthcare and taking action against malnutrition.

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PREFACE

Healthcare professionals, patients, and families have worried about disease-related malnutrition for thousands of years. In the ancient Egyptian civilization, people who were too sick to eat were given nutrient-enriched enemas to bridge the gap until they could eat again.[1] Spanning many more centuries, the early history of nutrition contained accounts of feeding brandy, milk, raw eggs, and meat broths by way of the rectum or the upper gastrointestinal tract.[1] In the mid-20th century, reliable commercial formulas of defined composition were developed. Such formulas could be given as oral nutrition supplements or delivered by tube-feeding to the stomach or the intestines, thus filling nutritional gaps for many people who could not eat enough of a regular diet.[2] About the same time, feeding by way of central or peripheral venous lines was introduced; this parenteral feeding provided life-saving nutrients for infants, children, and adults who were severely ill or injured.[3]

Then in the 21st century, a new kind of nutrition emerged; feeding formulas containing specialized ingredients were introduced.[2, 4] Today's nutrition is given as therapy rather than as simple sustenance. With more than 300 enteral formulas and innumerable ingredients for parenteral feeding available around the world, it is now possible to choose what, when, and how to meet the nutrient needs of each hospitalized patient. Yet we practitioners often find it difficult to decide what feeding is best for each of our patients. In terms of much-needed nutrition, our patients often get "too little, too late."

The **feedM.E.** monograph compiles scientific background information, clinical evidence, and clinical guidelines as a way to encourage use of best-practice hospital nutrition worldwide. We present this monograph and its companion teaching materials to help you recognize patients at risk of malnutrition and guide you in making good nutritional choices. We have also assembled a set of practical tools and practice algorithms. Our goal is to show how evidence-based nutrition care is logical, stepwise, and straightforward. To do so, we comprehensively review the rapidly building medical literature on nutrition, and we cite representative studies from all regions of the world.

We feel strongly that best-practice nutrition improves patient outcomes—by averting complications, speeding recovery, improving patients' quality of life, and lowering the likelihood of hospital readmissions. As a result, attention to nutrition saves money too. With this evidence-based medical education monograph as a starting point, we challenge you to use nutrition to make a difference for your patients and your hospital.

Nutrition matters!

February 1, 2014

EDUCATIONAL OBJECTIVES

The **feedM.E**. monograph reviews appropriate use of nutrition therapy as part of care for patients in the hospital and on their return to the community. After studying the four chapters of this monograph, health professionals will be able to meet the educational objectives listed below.

1. Health and Financial Impact of Malnutrition and its Treatment

Discuss health and financial consequences of malnutrition in hospitalized patients; describe evidence of benefits from nutrition interventions in those who are malnourished or at risk of malnutrition.

2. Barriers to Best-practice Nutrition Care

Discuss barriers to uptake of best-practice nutrition care, and describe problem-solving strategies to overcome barriers; review evidence-based nutrition guidelines that inform best practices.

3. A Simple Pathway for Basic Nutrition Care

Use validated tools to screen and assess the nutritional status of each hospitalized patient; explain how to meet nutrition needs of patients capable of oral intake.

4. Advanced Nutrition Care

Describe advanced nutrition interventions for patients with specialized and complicated nutritional needs, including guidance for making decisions about how, what and how much to tube-feed by enteral and parenteral access.

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OVERVIEW

In 2013, the US Alliance to Advance Patient Nutrition was launched with sponsorship from Abbott Nutrition.[5, 6] The Alliance to Advance Patient Nutrition was formed to address the issue of malnutrition in the hospital setting and to spotlight the importance of patient nutrition. The Alliance, which is a consortium of 5 professional organizations, represents over 100,000 dietitians, nurses, physicians, and other clinicians from all 50 states. The Alliance's mission is to transform patient outcomes through nutrition.[6]

In 2014, Abbott Nutrition extends the reach of this program worldwide. With guidance from international experts on medical nutrition, we introduce the **feedM.E.** program as a global call to action for improved identification and treatment of malnutrition in hospital settings and beyond.

When a patient is too sick to eat enough of a regular diet to meet nutrient needs, nutritional intervention is essential. This **feedM.E.** monograph is about making the best nutritional choices for patients who are hospitalized. The monograph compiles scientific rationale, presents clinical evidence from hospitals around the world, and highlights practice guidelines for decision-making about how to intervene nutritionally. The monograph provides simple step-by-step advice about how to meet the protein, energy, and micronutrient needs of various patients.

In Chapter 1, we open with striking numbers to illustrate how malnutrition among hospitalized patients has negative effects on recovery and costs of care. We provide compelling clinical data to show how carefully-planned use of oral nutrition supplements (ONS) and tube-fed enteral nutrition can decrease complication rates, shorten hospital length of stays, and in some cases, lower mortality. We also describe how overall costs of care are lowered when these nutrition interventions are used.

With proper attention to nutrition during hospitalization, patient outcomes can be improved and overall costs of care can be lowered.

In Chapter 2, we identify barriers to adoption of best-practice nutrition care, and we offer steps to help overcome common barriers. We underscore the importance of building a healthcare culture that values nutrition, and we review evidence-based guidelines for up-to-date nutrition care.

In Chapter 3, we offer a Simple Nutrition Care Pathway to help implement basic nutrition care for hospitalized patients who are malnourished or at nutritional risk, particularly those who are capable of oral intake. We offer guidance on who, what, and how much to feed patients in the hospital. We also review how post-discharge nutrition interventions can help lower readmission rates, improve patient quality of life, and may reduce risk of death. The pathway we suggest is simple, practical, and can be tailored and applied globally.

In Chapter 4, we offer specific protocols and algorithms to facilitate best-nutrition practices for patients who need advanced nutrition care. We summarize expert recommendations to achieve optimal enteral feeding when it is appropriate. We also provide information and tools to help tailor nutritional choices to each patient's condition—formula selection, route of feeding, when to start feeding, and other aspects of the feeding regimen.

INTRODUCTION

What Is feedM.E.?

FeedM.E. is a malnutrition awareness and medical education program. The **feedM.E**. Global Group on Nutrition in Healthcare includes nutrition leaders from Asia, Europe, the Middle East, and North and South America. Together we are committed to increasing recognition of nutrition's role in improving outcomes for patients hospitalized around the world. We add our support to an international 'call to action' for preventing and treating malnutrition in healthcare.[6-11]

To help incorporate best-practice nutrition care around the world, this monograph provides evidence of the problem of malnutrition in hospitals and in the community. Importantly, the monograph offers a straightforward and stepwise strategy for nutrition care—a simple and efficient Nutrition Care Pathway. We show how to use this Care Pathway for patients with mild-to-moderate malnutrition risk, and we offer guidance for providing advanced care for individuals with severe and complicated nutrient needs. We also emphasize that use of the Nutrition Care Pathway begins in the hospital, but the need for nutrition care continues long after the patient leaves the hospital.

Why Change Hospital Nutrition Practices?

In hospitals around the world, malnutrition is common and costly, especially among patients who are older.[12-21] Hospitalization itself is often associated with patient risk of worsening nutritional status, which can in turn lead to declining functional abilities and lowered quality of life.[17, 22-25]

We need to improve nutrition care in hospitals and beyond because an ever-growing number of studies show that optimal nutrition care improves patients' clinical outcomes and cuts healthcare costs.[15, 26-32] Despite compelling evidence, nutrition is still not fully utilized; barriers such as inadequate time, money, and training are given as reasons.[33, 34] The truth is that we can no longer afford to not pay attention to nutrition care in practice.

Professional nutrition guidelines and recommendations support 'screen, intervene, and supervene' as today's nutrition care mantra.[35-38] Attention to nutrition during a patient's hospital stay is vital to quality care; post-discharge nutrition planning and follow-up care are likewise necessary.[6, 38-41]

1. NUTRITION MATTERS

By the time a person is sick enough to be admitted to the hospital, he or she will likely have little or no appetite and have lost weight already.[12, 42] In fact, results of a recent hospital survey showed that more than 40% of patients experienced weight loss in the 3 months prior to entering the hospital and 50% had reduced food intake the week before admission.[12] For patients admitted to hospitals around the world, malnutrition prevalence ranges from 20% to 50% depending on the malnutrition criteria used and the population of patients coming to the hospital.[13-20] Anyone who is sick or injured is at risk of malnutrition and its adverse effects; hospitalized older people are particularly vulnerable.[21]

Worse still, hospitalization itself is a risk factor for declining nutritional status.[22] Traditional preparation for surgery, missed mealtimes due to medical procedures, and nil per os (nothing by mouth) orders all equate to problems of caloric deficit and weight loss. Risk of dying is increased when food intake is severely limited by illness.[12] Additionally, impaired functional recovery is evident in patients who experience malnutrition and loss of lean body mass, even a full year after hospital discharge.[25]

Tolls of Malnutrition

Hospitalized patients who are poorly nourished are at distinctly higher risk for complications, prolonged hospitalizations, and costly outcomes than are adequately-nourished patients.[18] The health and financial costs of malnutrition are evident all around the world, as shown by results of studies in Asia, North and South America, Europe, and Australia.[12, 15, 43-52]

Health Costs

Malnutrition is connected to a wide range of complications—pressure ulcers, surgical-site infections, urinary tract infections, falls, and death. To illustrate the presence of malnutrition and its clinical consequences in hospitals worldwide, we list examples from the United States (US),[43, 49] France,[44] South Korea,[45] Australia,[46] and Brazil.[52]

- Following surgery, malnourished US patients were 4-times more likely to develop pressure ulcers, 2-times more likely to have surgical-site infections, and 5-times more likely to get catheter-associated urinary tract infections during hospitalization when compared to adequately nourished post-surgical patients.[43]

- The odds of incurring complications were significantly higher for US patients who declined nutritionally during their hospital stay compared to a non-declining reference group.[49]

- Severely malnourished patients in a French hospital were 5-times more likely than nourished patients to get hospital-acquired infections.[44] Similarly, Korean patients who were critically ill and severely malnourished were at least 2-times more likely to incur an infection during hospitalization than were their better-nourished peers.[45]

- During hospitalization, malnutrition and falls go together. Australian patients who experienced falls while hospitalized had a higher prevalence of malnutrition than did their no-fall peers.[46] Not surprisingly, 'fallers' consumed significantly less energy and protein during their hospital stay.[46]

- Patients hospitalized around the world—in the UK,[47] US,[48] Singapore,[15] Europe,[12] and Brazil[52]—were consistently at higher risk of dying if they were malnourished.

Financial Costs

As there is evidence for disease-related malnutrition in hospitals around the world, so too is there evidence of excessive costs of care due to malnutrition.

- In a large Brazilian hospital study, malnourished patients stayed in the hospital for 16.7 days, versus 10.1 days for nourished patients, and costs of care averaged 60% more (or up to 3-times more when medication costs were included).[52]

- Malnutrition likewise increased overall hospital costs of care in the United States. US patients who declined nutritionally during hospitalization, regardless of their status on admission, had 60% higher hospital charges compared to patients who were adequately nourished.[49]

- In European Union (EU) countries, about 20 million patients are affected by disease-related malnutrition, costing EU governments up to €120 billion annually.[50] In the Netherlands, added costs of managing such patients were estimated to be 2.1% of total national health expenditures.[50]

- Patients hospitalized in Portugal were classified according to their diagnosis-related group (DRG) and whether or not they were at risk for malnutrition. Study results showed that 42% were at risk of malnutrition. Mean hospital costs for those at malnutrition risk were more than double compared to patients in the same DRG but without malnutrition risk.[51]

- Malnourished patients in a Singapore hospital had longer hospital stays, were more than twice as likely to be readmitted, and were at greater risk of dying within the next 1 to 3 years compared to their adequately-nourished peers.[15]

Benefits of Nutrition

Around the world, research has consistently shown that nutrition interventions have a positive impact on hospitalized patients who cannot meet their nutritional needs with food. In terms of patient health benefits, evidence shows that nutrition therapy can improve nutritional status and strength; lower rates of infections and other complications; improve quality of life (QoL); and lower risk of mortality **(Table 1.1)**.[26-28, 53-55] In terms of costs, attention to nutrition care can shorten length of hospital stay; reduce readmissions; and lower overall costs for hospital care **(Table 1.2)**.[27, 29, 32, 53, 56, 57]

Beneficial Outcomes Related to Patient Health

With nutrition interventions, there were significant clinical and economic benefits across patient groups and in different settings, as shown by results of randomized, controlled trials (RCTs) and by meta-analyses.

Fewer in-hospital complications. In a meta-analysis of 3 RCTs in patients with chronic co-morbid conditions, hip fracture, and acute illness, the incidence of all complications during hospitalization was 30% lower in the group receiving oral nutrition supplements (ONS) (p=0.005).[27]

Reduced pressure ulcer incidence. Among hospitalized patients at risk for developing pressure ulcers, those who received ONS or enteral tube feeding were 26% less likely to develop pressure ulcers than those who were given a usual diet, as shown by a meta-analysis of results from RCTs.[26] RCTs were conducted in Switzerland, Sweden, France, and the Netherlands.[26]

Higher protein and energy intake. When studies of similar design were combined for meta-analysis, ONS-treated patients had greater total protein and energy intake.[27]

Higher handgrip strength. ONS-treated patients had significantly improved (p=0.014) handgrip strength compared to controls.[27]

Improved quality of life. In a Swiss study of hospital patients who were at risk of malnutrition, individualized nutrition support led to higher scores on the Quality of Life (QoL) SF-36 function summary scale compared to patients who received standard hospital care.[53] Additionally, in a three-month post-hospital nutrition intervention with high protein and energy supplements in malnourished GI patients in Germany, all 8 scales of the QoL improved in patients who received ONS in addition to dietary counseling compared to only 3 scales in patients who received dietary counseling alone.[58]

For patients who are malnourished or at risk of malnutrition, nutrition intervention results in:

- Lower rates of pressure ulcers and other complications
- Fewer hospital readmissions
- Shorter hospital stays
- Lower hospital costs
- Lower risk of mortality

Reduced risk of mortality. In a meta-analysis of nutrition trials in older people, Milne and colleagues found that mortality was reduced when malnourished older adults were given oral protein and energy supplementation with ONS.[28] In a prospective study of critically ill adult patients, the risk of death was 56% lower in patients who received enteral nutrition compared to patients receiving no nutrition intervention, parenteral and enteral nutrition, or parenteral nutrition alone (p = 0.007).[55]

Table 1.1 *Review of Studies on Clinical Outcome Benefits of Nutrition Intervention*

Benefit	Study	Results
Nutritional Status	Cawood 2012[27]	High-protein ONS led to improvements in total protein and energy intake in intervention patients versus controls in all but 1 trial, and significantly so on meta-analysis.
		Meta-analysis of 4 RCTs (n = 118; 1 RCT in hospital and 3 RCTs in community patients) showed significant improvements in mid-arm muscle circumference in patients who received high-protein ONS versus controls (mean difference 0.47 cm [95% CI 0.30 to 0.64], p < 0.05).
Strength	Cawood 2012[27]	A systematic review and meta-analysis of 4 RCTs in community patients with chronic obstructive pulmonary disease (COPD), gastrointestinal (GI) disease and hip fracture found that multi-nutrient, high-protein ONS significantly improved hand-grip strength compared with the controls (1.76kg [95% CI 0.36 to 3.17], n = 219, p = 0.014 random effects model).
Complications	Cawood 2012[27]	High-protein ONS use significantly reduced the incidence of complications in hospitalized patients with hip fracture, leg and pressure ulcers, and acutely ill patients compared with controls (3 RCTs, n = 932; OR 0.69, 95% CI 0.53 to 0.89, p = 0.005).
	Milne 2009[28]	There was a reduction in complications in older people treated with ONS compared to routine care (24 trials, n = 6225, RR 0.86; 95% CI 0.75–0.99) and in a subgroup analysis of patients with hip fracture (6 trials, n = 298, RR 0.60; 95% CI 0.40 to 0.91).
	Stratton 2005[26]	Meta-analysis showed that ONS use (250–500 kcal, 2–26 weeks) was associated with a significantly lower incidence of pressure ulcer development in at-risk patients compared to routine care (odds ratio 0.75, 95% CI 0.62 to 0.89, 4 RCTs, n = 1224 elderly, post-surgical, chronically hospitalized patients).
Quality of Life	Starke 2011[53]	For patients defined as at risk of malnutrition, individualized nutrition support led to higher scores on the QoL SF-36 function summary scale (37 +/-11% vs. 32 +/-9%, p = 0.030) compared to at-risk patients who received standard hospital care.
	Norman 2008[58]	In a three-month post-hospital nutrition intervention with high protein and energy supplements in malnourished GI patients all 8 scales of the QoL improved in patients who received ONS in addition to dietary counseling compared to only 3 scales in patients who received dietary counseling alone.
Mortality	Milne 2009[28]	Mortality results were statistically significant or approaching statistical significance in trials in which older adult participants (n = 2461) were defined as undernourished (RR 0.79, 95% CI 0.64 to 0.97).
	Barr 2004[55]	The risk of death was 56% lower in critically ill ICU patients who received enteral nutrition compared to patients receiving no nutrition intervention, parenteral and enteral nutrition, or parenteral nutrition alone (hazard ratio, 0.44; 95% CI, 0.24 to 0.80; p = 0.007).

Beneficial Outcomes Related to Financial Costs

Reduced length of stay (LOS). In a meta-analysis of 9 RCTs in hip fracture and acutely ill patients, drinking high-protein ONS reduced hospital LOS by nearly 4 days compared to a control group (p=0.04).[27] In another RCT, older adult patients who did not receive a dietitian-recommended nutrition plan had a mean length of stay that was 1.7-times longer than for those who received the feeding recommended by the dietitian (p=0.0074).[56]

Fewer readmissions. In a meta-analysis of 2 RCTs in acutely ill patients with a wide variety of conditions and in patients with GI disease, ONS use had a significant effect on lowering hospital readmissions by more than 30% compared to controls (p=0.004).[27] In a very recent meta-analysis of 6 RCTs with older patients, ONS use reduced readmission by 40% (p=0.001).[57] In a RCT of patients defined as at risk of malnutrition, individualized nutrition support led to fewer readmissions compared to patients who received standard hospital care.[53]

Lowered cost of care. Results of a recent US health economics study revealed clear financial benefits for nutritional intervention among hospitalized patients.[29] Based on analysis of propensity-matched patients who did or did not receive ONS (1.2 million episodes), Philipson and colleagues found that those patients who got ONS had shorter lengths of stay by 2.3 days (21% shorter), and decreased episode costs by $4734 (USD; 21.6% lower).[29]

In another US study, more than half of patients in two hospital wards were identified as malnourished or at risk of malnutrition; such patients were assigned to receive care with nutrition intervention or usual hospital care without added focus on nutrition.[32] Nutrition intervention reduced LOS an average of 1.93 days in the malnourished group and 3.2 days in a severely malnourished subgroup (compared to patient groups who got usual care). Identifying and treating the severely malnourished patients in this study led to a savings of $1514 USD/patient.[32]

Take-home Message: Nutrition Makes a Difference

Attention to nutrition is fundamental to good clinical practice. In this chapter, we have compiled overwhelming evidence to show we can no longer afford to overlook the problem of patient malnutrition. Both during hospitalization and after discharge for recovery in the community, nutrition care improves patient outcomes and cuts healthcare costs.

Table 1.2. *Review of Studies on Outcomes Associated with Financial Savings as a Result of Nutrition Intervention*

Benefit	Study	Results
Length of Stay	Cawood 2012[27]	Meta-analysis of 9 RCTs in hip fracture and acutely ill patients (n = 1227) and across hospital and community [7 RCTs]) showed a significant reduction in length of stay in patients who received oral nutrition intervention with high-protein ONS versus controls (-3.77 [95% CI -7.37 to 0.17] days, p = 0.040 random effects model).
	Somanchi 2011[32]	Of the 400 patients assessed, 53% were malnourished or at risk of malnutrition. Multiple general linear regressions showed that nutrition intervention reduced LOS an average of 1.93 days in the cohort group (95% CI –3.19, –0.661) and 3.2 days (95% CI, –6.43, 0.028) in subgroup of severely malnourished patients.
	Lee 2012[56]	Older adult patients who did not receive a dietitian-recommended nutrition plan had a mean LOS of 26.4±15.5 days, which was 1.7-times longer than LOS for those who received the dietitian-recommended plan (15.8 days±6.9; p=0.0074).
	Philipson 2013[29]	Based on a matched sample of 1.2 million episodes, this retrospective data analysis showed that patients who received ONS had a shorter LOS by 2.3 days (from 10.9 to 8.6 days or 21% shorter) (95% confidence interval [CI] – 2.42 to –2.16).
Readmission	Cawood 2012[27]	Meta-analysis of 2 RCTs in acutely ill patients with a wide variety of conditions and in GI disease patients (n = 546) showed that high-protein ONS had a significant effect on reduction of hospital readmissions compared with controls (OR 0.59 [95% CI 0.41 to 0.84] days, p = 0.004 random effects model). High-protein ONS reduced overall readmissions by 30% compared to the control group.
	Starke 2011[53]	In a RCT of patients defined as at risk of malnutrition, individualized nutrition support led to fewer readmissions (17/64 vs. 28/61, p = 0.027) compared to patients who received standard hospital care.
	Stratton 2013[57]	Meta-analysis of 6 RCTs, including mostly people ≥ 65 years, found that ONS use significantly lowered the likelihood of hospital admissions (OR 0.59, 95% CI 0.43 to 0.80, p = 0.001) compared to people who received routine care
Cost of Care	Philipson 2013[29]	Based on a matched sample of 1.2 million episodes, this retrospective data analysis showed that ONS patients had a decreased episode cost of $4734 (95% CI – $4754 to – $4714), from $21,950 to $17,216 (21.6% decline) compared to matched patients who did not receive ONS.

2. BARRIERS TO BEST-PRACTICE NUTRITION CARE

Room for Improvement in Hospital Nutrition Care

All too often patients' nutritional needs are overlooked or under-treated in hospitals around the world. In a Europe-wide survey of hospital nutrition care (1217 units, 325 hospitals, 25 countries, > 21,000 patients), only half of the units reported routine use of nutrition screening on admission, usually with a local screening tool rather than a national tool.[59] Even when energy intake was assessed and an energy goal was specified, 43% of patients consumed less than their energy goal, and 53% self-reported inadequate food intake.[59] In a 24-hour audit at an Australian hospital, 55% of malnourished patients and 35% of well-nourished participants consumed less than half of food offered.[19]

Worsening nutritional status is not unusual during hospitalization.[49] In a UK study, over 60% of hospital patients experienced a decline in nutritional status during their stay.[23] In 3 Chinese teaching hospitals, the proportion of undernourished patients went from 8.2% on admission to 11.5% at discharge.[17] In patients with acute ischemic stroke who were hospitalized in South Korea, nutritional status deteriorated from 12.2% undernourished at baseline to 19.8% just one week later.[24] Worse still, hospitalization itself is a risk factor for declining nutritional status. Traditional preparation for surgery, missed mealtimes due to medical procedures, and nil per os (nothing by mouth) orders all add up to problems of caloric deficit and weight loss.[22]

Poor nutritional status during hospitalization predicts prolonged recovery from illness. Recovering Korean stroke patients were less likely to be able to perform self-care at 3 months if they were found to be under-nourished during their hospital stay.[24] Among older, poorly nourished Taiwanese patients with hip fracture, just half were able to walk by 12 months post-fracture if they had only usual care without nutrition intervention.[25] Thus, impaired functional recovery was evident in these under-nourished patients even a full year after hospital discharge.[25]

What Are the Barriers to Best-practice Nutrition?

Not having enough time, training, or money are the main reasons cited for failing to update nutrition care in hospital programs **(Table 2.1)**.[33, 34] Nurses at the bedside express practical concerns—added work, overload of new practice information, and worry about patient tolerance of feedings.[34] Physicians report inaccessibility and complexity of nutrition care guidelines.[34] Institution leaders need to deal with resistance to change and resource constraints.[34, 60, 61]

Why should we work to overcome barriers to updating nutrition care? Because following good nutrition practices can save time, improve patient outcomes, and lower overall healthcare costs.

Table 2.1 *Barriers to Best Nutrition Practice and Reasons to Surmount Them*

Barriers to updating nutrition practice	Why overcome this barrier?
Practice change takes time	Adoption of standardized, practical protocols makes feeding decisions stepwise and logical, which can save time.
Practice change requires staff education and training	Achieving better nutritional status for patients can improve clinical outcomes and lower costs of care.
Practice change will cost a lot	Due to the high costs of care for patients who are malnourished, hospitals can't afford not to improve nutrition care.

How to Overcome the Barriers

FeedM.E. offers 5 steps toward overcoming barriers and encouraging optimal feeding practices: (1) create a hospital culture that values nutrition; (2) know the latest evidence-based nutrition guidelines; (3) educate and train clinical staff on best nutrition practices; (4) empower nutrition "champions" and nutrition support teams; and (5) use benchmarking and audits to monitor progress.

Create a Culture That Values Nutrition

Create a culture that values nutrition by making good nutrition a part of a hospital's mission and goals **(Figure 2.1)**.[62]

- Hospital leaders who understand the clinical and financial benefits of good nutrition can create local nutrition policies and guidelines to emphasize the importance of nutrition screening and interventions.

- Staff education and training is essential to transfer policies and guidelines to everyday practice.[34] To do so, hospital leaders can develop their own protocols to reflect nutrition practice guidelines, or they can adopt or adapt existing algorithms, such as those we offer in the **feedM.E.** program.

- To sustain good nutrition and keep practices current, clinical educators recognize that it is important to reinforce messages and refresh training routinely, and to make changes as needed.[34] It is likewise important to encourage ongoing and open discussions about nutrition care.[34]

Figure 2.1 *Create an Institutional Culture that Values Nutrition.*

Know Evidence-based Nutrition Guidelines

In today's practice of medicine, treatments are recommended by evidence of best outcomes. With hundreds of new articles on nutrition science and clinical outcomes published in the medical literature each year, it is difficult for practitioners to keep up with all the latest evidence.

Nutrition experts in Europe, North America, and elsewhere regularly review the evidence and publish guidelines to help clinicians implement the best nutrition practices **(Table 2.2)**. The following list features examples of evidence-based nutrition guidelines and recommendations now available in the English language. Expert guidelines are available from other world regions or countries and in many other languages.

- Terminology and definitions for enteral nutrition[63, 64]
- Screening and assessment of nutritional status for hospitalized patients[65-68]
- Best practices for enteral nutrition for hospitalized patients[64, 69, 70]
- Enteral nutrition therapy for patients who are critically ill[37, 69, 70]
- Appropriate use of parenteral nutrition[73, 74]
- Nutrition for patients with special health considerations,[37, 69, 70] including pulmonary, liver, and renal disease,[75-77] acute pancreatitis,[78] and cancer[79]

Table 2.2 *Websites for Guidelines from Europe and North America*

Guidelines	Where to Find Them
American Gastroenterological Association Multidisciplinary Practice	http://download.journals.elsevierhealth.com/pdfs/journals/1051-0443/PIIS1051044311008505.pdf
American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)	http://www.nutritioncare.org/Library.aspx
Canadian Critical Care Nutrition	http://criticalcarenutrition.com/
European Society for Clinical Nutrition and Metabolism (ESPEN)	http://www.espen.org/espenguidelines.html

Educate and Train Clinical Staff on Best Nutrition Practices

Research results inform practice guidelines, which in turn guide training for day-to-day care. Once current and evidence-based nutrition practice guidelines are found, the next step is to make this information accessible and easy to apply in practice.[34]

Program formats. The most effective nutrition education and training programs use multiple strategies as a way to reinforce learning. Such programs can be formal or informal:

- Grand rounds presentations
- In-service training sessions
- Workshops
- Computer-based learning modules
- Bedside instruction for small groups or one-on-one training
- Visual reminders such as posters and checklists

Teaching materials. Some hospital educators develop their own nutrition education programs to meet local needs and cultures, while others prefer ready-to-use materials. Below we offer resources for either strategy:

- Abbott Nutrition **feedM.E.** resources include this monograph, a practical handbook, and 3 presentation slidesets targeted to hospital administrators, clinical leaders and educators, and bedside clinicians.

- Abbott Total Nutrition Therapy (TNT) courses are available as Abbott-sponsored 1 or 2-day programs on nutrition for (1) adult in- and outpatients, (2) critical care patients, (3) geriatric in- and outpatients, and (4) pediatric in- and outpatients.

Contact your local Abbott representative to learn more about courses developed by Abbott Nutrition:

- **feedM.E.** lecture programs are targeted to hospital administrators, clinical leaders and educators, and bedside clinicians (30- to 60-minute presentations). The slide presentations review why and how to implement evidence-based nutrition practices.
- Total Nutrition Therapy (TNT) courses for adult, critical care, geriatric and pediatric nutrition (1 or 2-day training courses)

- The Abbott Nutrition Health Institute website (http://anhi.org/) is a rich source of information on malnutrition and its costs, including videotaped lectures from international conferences and medical education courses for credit.

- The American Society for Parenteral and Enteral Nutrition has recently published The A.S.P.E.N. Adult Nutrition Support Curriculum (2nd Edition).[80]

- The European Society for Clinical Nutrition and Metabolism (ESPEN) has a similar resource, Basics in Clinical Nutrition (4th Edition).[69]

- A critical care nursing team described teaching materials and outcomes of a critical care nutrition education program in their US hospital.[81]

- A dietitian-led team reports how they designed and implemented a program to improve malnutrition diagnosis and intervention in Canadian hospitals.[82]

Evidence that healthcare professionals need and want more nutrition education. Before nutrition training, ICU nurses in a US hospital system took a baseline 10-question test of their understanding of enteral nutrition practice; the mean score was 45% correct answers.[81] After an educational slide presentation of evidence-based care guidelines and follow-up discussions, the mean score increased to 84%. In discussions, nurses expressed surprise at the disparity between the research evidence and their practice knowledge before the educational program—including those who had many years of experience.

Likewise, many physicians realize that their training in nutrition falls short of needs. Behara and colleagues conducted an electronic survey on physicians' attitudes about nutrition at a US university hospital.[83] Physicians (n=182 respondents) were asked to answer 12 questions on nutrition. On a scale of 1-5 (1=low, 5=high), attending physicians' rating for the importance of nutrition was 4.6. They rated their level of comfort with the Nutrition Support Team at their hospital as 3.6, but their own understanding of nutrition for ICU patients as 3.33 **(Figure 2.2)**.

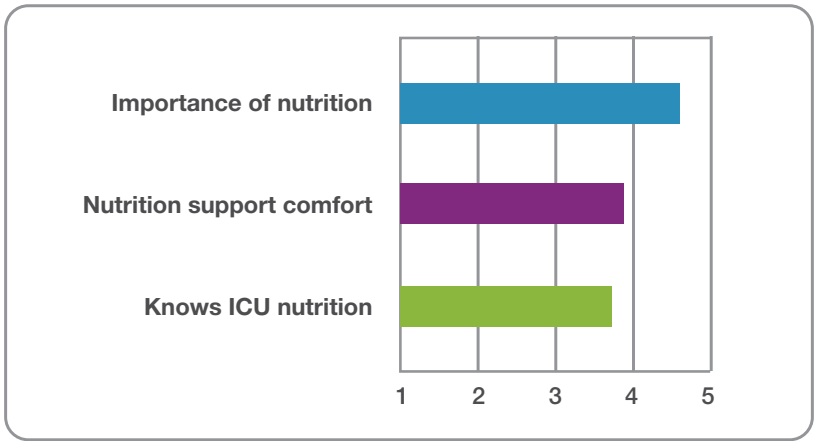

Figure 2.2 *Physicians Survey Responses About Nutrition Attitudes and Knowledge, as Reported By Physicians at a US University Hospital. Scores Are on a Scale of 1 to 5, from Lowest to Highest Level of Agreement.*[83]

In terms of actual knowledge, physicians had misconceptions or poor practices:

- Attending physicians, fellows, and residents waited an average of 2.4, 1.8, and 2.6 days before addressing nutritional status in ICU patients
- 52% of physicians chose parenteral nutrition for patients with pancreatitis, even though enteral nutrition is advised by guidelines
- Many physicians would stop tube feeds for reasons of intolerance.

The researchers were concerned by the discordance between physician perceptions of the importance of nutrition and their actual practice patterns.[83] Such survey results provided a rationale for physician training on evidence-based nutrition at this hospital.

Empower Nutrition Champions

A tried-and-true way to enhance nutrition practice is to identify and empower nutrition "champions." Nutrition champions are clinicians who advocate, model, teach, and reinforce best-practice nutrition care in hospitals. Champions may be nutrition specialist physicians,[84] dietitians,[85] or nurse leaders.[81]

An important aspect of monitoring practice change is to share findings with colleagues. Give feedback early and often.

The traditional champions of nutrition are the Nutrition Support Team—a physician, a nurse, a dietitian, and a pharmacist.[86] Some hospitals still use formal Nutrition Support Team programs, while others function with informal interdisciplinary teams. When individuals with different perspectives collaborate, the safety and efficacy of nutrition care can be enhanced, and patients' clinical outcomes were reported to improve.[86, 87]

Use Benchmarking and Audits to Monitor Progress

Local surveys. To achieve and maintain quality nutrition care, it is essential to monitor results before and after education or training programs, and again after periodic review courses. If education or training is designed to increase compliance with specific nutrition policies or protocols, the training team needs to develop measures specific to its site and plan. For optimal impact, also consider ways to monitor changes in terms of patient outcomes and healthcare costs. An important aspect of monitoring practice change is to share findings with colleagues. Give feedback early and often.

NutritionDay Survey
Visit **http://www.nutritionday.org/** for more information and to register as a participating site.

International surveys. For a broader look at nutrition care at your institution, consider participating in an international survey program.

For example, nutritionDay is a 1-day cross-sectional audit of food intake by patients in hospitals and nursing homes; nutritionDay surveys are conducted yearly.[12]

Canadian Survey of ICU Nutrition
Visit **http://criticalcarenutrition.com/** for more information and to register as a participating site in the next survey.

The Vienna-based program was developed to help hospital units improve how they identify patients at malnutrition risk and to improve nutritional care for all patients. Initially, care of European hospital patients was surveyed; over time, the nutritionDay survey has expanded to hospital, nursing home, and intensive care units throughout the world. After 6 years of surveys, more than 100,000 patients from 3,000 sites are now in the database. Facilities participating in the NutritionDay survey use standardized protocols to collect data on nutrition care provided, which can in turn be related to patient outcomes such as length-of-stay, hospital acquired infections, complication rates, and readmission rates.

For attention to nutrition care in the intensive care unit (ICU), Canada's Clinical Evaluation research Unit in Ontario conducts surveys on ICU practices worldwide every other year.[88] Three international surveys have now been completed; the 2011 survey included a total of nearly 4,000 patients in 221 ICUs of 21 countries. This ongoing quality improvement initiative allows participating ICUs to benchmark their nutrition practices and to compare their record within and across different countries.

Take-home Message: Now Is the Time to Take Action to Improve Nutrition Care

Our **feedM.E.** program is intended to help overcome common barriers to best-practice nutrition. To do so, we offer ways to translate knowledge into actions **(Table 2.3)**. In this chapter, we provided examples of published nutrition guidelines, we gave suggestions for training staff on following these evidence-based guidelines, and we emphasized the importance of regularly measuring the quality of nutrition care in the hospital.

In the next chapters and in the companion **feedM.E.** Handbook, we provide practical algorithms and tools to help guide nutrition training and practice.

Knowledge translation **is a term used in healthcare to describe the process of moving information from research into clinical practice. Research results inform practice guidelines, which in turn guide training for day-to-day care.**

Table 2.3 *Call to Action*

Improve Nutrition Care at Your Hospital	
Know what to do, and train staff to do it.	• Appraise evidence-based nutrition guidelines and recommendations. • Develop or adopt protocols to guide nutrition practices at your site. • Use education and training to incorporate best nutrition practices. • Use nutrition champions and nutrition teams to sustain quality care. • Update practice and training as new evidence-based guidelines are released.
Evaluate practice and discuss findings; adjust and reassess care processes.	• Benchmark present practices and outcomes. • Discuss findings with administrators and caregivers. • Set change goals, e.g., reduce practice variation, contain costs, or increase guideline compliance. • Implement changes, as needed, by refreshing policies and retraining staff. • Monitor compliance and outcomes; share results with colleagues early and often.

CASE EXAMPLE

Question: How prevalent is malnutrition in hospitals in my country?

Case Example: Leaders in the Canadian Nutrition Society (CNS) took a close look at contemporary nutrition care in Canada. The expert team, Canadian Malnutrition Task Force (CMTF), led by gastroenterologist Johane Allard, MD, and dietitian Heather Keller, RD, PhD have conducted this comprehensive study in 18 hospitals across 8 provinces in Canada. Goals of the project were to determine prevalence of malnutrition on admission and at discharge, to measure outcomes associated with malnutrition, and to describe the nutrition care process for the 1022 patients entered into the study.[1]

Malnutrition was determined by the Subjective Global Assessment (SGA).[2] Malnourished patients were identified to have a specific malnutrition syndrome according to new diagnostic categories of malnutrition—chronic disease-related malnutrition, acute disease- or injury-related malnutrition, and starvation-related malnutrition.[3] Patients with SGA scores of B or C were deemed malnourished, and those with disease-or injury-related malnutrition had C-reactive protein (CRP) levels ≥ 10 mg/L, which marked the presence of inflammation.

Answer: The prevalence of malnutrition at admission was 45% (patients with SGA B or C).

This level of malnutrition risk on hospital admission is consistent with the 20% to 50% range reported elsewhere in the world.[4]

Of the Canadian hospital patients who were malnourished, nearly 60% had disease-related malnutrition syndromes (SGA levels B or C, and C-reactive protein [CRP] ≥ 10 mg/L); others had starvation-related malnutrition syndrome (SGA B or C, and CRP < 10 mg/L). CRP levels dropped during hospitalization, suggesting lessening of inflammation.

Not surprisingly, malnutrition in the CMTF survey population predicted patient outcome, specifically a longer length of stay and increased likelihood of readmission within 30 days.

Conclusion: Malnutrition is common in hospitals around the world. Surveys can be conducted to measure malnutrition risk and to assess malnutrition severity in national health programs, large and small hospitals, and even in specific wards within hospitals. Increased awareness of hospital malnutrition is the first step toward implementing individual nutrition care plans and improving outcomes for patients who are recovering from illness or injury.

CMTF criteria for malnutrition syndromes

- **Disease- or injury-related malnutrition**
  - o SGA level B or C
  - o CRP ≥ 10 mg/L
- **Starvation-related malnutrition**
  - o SGA level B or C
  - o CRP < 10 mg/L

1. Canadian Malnutrition Task Force. http://nutritioncareincanada.ca/.
2. Detsky AS, McLaughlin JR, Baker JP, et al. What is subjective global assessment of nutritional status? *JPEN J Parenter Enteral Nutr*. 1987;**11**:8-13.
3. White JV, Guenter P, Jensen 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**:275-283.
4. Norman K, Pichard C, Lochs H, et al. Prognostic impact of disease-related malnutrition. *Clin Nutr.* 2008;**27**:5-1.

3. A SIMPLE PATHWAY FOR BASIC NUTRITION CARE

In contemporary hospital care, it is now clear that caregivers can improve patient outcomes by early identification of risk for nutrition problems and by making the right choices for nutrition intervention. This chapter of the **feedM.E.** monograph will focus on the basics of nutrition care and will provide recommendations for hospitalized and post-discharge patients who can eat orally but cannot meet their nutrient needs with a diet of regular food.

New Definition of Malnutrition

Malnutrition results when nutrient intake is disproportionate with nutrient needs; the reasons for this disproportion vary widely. As a result, malnutrition has been newly defined as 3 different clinical syndromes, which are characterized according to underlying illness/injury and varying degrees of inflammation.[89] The 3 syndromes are: (1) starvation-related malnutrition, i.e., a form of malnutrition without inflammation; (2) chronic disease-related malnutrition, i.e., nutritional inadequacy associated with chronic conditions that impose sustained inflammation of a mild-to-moderate degree; and (3) acute disease- or injury-related malnutrition, i.e., under-nutrition related to conditions that elicit marked inflammatory responses **(Figure 3.1)**. Many chronic conditions (such as kidney disease, cancer, heart failure, or rheumatoid arthritis) have inflammation as a disease component, thus increasing risk of malnutrition.[90, 91] Most severe acute health crises (such as severe infection, surgery, burn injury, or sepsis) have marked inflammation, which contributes to risk of severe malnutrition.[90, 91]

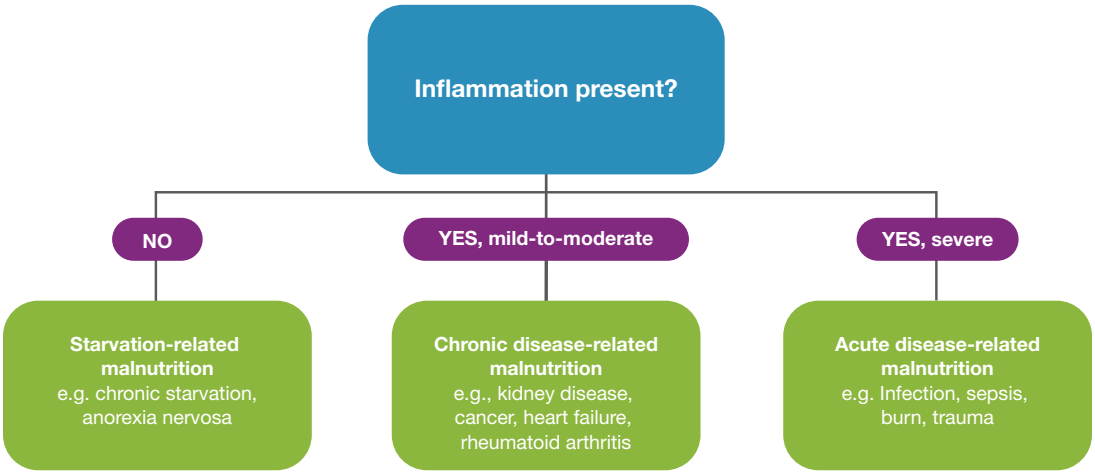

Figure 3.1 *Three Malnutrition Syndromes and Examples of Underlying Causes*

Incorporating the New Definition Into Practice

The updated definition of malnutrition necessitates a new approach to identifying patients at risk; it is now important to identify whether a patient has an illness or injury that is likely to increase risk of malnutrition.[89-91] In **feedM.E.**, we recommend that recognition of risk for disease-related malnutrition be part of the screening practice.

Nutrition screening on admission to the hospital is a new standard of care; patient screening is recommended by both the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) and the European Society for Clinical Nutrition and Metabolism (ESPEN).[65, 66]

Screening for Malnutrition Risk

We recommend questions to screen for malnutrition risk **(Table 3.1)** that pair (1) a quick clinical judgment about whether the patient's illness or injury carries risk for malnutrition[89-91] with (2) the two Malnutrition Screening Tool (MST) questions.[92, 93]

In the first step, the clinician makes a quick judgment about the patient's condition and its likelihood to cause or worsen malnutrition. Many chronic diseases (such as kidney disease, cancer, heart failure, or rheumatoid arthritis) and acute conditions (such as infection, surgery, burn, sepsis, or trauma) carry risk for malnutrition. This step of the screen raises awareness to potential risk for malnutrition.

As a next step, we recommend the 2 Malnutrition Screening Tool (MST) questions, which query the patient about recent weight loss and appetite loss as a way to recognize symptoms of risk for malnutrition. The MST score provides a quick estimate of the severity of malnutrition risk.[92, 93] MST is both sensitive and specific.[92, 94]

Table 3.1. *Screening for Malnutrition Risk Guides Immediate and Subsequent Nutrition Care*

Screen for Malnutrition Risk for Hospitalized Patients
1. Does the patient have an inflammatory illness or injury that can increase risk for malnutrition?
2. (For the patient) Have you been eating poorly because of a decreased appetite?*
3. (For the patient) Have you lost weight recently without trying?*
If indicated, intervene with prompt oral feeding or ONS to lessen malnutrition risk.

*MST Questions[92, 93]

With the **feedM.E.** program, we introduce 'screen and intervene' as a new paradigm to advance nutrition care. That is, when underlying illness, injury, or symptoms indicate malnutrition risk, consider immediate oral feeding or oral nutrition supplements (ONS) as a way to prevent or lessen the impact of malnutrition in all patients who are capable of oral feeding. As a notable exception, if the patient is near end-of-life, he or she can be kept comfortable without provision of food.[95]

When screening identifies a person as malnourished or at risk of malnutrition, the Screen for Malnutrition Risk leads to the full Nutrition Care Pathway **(Figure 3.2)**. As the next step, a nutrition assessment is used to define specific nutrition needs.

CASE EXAMPLE

Question: For a patient who is terminally ill, is it ethical to withdraw and withhold feeding?

Case Example: A 74-year-old man is mentally alert, but he is no longer able to swallow because of advanced esophageal cancer. The patient is aware that his condition is terminal. When the physician was discussing placement of a percutaneous endoscopic gastrostomy tube with the patient's adult son, the patient intervened to refuse such feeding. The son agreed to follow his father's wishes, but a nurse stepped in to say that the physician was ethically bound to provide tube-fed nutrition in order to prevent the patient from dying of hunger and thirst. The physician consulted the hospital ethics committee for advice about dealing with these conflicting viewpoints.

Answer: While there may be cultural and legal differences around the world about the appropriateness of feeding a dying person, it is important to recognize that the patient is dying from the disease process and not from starvation or dehydration. With quality palliative care, a patient can be kept comfortable at the end of life.[1]

Conclusion: It is widely accepted that a patient can refuse food when he or she is terminally ill but still mentally able to make decisions. To ensure compliance with cultural and legal practices at specific sites, caregivers should be aware of local policies on ethical feeding.

1. Ganzini L. Artificial nutrition and hydration at the end of life: ethics and evidence. *Palliat Support Care*. 2006;**4**:135-143.

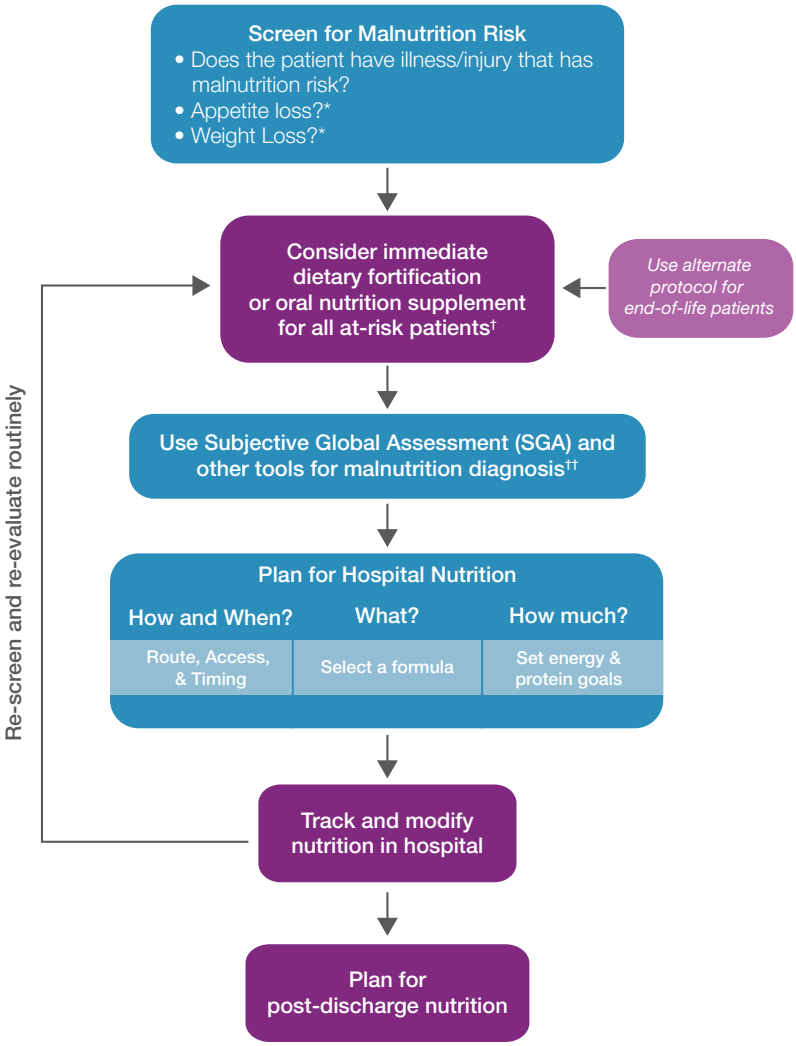

Figure 3.2. *Nutrition Care Pathway for Hospitalized Patients with Disease or Injury*

*For information on nutrition screening with the MST see: Ferguson M, et al. *Nutrition* 1999;15:458-464.[92]
†This advice is for patients who are able to consume food orally.
††For information on nutrition assessment and malnutrition diagnosis see: Detsky AS, et al. *JPEN* 1987;11:**8**-13.[96]; Jensen GL, et al. *JPEN* 2012;**36**:267-274.[91]; White JV, et al. *JPEN.* 2012;36:275-283. *J Acad Nutr Diet.* 2012;112:730-738.[90, 97]

The Nutrition Care Pathway: Nutrition Assessment, Malnutrition Diagnosis, and Intervention

For nutrition assessment, the Subjective Global Assessment (SGA) is widely used for most adults,[96] and the Mini-Nutritional Assessment (MNA) can be used for older persons.[98, 99] Such assessments, conducted by a qualified and trained clinician (dietitian, nutrition specialist, physician, or nurse), determine the extent of nutritional shortfall. Following assessment, the clinician creates an individualized plan that specifies how, what, and how much to feed.[18] Guidelines support prompt intervention, i.e., targeted nutrition therapy within 24 to 48 hours of admission.[35-37]

To facilitate malnutrition diagnosis and help standardize malnutrition care, experts from A.S.P.E.N. and the Academy of Nutrition and Dietetics (AND) defined specific criteria for malnutrition diagnosis.[97] These groups have also worked to clarify coding for malnutrition. ICD-9/ICD-10 malnutrition codes for mild-to-moderate and severe malnutrition are 263 and 262, respectively. The long-term goal is to tie diagnosis and coding of malnutrition to reimbursement for malnutrition care.

Intervene With Nutrition Care

How and when to feed. Choosing the appropriate form of nutrition therapy is stepwise and systematic **(Figure 3.3)**.[39] Enteral nutrition (EN), feeding by way of the gastrointestinal system, includes providing regular food, adding oral nutritional supplements (ONS) to the diet, or delivering formulas by tube feeding via nasogastric, nasoenteral, or percutaneous tubes.[63] Oral feeding with diet enrichment or with ONS is the primary and first choice for a majority of patients.[39] When oral food and ONS are impossible or inadequate, nutrition can be given as enteral tube feeds. When the gastrointestinal tract is compromised, parenteral nutrition can be used either alone or in combination with enteral nutrition.

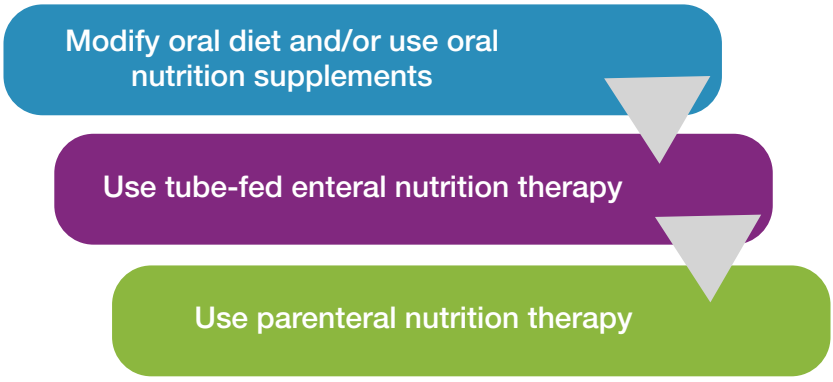

Figure 3.3. *For At-risk or Malnourished Patients, Meet Nutrition Targets By Using One or More Nutrition Intervention Strategies. Guidelines support prompt intervention, i.e., individualized nutrition therapy within 24-48 hours of admission.*[35-37]

What to feed. Many hospitalized individuals are able to eat food, but their appetite is limited. In such cases, experts recommend foods with energy-rich additives (maltodextrin, protein fortification), eating smaller but more frequent meals or high-energy snacks between meals, or using ONS.[18]

Standard commercially-prepared enteral formulas are generally complete and balanced and contain an energy level of 1.0 kcal/mL, thus meeting the needs of many sick or injured patients who cannot get adequate nutrition with a diet of regular food.[100] Specialized commercially-prepared formulas meet basic needs but also meet disease- or condition-specific needs; some are formulated and flavored for use as ONS, and others are used as enteral tube feeds **(Table 3.2)**.[4]

Table 3.2. *Examples of Enteral Formula Features for Specific Health Conditions*

Disease Condition	Special Nutritional Ingredients and Composition
Volume-restricted (e.g., with heart failure)	Calorically-dense, i.e., high energy and/or high protein[70] for patients sensitive to fluid volume
Glucose Intolerance, Diabetes	Specific ingredients minimize post-feeding blood glucose rises, i.e., slowly-absorbed carbohydrates and fats[101, 102]
Chronic Kidney Disease Pre-Dialysis	Low protein, low phosphorus to spare clearance burden on the kidneys before dialysis begins[75, 103]
Chronic Kidney Disease With Dialysis	Low phosphorus to spare clearance burden on kidneys and high protein to compensate dialysis-related losses[75, 103]
Cancer	High protein to maintain or restore lean body mass, anti-inflammatory omega-3 fatty acids,[103] and antioxidants[104]

How much to feed. Clinicians estimate energy and protein needs and establish a target energy goal for each patient.[36, 37] Adult energy requirements depend on needs for basal metabolism, physical activity, and metabolic stresses of different disease conditions.[105] These requirements can be calculated by predictive equations or measured by indirect calorimetry; predictive equations are less accurate for individual patients, while indirect calorimetry requires specialized equipment. The easiest method to estimate energy needs is to use the simple predictive formula that determines daily calorie requirements by multiplying the patient's body weight (BW, in kg) by 25 to 30 kcal, i.e., 25-30 kcal/kg BW/day **(Table 3.3)**.[37]

Sarcopenia (i.e., loss of muscle mass with low strength or performance) is caused and worsened by injury, illness, and inactivity during hospitalization. Adults who are sick or injured are at risk of sarcopenia, as are those who are of older age.[106, 107] Protein is an essential nutrient for maintaining muscle synthesis and preventing its degradation. Dietary protein intake thus requires special attention during and after hospitalization.

The usual recommendation for adult dietary protein intake is 0.8g protein/kg body weight (BW)/day.[108] Protein targets for adults with disease or injury vary widely according to severity of the condition (1.0 to 2.0 g/kg actual body weight per day).[37, 109] To maintain lean body mass and function, adults older than 65 years have higher needs than do younger adults (≥1 g protein/kg BW/day).[109] In patients who are obese (body mass index > 30), protein need is ≥2.0 g/kg body weight per day (ideal body weight is used for obese adult estimates).[37, 109]

Table 3.3. *How Much to Feed*

Estimating Daily Energy and Protein Targets for Patients Recovering from Illness or Injury
Simple formula for estimating energy requirement: **25 to 30 kcal/kg BW/day***
Guidelines for dietary protein needs: **1.0 to 2.0 or more g protein/kg BW/day†**

*Recommendation based on metabolic stress of disease, physical activity, and actual nutritional status

†Recommendation determined by age, illness or injury severity, and actual nutritional status

CASE EXAMPLE

Question: Why do kidney dialysis patients experience anorexia and weight loss, and what nutrition intervention is appropriate?

Case Example: A 49-year-old male outpatient has type 2 diabetes and stage 5 kidney failure; he requires hemodialysis three-times weekly. Laboratory findings last month showed that his albumin level fell to 3.5 g/dL, and the latest determination showed further decrease to 3.4 g/dL. His prealbumin level decreased from 15 mg/dL to 12 mg/dL over the same interval, and his serum bicarbonate level was low, 15 mEq/L. The patient reported a poor appetite saying, "I rarely eat more than two small meals each day." He has lost 5 kg in the last month.

Answer: The patient is experiencing metabolic acidosis and protein-energy wasting. As kidney function declines, urea and other waste products are retained in the blood rather than being excreted in the urine. Metabolic acidosis builds, blood pH is lowered, and plasma bicarbonate levels are reduced. Metabolic acidosis, even when mild, has consequences, including increased degradation of muscle protein (muscle wasting), reduced albumin synthesis (hypoalbuminemia), and anorexia. The dialysis procedure itself also contributes to metabolic problems. Dialysis removes amino acids from the blood, and dialysis procedures can activate inflammatory cytokines. As the amino acid pool is depleted, muscle is broken down to replete amino acids in the pool.

Intervention: The patient needs to be treated for metabolic acidosis and for protein-calorie deficit. Current guidelines for treatment of metabolic acidosis recommend using serum bicarbonate to maintain blood levels at or above 22 mEq/L for hemodialysis patients. This patient also needs nutritional intervention; oral nutrition supplements (ONS) are recommended. The patient will benefit from a high protein, low phosphorus, supplement specifically formulated for people with advanced kidney disease and on dialysis. Clinicians in many countries have adopted a new treatment strategy of giving ONS with each in-center dialysis session, along with daily at-home ONS to reduce protein and calorie deficits.

Conclusion: For many years, clinicians have known that ONS can improve nutritional markers and Subjective Global Assessment (SGA) scores in patients on dialysis. A new study by Lacson and colleagues showed that ONS during dialysis was associated with increased survival.[1] Remarkably, this research team found that hemodialysis patients had a 34% reduced risk for one-year mortality when they consumed ONS for one year during dialysis visits.

1. Lacson E, Jr., Wang W, Zebrowski B, et al. Outcomes associated with intradialytic oral nutritional supplements in patients undergoing maintenance hemodialysis: a quality improvement report. *Am J Kidney Dis.* 2012;**60**:591-600.

Supervene With In-Hospital Tracking and Post-Discharge Nutrition Planning

Individuals receiving nutrition therapy should also be monitored regularly to ensure feeding tolerance and adequate supplies of energy with sufficient protein. For a patient who is initially well-nourished, rescreening should occur at regularly determined intervals, especially when his or her clinical status changes.[68]

Nutrition care does not end when a patient is released from the hospital; follow-up with continued care is important. Poor nutritional status on discharge, with weight loss and low serum albumin levels as biomarkers, has been recognized as a predictor of hospital readmission within 30 days.[110] New focus on post-discharge nutrition planning[38] is expected to help lower costly hospital readmissions,[40] improve quality of life for patients,[53, 58] and in some cases even reduce risk of death.[28] Effective treatment calls for a post-discharge nutrition plan along with follow-up to ensure that the plan is implemented.

An effective nutritional plan considers multiple aspects of care.[38] It requires that the patient have cognitive competence, social and functional abilities, and economic access to food; alternatively, some patients need a caregiver and other social support programs to meet their needs. The nutrition plan should be prepared for and discussed with the patient, modified as needed to meet personal and cultural preferences, and include ongoing measures/assessment of the patient's nutritional status.

The **feedM.E.** Global Group recommends continued efforts to prevent and treat malnutrition for patients who have been discharged from the hospital into long-term care centers or into the community. Such efforts include nutrition education for the patient or caregivers, along with individualized dietary advice on the use of food enrichment or ONS. We also emphasize the importance of routine rescreening of nutrition status in the community.

Take-home Message: Screen, Intervene, and Supervene

The **feedM.E.** Global Group on Nutrition in Healthcare calls clinicians worldwide to take action with 'screen, intervene, and supervene' nutrition practices for hospitalized patients, i.e., screen always, intervene promptly when needed, and supervene with in-hospital nutrition tracking and post-discharge nutrition planning.

In this chapter, we presented questions to screen for malnutrition risk, and we discussed how to use a practical and efficient Nutrition Care Pathway for patients with mild-to-moderate malnutrition risk. In the next chapter, we offer guidance for providing advanced care for individuals with severe and complicated nutrient needs.

4. ADVANCED NUTRITION CARE

When a hospitalized patient cannot consume enough fortified foods or ONS to meet nutrient needs, advanced nutrition intervention is essential. For these patients, nutrition can be delivered by either the enteral or parenteral route. Nutrition decisions for these people, usually the very sickest, can be complex. It is important to consider the individual's general health and medical issues (underlying disease, comorbidities, mental status, expected prognosis) as well as relevant ethical issues (personal wishes, stage of terminal illness).[18]

This chapter of the **feedM.E**. monograph will focus on recommendations for feeding critically ill or injured patients with complex nutritional needs. For such patients, one of the most important choices a clinician makes is the decision between enteral and parenteral feeding.

- Enteral nutrition (EN), feeding by way of the gastrointestinal system, for these patients means tube feeding via nasogastric, nasoenteral or percutaneous tubes.[63]

- Parenteral nutrition (PN), feeding nutrients by way of percutaneous central or peripheral venous lines,[111] bypasses the usual process of eating and digestion.

Background

Dozens of studies support the concept that nutrition therapy facilitates recovery and improves survival. Based on both health and cost benefits, nutrition guidelines universally recommend enteral over parenteral feeding for most hospitalized patients who cannot eat regular food. In this section, we discuss research reports and guidelines about feeding from the English-language literature.[36, 37, 112]

Benefits of Enteral Over Parenteral Nutrition for Many Patients

Health benefits of EN use:
- Fewer infectious complications
- Shorter hospital stays
- Reduced risk of death in some cases

Cost benefit: EN is less costly than PN

Many studies have compared enteral to parenteral nutrition in patients with disease-related malnutrition. Randomized, controlled trial results, as well as combined meta-analyses, demonstrated that hospitalized patients fed enterally had fewer infectious complications than did those fed parenterally;[36, 37, 112] such patients also had fewer non-infectious complications and shorter hospital stays.[37] Risk of death was significantly lower for enterally-fed patients (compared to parenterally-fed patients), as shown for patients with acute pancreatitis,[113, 114] in trauma patients given early enteral support,[115] and in patients recovering from intestinal surgery.[116] In addition, the lower cost of EN offers an important advantage over more expensive PN.[36, 37, 112]

However, parenteral nutrition is well-justified for a small proportion of critically ill, hospitalized patients who cannot meet their nutrition needs with oral or enteral feeding—including those whose gut is not functional or accessible, or in whom EN is unlikely to be safe or effective.[117]

CASE EXAMPLE

Question: What medical nutrition therapy is preferred for a patient who has bowel obstruction at a site distal to the duodenum?

Case Example: A 58-year-old woman was admitted to the hospital with severe abdominal pain and distension; she was very weak and had vomited the entire night before coming to the hospital. Her height was 150cm and weight 45kg. Laboratory findings suggested dehydration and electrolyte abnormalities. The patient had two previous laparotomy procedures for colorectal surgery in the past 3 years. Physical examination showed no evidence of hernia, and stools were negative for blood. A computed tomography (CT) scan of the abdomen showed a discrete transition zone in the jejunum with proximal bowel dilation and distal bowel decompression. Intraluminal contrast did not pass beyond the transition zone, and the colon contained little gas and no fluid. The diagnosis was small bowel obstruction with potential risk for ischemia.

Answer: In this case, the patient was put on "bowel rest," and parenteral nutrition was initiated. The patient underwent an exploratory laparotomy with lysis of lesions. After one week and CT evidence that adhesions were no longer restricting the bowel, she was transitioned to enteral feeding (tube feeding), then advanced to regular food.

Conclusion: Small bowel obstruction is an indication for use of parenteral nutrition. In many patients, opening the peritoneal cavity surgically can lead to the formation of obstructive structures (adhesions).[1] With increased use of abdominal surgery in recent decades, adhesions are the most frequent cause of small bowel obstruction. For patients previously admitted with adhesions and small bowel obstruction, the relative risk of recurrent obstruction increases with the number of prior episodes.[2] This patient should be carefully monitored if gastrointestinal intolerance recurs.

1. Duron JJ, Silva NJ, du Montcel ST, et al. Adhesive postoperative small bowel obstruction: incidence and risk factors of recurrence after surgical treatment: a multicenter prospective study. *Ann Surg*. 2006;**244**:750-757.

2. Di Saverio S, Catena F, Kelly MD, et al. Severe adhesive small bowel obstruction. *Front Med.* 2012;**6**:436-439.

How and When to Feed

Critically ill, hospitalized patients who cannot meet their nutrition needs with oral feeding are in need of advanced nutrition support. This section will review the critical choices necessary to provide appropriate nutrition support, which include deciding whether the patient should receive EN or PN; determining feeding route, access, and timing; choosing which formula to feed; and setting protein and energy goals to target **(Figure 4.1)**.

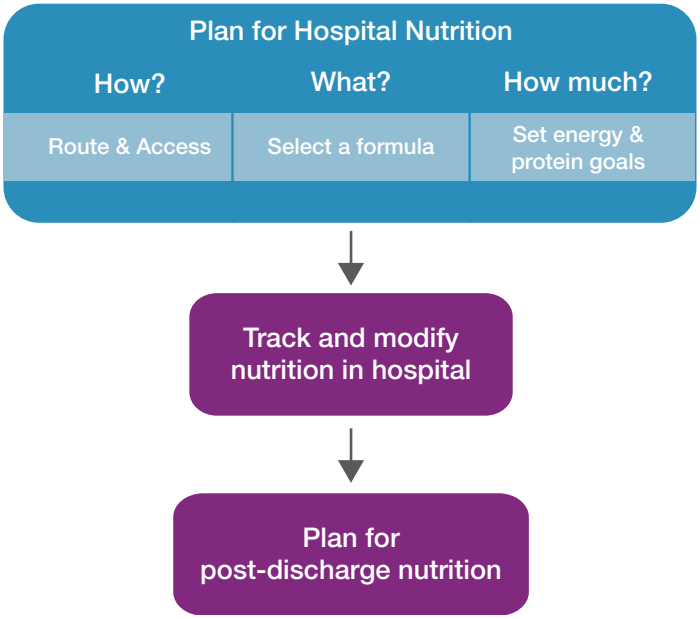

Figure 4.1 *Most Critically Ill Patients Require Nutrition Support, and Decisions On the Nutrition Care Pathway Will Determine How to Provide Support, and What/How Much to Feed.*

Who Should Receive Enteral Versus Parenteral Nutrition?

For those who have failed to respond to oral feeding alone or are likely to fail, enteral or parenteral nutrition is needed either as a sole source of nutrition or as a supplement to oral feeding **(Figure 4.2)**. Tube-fed nutrition can be given for a short-term or long-term interval depending on the patient's underlying medical problem.

Enteral tube feeding. Practice guidelines in Europe, Canada, and the US endorse enteral tube feeding for patients who are critically ill and hemodynamically stable.[36, 37, 112] Enteral nutrition is preferred over parenteral nutrition for most intensive care unit (ICU) patients. This evidence-based practice is supported by numerous clinical trials involving a variety of critically ill patient populations, including those with trauma, burns, head injury, major surgery, and acute pancreatitis. For ICU patients who are candidates for enteral feeding, early initiation (within 24-48 hours of arrival in the ICU) has become a recommended standard of care. Experts identify these early hours as a window of opportunity to provide nutrition that maintains gut barrier function and supports immune responses.[36, 37]

Indications: Enteral nutrition is indicated when a patient cannot eat or is unable to consume adequate oral nutrition to meet nutrition needs; for EN, the GI tract must be accessible and functional with adequate motility and absorptive capacity.[118, 119]

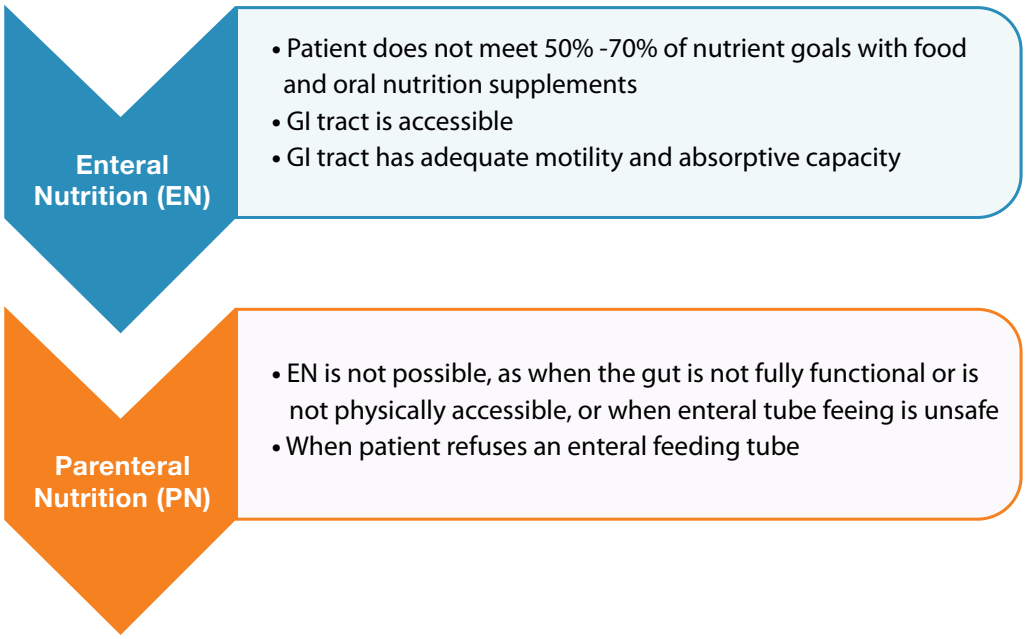

Figure 4.2 *Indications for Advanced Nutrition Therapy*[119]

Contraindications: EN may be contraindicated and PN necessary in patients with a perforated bowel (prior to repair); bowel obstruction; severe short bowel syndrome (< 100 cm); inability to adequately propel and absorb bowel contents; uncontrolled vomiting and diarrhea; intermittent bowel ischemia; and severe hemodynamic instability.[112, 118, 119]

Generally, the absence of bowel sounds is no longer considered an absolute contraindication to EN,[37] and new evidence in patients with hemodynamic instability points to improved survival in those given EN in the first 48 hours.[120]

CASE EXAMPLE

Question: What nutrition therapy should this patient with acute pancreatitis be given?

Case Example: A 42 year-old woman is rushed by ambulance to the emergency department in the early evening. She complained of 24 hours of severe and steady epigastric pain radiating to her back, along with nausea and vomiting. She has experienced similar pain before, usually after eating a heavy supper, but it resolved overnight. This time the pain persisted, so she sought medical attention. Her medical history was unremarkable. She is married with 2 school-aged children, does not smoke, and rarely drinks alcohol. On examination, the patient had no fever, but she was tachycardic (heart rate 104 beats per minute) with blood pressure of 114/73 mm Hg and shallow respiration (22 breaths per minute). Her abdomen was soft, yet mildly distended and sensitive to gastric palpation. Laboratory findings showed high levels of bilirubin (9.1 mg/dL total; 4.7g/dL direct), alkaline phosphatase (284 IU/L), aspartate aminotransferase (AST, 77 IU/L), alanine aminotransferase (ALT, 91 IU/L), and amylase (1249 IU/L). White blood cell counts were also high (16,500/mm^3).

The patient's symptoms (severe epigastric pain and nausea) and elevated amylase levels were consistent with acute pancreatitis. Hyperbilirubinemia and elevated alkaline phosphatase suggested that pancreatitis likely resulted from an obstruction of the common bile duct by a gallstone. With such findings and a markedly elevated white cell count, the patient was admitted to a hospital ward. Right upper quadrant ultrasonography confirms the diagnosis.

Answer: Traditionally, patients with acute pancreatitis were given parenteral nutrition (PN) in order to allow the inflamed pancreas to rest and repair itself. More recently, evidence supports use of enteral nutrition (EN) rather than PN. In patients with moderate-to-severe acute pancreatitis, EN is well tolerated when provided by the gastric or jejunal route. As symptoms lessen, the patient can be transitioned to a lowfat oral diet.

Yi and colleagues in Asia recently conducted a meta-analysis of results from 8 feeding trials for patients with acute pancreatitis; results showed that patients given EN had reduced risk of death by more than 60% compared to those given PN (RR = 0.37, 95% CI 0.21-0.68).[1] Enteral feeding also cut risk of other serious complications by more than 50%: multiple organ failure (RR=0.44, 95% CI 0.22-0.88), further surgical interventions (RR=0.41, 95% CI 0.23-0.74), and occurrences of infectious complications (RR = 0.46, 95% CI 0.27-0.78). Other researchers in the Middle East and in the US likewise performed meta analyses of major trials and found similar benefits to preferred use of EN over PN (reduced length of hospital stay, complications, multiple organ failure, and mortality).[2, 3]

Conclusion: Based on evidence of benefits for increased survival and decreased risk of complications, EN should now be considered the standard of care for patients who have acute pancreatitis and require nutritional therapy.

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2. Al-Omran M, Albalawi ZH, Tashkandi MF, et al. Enteral versus parenteral nutrition for acute pancreatitis. *Cochrane Database Syst Rev.* 2010:CD002837.

3. Marik PE. What is the best way to feed patients with pancreatitis? *Curr Opin Crit Care*. 2009;**15**:131-138.

Parenteral nutrition. Nutrition guidelines around the world do not agree on when PN should be started in patients who are not candidates for EN but are otherwise well nourished.[36, 37, 112] ICU patients who need PN represent a range of different and complicated conditions; under such circumstances, feeding decisions are usually made on a case-by-case basis.

For malnourished ICU patients, US and European experts agree that EN should be initiated within 24 hours of admission **(Figure 4.3)**.[36, 37]

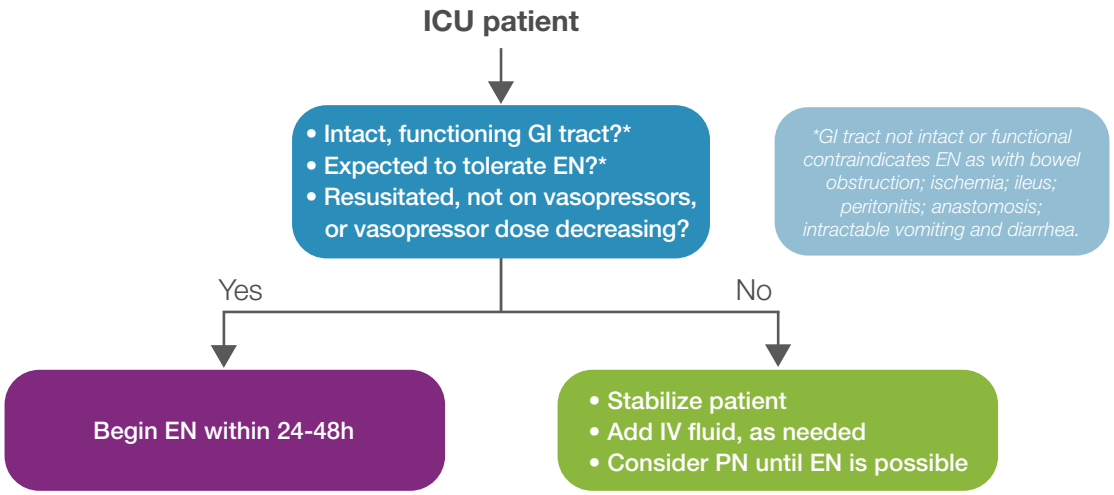

Figure 4.3 *Is My Critically Ill Patient a Candidate for PN?* [4, 121, 122]

The presence of extreme hemodynamic instability (rising lactate levels or escalating vasopressor requirements) generally rules out EN for hospitalized patients **(Figure 4.3)**. However, recent evidence suggests that early EN feeding in some vasopressor-dependent ICU patients can improve survival.[120] In a large, multicenter observational study, mechanically ventilated, vasopressor-dependent patients (n=1,174) were given enteral nutrition early (within the first 48 hours) or later (after 48 hours). Using statistical methods to adjust for potentially confounding variables, the study showed the early group had a significant survival advantage compared to the late group, as measured by ICU and in-hospital mortality. Importantly, the positive effect of early feeding was more evident in the sickest patients, and there was no evidence of harm caused by the early start of enteral nutrition. However, critically ill patients who are on vasodepressors should be carefully monitored if fed enterally because they are at risk for developing feeding intolerance (e.g., abdominal distension, rising lactate levels).[123]

In a recent observational study, the positive effect of early enteral nutrition was evident in the sickest patients, i.e., those on multiple vasopressors.

CASE EXAMPLE

Question: What is the best way to achieve goal nutrition in a patient who is critically injured and hemodynamically unstable?

Case Example: A 33-year-old man involved in a motor vehicle collision was admitted to the trauma unit with grade 5 spleen laceration, grade 2 renal laceration, and multiple bilateral rib fractures. Overnight he became hypotensive (mean arterial pressure [MAP] < 50 mm Hg) requiring treatment with norepinephrine to raise MAP above 60 mm Hg. His 6 a.m. blood pressure was 106/58 (MAP 74), and a maintenance dose of 2 mcg/min norepinephrine sustained low-normal blood pressure for 4 hours. At noon on hospital day 1, the patient underwent surgery to repair his spleen; surgical correction of shallow renal lacerations was not necessary. A gastrostomy tube was placed at the time of surgery.

Following surgery and within 48 hours of hospital admission, enteral feeding was initiated with an immune-modulating formula at a feeding rate set to deliver at least 20% of target energy/protein. The patient was carefully monitored for signs of feeding intolerance (vomiting, diarrhea, abdominal distension), and feeding was slowly advanced toward target.

Answer: In consultation with the trauma physician, a dietitian advised set target energy levels at 2100 kcal/day (30 kcal/kg/day) and target protein at 105 g/day (1.5 g/kg/day).[1] To facilitate feeding to target, protocols advised early initiation of enteral feeding and reduced times of "holding" feeds for other hospital procedures.[2] For patients with traumatic injury or critical illness, goal feeding is 50% to 65% of target energy and protein within the first week of hospitalization.[3] Guidelines for feeding trauma patients recommend enteral formulas with immune modulating ingredients (antioxidants, arginine and omega-3 fatty acids) and addition of glutamine.[2-5]

Patients in the intensive care unit (ICU) typically experience catabolic stress and systemic inflammatory response; in turn, these responses alter both the morphology and function of the gastrointestinal tract.[6] Up to 60% of ICU patients suffer gastrointestinal dysfunction due to impaired gastrointestinal motility, digestion, or absorption.[7, 8] Such dysfunction, often coupled with inadequate caloric intake, leads many trauma or critically ill patients to develop an energy deficit and lose lean body mass.

Patients with hemodynamic instability were previously thought to be candidates only for parenteral nutrition, but new evidence indicates that enteral started in the first 48 hours can significantly reduce mortality in such patients.[9] Results of a recent observational study showed that the sickest patients, i.e., those on multiple vasopressors, were most likely to benefit from early enteral feeding.[9] However, patients with extreme hemodynamic instability, i.e., with rising plasma/blood/serum lactate concentrations or escalating requirements for vasopressors, are considered candidates for parenteral feeding.

Conclusion: Early enteral feeding helps prevent energy deficit and loss of lean body mass in patients with critical injury or illness. Even patients being treated for hemodynamic instability can benefit from provision of early enteral nutrition.

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Why Is Parenteral Nutrition Overused?

It has been estimated that 85% to 90% of patients who require specialized nutrition can be fed enterally through gastric or intestinal tubes and then transitioned to an oral diet with supplements (Figure 4.4).[124] About 10% to 15% of critically ill patients must be fed by the parenteral route because they cannot be given enteral feeding due to gastrointestinal dysfunction.[124] However, for a wide variety of reasons, parenteral nutrition is overused today.

- Caregivers may not understand when and why PN is needed.[83] There are numerous guidelines for feeding patients with different conditions, and some caregivers may be confused about the guidelines.

- Patients and their families worry about discomfort of nasogastric tubes, and they do not understand the benefits of EN feeding.[125]

- Caregivers make traditional choices rather than following newer evidence-based recommendations.[34] It is important for hospital leaders to build a culture that accepts change, so they can adapt to evidence-based practices.

- Physicians, or patients and their families, may think PN is better because the cost is higher. In fact, studies show that rates of infections and complications are higher in PN-fed patients compared to those getting EN; such adverse consequences are both costly and life-threatening.[126, 127]

- In some cases, parenteral feeding is used simply because a central or peripheral line is already in place.

Figure 4.4 *The Vast Majority of Hospitalized Patients Who Need Specialized Nutrition Are Candidates for Enteral Rather Than Parenteral Nutrition.*[124]

CASE EXAMPLE

Question: How would you determine whether parenteral nutrition is being used appropriately in your hospital?

Case Example: Your hospital pharmacy manager just reported that costs for parenteral nutrition use increased by 35% in the last quarter compared to the prior quarter. According to reports from hospitals in Europe and the US, the direct cost of parenteral feeding formulas can be 4 to 5 times (and in some locations, 30 times) higher than that of commercially-available enteral nutrition.[1, 2] The pharmacy manager asked, "Has our case load changed? Or are we over-using parenteral nutrition for some cases where enteral nutrition is appropriate?

Answer: The charts of all patients were reviewed by a clinical auditor, and the reason for using PN was recorded, as was the interval of PN use. Reasons for use were compared to evidence-based practice recommendations (see box for examples). Of the 74 patients who received PN, 36 patients, or about half, were given PN inappropriately for a total of 183 days of feeding.

A study in a regional US hospital found the cost of providing 5 days of parenteral nutrition was $5,000 per patient, or $1000 per patient per day.[2] If EN is only 20% as costly as PN, your hospital could save up to $150,000 per quarter by appropriately identifying patients who qualify for parenteral nutrition. Savings are expected to be even higher when costs associated with surgical placement and monitoring of lines, and costs of treating infectious complications are included in the calculation.

Conclusion: Parenteral nutrition is indicated for some patients with special conditions; for most cases, enteral nutrition is preferred for both health and cost reasons.[6-8] Among patients who require artificial feeding intervention (enteral or parenteral nutrition), it has been estimated that parenteral nutrition is indicated for 10 to 15% of critically ill patients.[9] This proportion may vary depending on the population served by the hospital and its intensive care unit.

Contraindications to enteral feeding,[3-5] i.e., appropriate reasons to use parenteral nutrition

- Gastrointestinal perforation prior to repair
- Paralytic ileus
- Bowel ischemia
- Bowel obstruction
- High-output intestinal fistula
- Severe short-gut syndrome (<100 cm small bowel)

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9. Ziegler TR. Parenteral nutrition in the critically ill patient. *N Engl J Med*. 2009;**361**:1088-1097.

How to Feed: Choosing a Route for Enteral Feeding

Enteral feeding routes can access the gut in different ways, i.e., by way of a nasal tube to the stomach or intestine, or by direct access to the stomach or intestine. Selection of the optimal route will take into account the patient's health status, his or her gastrointestinal (GI) anatomy and function, and the expected length of therapy.[128] In general, the solution should be delivered as high up in the GI tract as possible, while ensuring maximum absorption.[100] The nasal route is best for short-term use, i.e., less than four weeks. For those patients at risk of aspiration, small bowel routes are a better choice.[128] When it is expected that nutrition therapy will last for more than four weeks, access points to the stomach (gastrostomy) or small bowel (jejunostomy) are necessary **(Figure 4.5)**.

Choosing the site where the feeding tube should terminate depends in part on the function of the patient's stomach. The advantages of stomach feeding include the similarity to normal nutrition and the relative ease of tube placement. Stomach placement also allows the feeding formula to be delivered continuously or intermittently, as the patient's tolerance allows. Placement in the small bowel can avoid problems in the stomach (gastric outlet obstruction, fistula), high risk of aspiration, or issues related to pancreatitis.[128] Small bowel feedings are best tolerated when feeding is given continuously rather than as a bolus.[129]

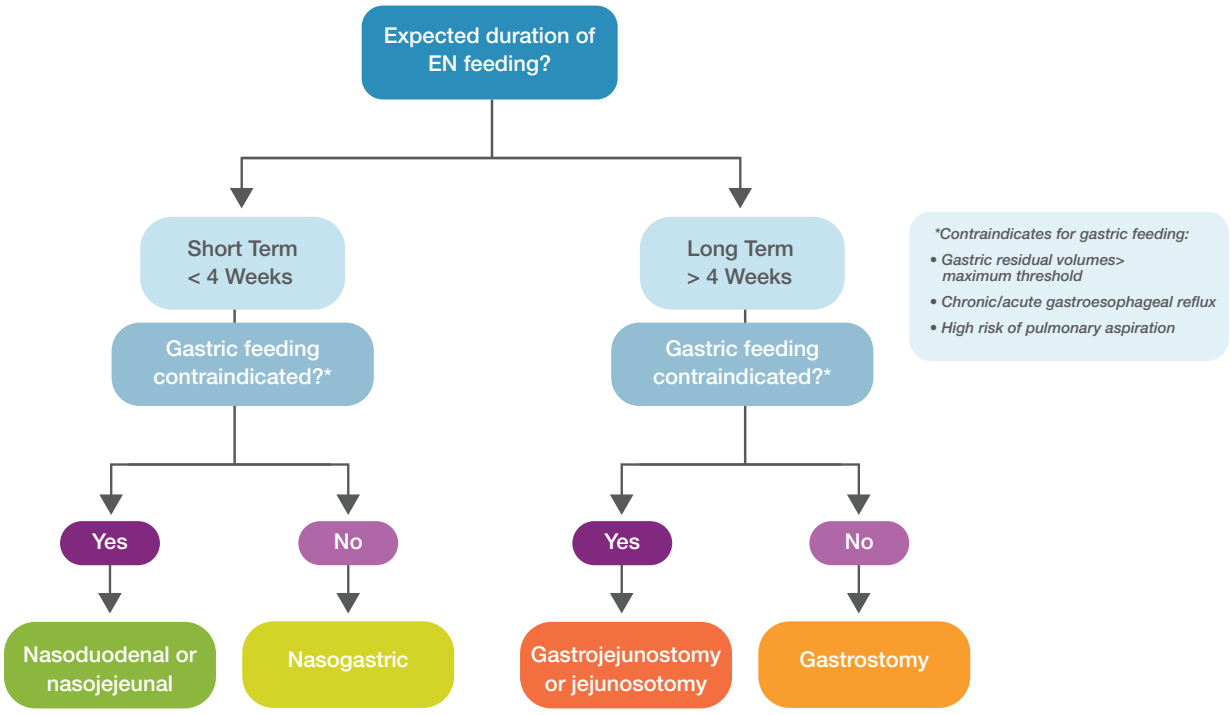

Figure 4.5 *Selecting an Enteral Feeding Device Depends on Patient Condition and Anticipated Length of Feeding Duration (Adapted from A.S.P.E.N. EN Handbook.*[122, 128]*)*

What and How Much to Feed: Choosing an Enteral Formula and Protein/Energy Targets

In some hospitals, tube feeding solutions are made by "blenderizing" regular foods.[69] While such blenderized feeds were believed to be naturally healthy and economical, study results revealed that neither belief was true. Results have unfailingly shown that blenderized feeds contain unsafe levels of bacterial contamination.[130-132] In addition, it is difficult to prepare "blenderized" foods with batch-to-batch consistency of nutrient contents.

Sterile liquid enteral formulas or powder formulas reconstituted with clean water are now recognized as safe and consistent. A simplified decision tree provides guidance for formula selection for most patients **(Figure 4.6)**.

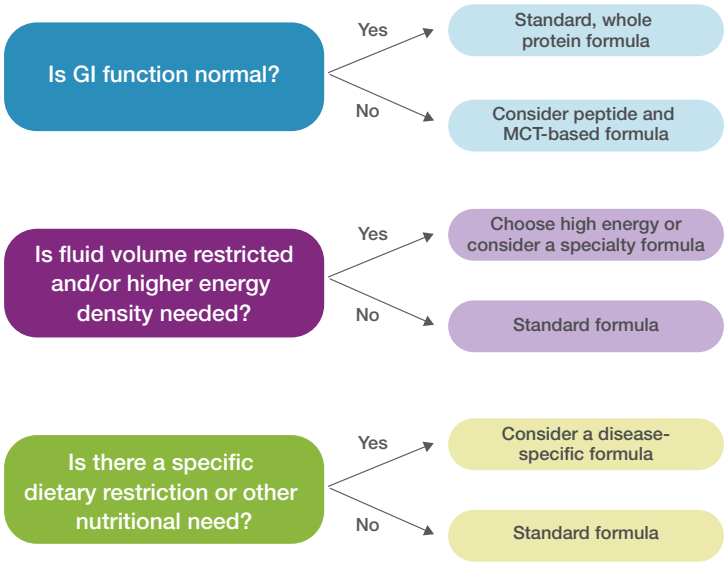

Figure 4.6 *Individual Patient Needs Will Determine the Most Suitable Enteral Feeding*[100]

While standard enteral formulas are able to meet the basic macro-and micronutrient needs of patients, various therapeutic enteral formulas can be used to meet basic needs and also deliver specific pharmaconutrients that can lessen hyperinflammatory responses, enhance the immune responses to infection, or improve gastrointestinal tolerance. Therapeutic formulas contain specific pharmaconutrients, i.e. arginine, antioxidants, certain ω-3 and ω-6 fatty acids, hydrolyzed proteins, and medium-chain triglycerides (MCT). Each of these ingredients is recognized to have functional properties. When combined in special formulas, they can improve patient outcomes;[4] certain diseases are associated with special nutrition needs **(Table 4.1)**.

Table 4.1 *Patients With Different Critical Care Conditions Have Special and Varying Nutrient Needs*

Condition	Special Formula Characteristics
SIRS/sepsis or ALI/ARDS	Anti-inflammatory fats (omega-3s)[103]
Surgery, Trauma, Burns	Arginine, glutamine, anti-inflammatory fats (omega-3s)[103]
GI Intolerance or Malabsorption	Hydrolyzed proteins, medium-chain triglycerides, prebiotics[4, 37]

SIRS= Systemic inflammatory response syndrome; ALI= Acute lung injury; ARDS= Acute respiratory distress syndrome

To determine how much to feed, ICU clinicians calculate or estimate energy/protein needs, then establish a target feeding goal for each patient.[36, 37] Adult energy requirements depend on needs for basal metabolism, physical activity, and metabolic stresses of illness or injury.[105] Requirements can be calculated by predictive equations or they can be measured by indirect calorimetry. Predictive equations are less accurate for individual patients, while indirect calorimetry requires use of specialized equipment.[37] When predictive equations are used, correction factors are needed to adjust estimates upward to accommodate higher energy needs due to inflammatory stress **(Table 4.2).**

Table 4.2 *How Much to Feed in the ICU: Energy*

Estimating Daily Energy Targets for Patients Recovering From Illness or Injury	
For ICU patients, measure daily energy requirements by indirect calorimetry or calculate with predictive equation[37]	
Correction factors based on inflammatory stress[133]	
Stress Condition	**Correction Factor**
Trauma	1.4 = skeletal or blunt trauma 1.6 = head injury with steroid therapy
Surgery	1.2 = minor surgery
Sepsis	1.6 = major sepsis
Burns	2.1 = major burns

Protein needs likewise increase with severe illness or injury; some patients require up to 2.0 grams of protein per kg of body weight per day **(Table 4.3)**. In a patient who is critically ill, muscle loss can exceed 1.4 kg per day; within 2 weeks, a patient can lose up to half the muscle mass he or she had on admission.[106] Protein is an essential nutrient for maintaining muscle synthesis and for preventing its degradation. Dietary protein intake thus requires special attention during and after hospitalization. Protein targets for adults with disease or injury are in the range of 1.0 to 2.0 g/kg actual body weight per day.[109, 134] To maintain lean body mass and function, adults older than 65 years have higher needs than do younger adults (≥1 g protein/kg BW/day).[109] In burn or multi-trauma patients, protein needs are greater than 2.0 g/kg body weight per day.[37, 109]

Table 4.3 *How Much to Feed in the ICU: Protein*

Estimating Daily Protein Targets for Patients Recovering From Illness or Injury
Guidelines for dietary protein: **1.0 to 2.0 or more g protein/kg BW/day**†
Older patients with acute and/or chronic disease: **1.2 to 1.5 g/kg BW/day**†[109]
Older patients with severe illness and/or marked malnutrition: **as much as 2.0 g/kg BW/day**†[109]
Patients with severe burn injury: **as much as 2.0 g/kg BW/day**†[37]

†Recommendation determined by age, severity of illness or injury, and actual nutritional status
BW=body weight

Special Enteral Feeding Considerations

- **Partial bowel obstruction and motility disorders**, do indeed present challenges to successful EN,but they are not considered absolute barriers.[118] It may be possible to accept gastric residual volumes up to 500ml, and use promotility agents to help reduce gastric residual volumes.[4]

- **Fistulas with a high output volume** may prevent the use of EN, but patients with more proximal or distal fistulas (rather than mid-gut), and low-to-moderate fistula output may be able to tolerate EN when feeding is closely monitored.[118] Fistulas require surgical repair for full resolution of feeding problems.

- **Intractable vomiting and diarrhea** are obstacles to the administration of EN but do not always preclude EN. Vomiting presents challenges in tube placement and maintenance of tube position, and represents a potential aspiration risk to the patient. To overcome such challenges, consider small bowel feedings in conjunction with gastric decompression, or use of prokinetic agents.[118]

  Diarrhea is the most commonly reported GI side effect of EN. For a patient with diarrhea, consider the underlying cause, i.e., whether it is likely caused by infection, inflammation, impaction, or medication. When possible, treat the cause directly, e.g., with an antibiotic for a bacterial infection. Diarrhea can also be lessened by feeding formula with added fiber or a peptide-based formula. An anti-diarrheal medication may be appropriate if gastrointestinal infection is ruled out.[118]

- **Aspiration** of enteral formula or gastric contents can have serious consequences, including pneumonia and lung injury. Tube placement in the small bowel can reduce the risk of aspiration and reflux in critically ill patients.[64] Guidelines recommend elevating the head of the patient's bed to a 30° to 45° angle during feedings where possible.[64, 112] This simple measure can reduce reflux of stomach contents and lessen the likelihood of aspiration pneumonia. However, head-of-bead elevation is contraindicated by spinal instability or hemodynamic instability.[64]

  Elevated gastric residual volume (GRV) has traditionally been associated with risk of vomiting or ventilator-associated pneumonia, but high GRV is no longer considered a reason to "hold" EN.[135] Newer evidence suggests that accepting GRV thresholds up to 400-500 mL can help support adequate EN delivery.[112, 136] However, a French research group recently found that GRV monitoring in critically ill patients on mechanical ventilation led to unnecessary interruption of EN; they therefore advised against use of GRV measurements for these patients.[137]

Fundamentals for Enteral Tube Feeding

While feeding guidelines exist for a wide range of conditions and circumstances, 3 recommendations are fundamental to best-practice advanced nutrition care **(Figure 4.7)**. For most hospitalized patients who need nutrition therapy but cannot eat food: 1) feed enterally, 2) initiate feeding as early as possible after admission, and 3) start feeding at target rate or advance deliberately to target, as tolerance permits.[36, 37, 64, 112]

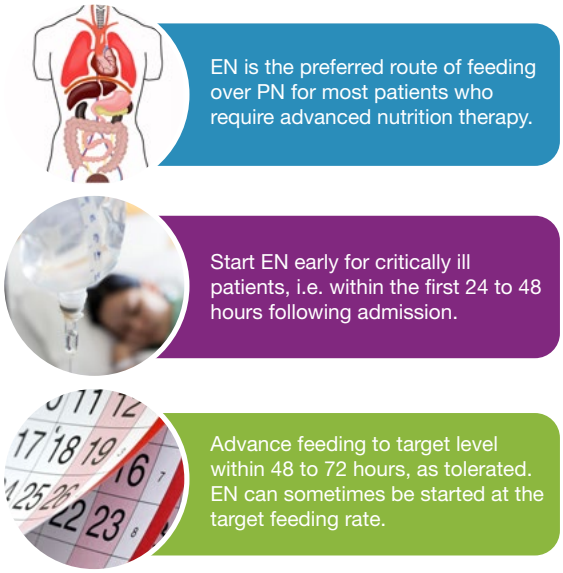

Figure 4.7 *Guidelines Fundamental to Best Nutrition Practice for Hospitalized Patients with Complex Feeding Needs*

Evidence of Health and Financial Benefits With Enteral Nutrition

Lower Risk of Infections and Non-infectious Complications

Many studies provide evidence to support preferential use of EN over PN. One such study was conducted recently at The Johns Hopkins Hospital in Baltimore, Maryland and at two university hospitals in Beijing, China.[127] Researchers enrolled 1831 patients and identified 45.2% of them as at nutritional risk. Patients at risk were divided into 3 groups: those who received no nutrition therapy, those who got PN support, and those who got EN support. Among these groups, the rate of infectious complications was significantly lower in those receiving EN or PN support compared to those who got no nutrition support at all (10.5% versus 18.9%, $P < 0.001$). On further analysis, the group receiving EN support had the lowest rate of infectious complications by far, i.e., 4.1% of EN-fed patients developed infections compared to 13.8% of PN-fed patients and 18.9% of patients who received no nutrition support **(Figure 4.8)**.[127]

Compared to parenteral feeding, enteral feeding is associated with significantly lowered risk for infection in ICU patients.

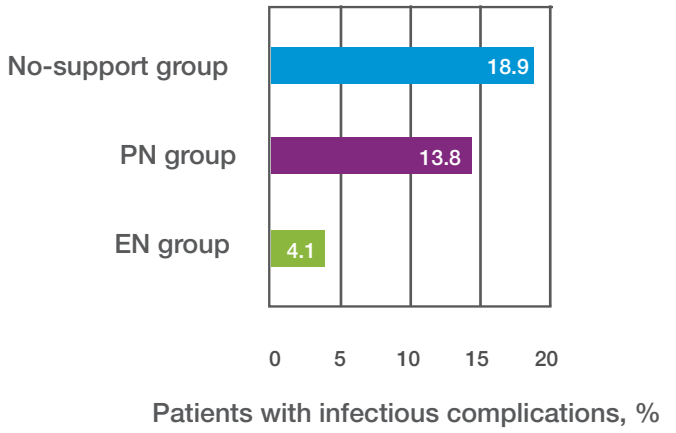

Figure 4.8 *Rate of Infectious Complications in Hospitalized Patients Who Received No Nutrition Therapy, Parenteral Nutrition, or Enteral Nutrition*[127]

The Canadian guidelines for critical care nutrition made a compelling case for use of EN. Based on a meta-analysis of combined results from 9 trials, ICU patients receiving EN had a 42% lower risk of infectious complications than did patients receiving PN (Relative risk [RR] 0.58, 95% CI 0.41- 0.80, P=0.04; **Figure 4.9**).[112]

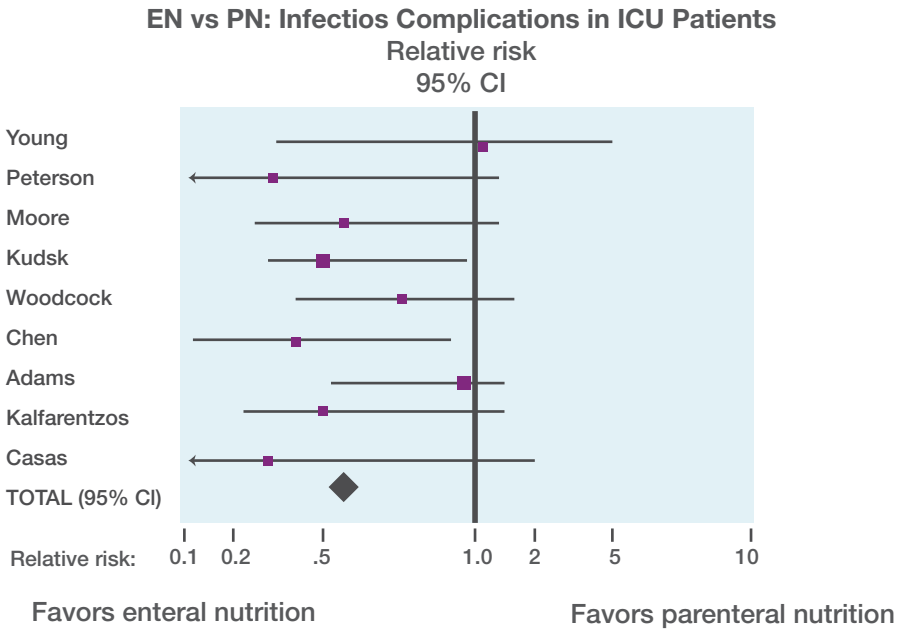

Figure 4.9. *Infectious Complications in ICU Patients Were 42% Lower with EN Than with PN (RR=0.58, 95% CI 0.41-0.80).*[112]

Evidence also shows that critically ill patients fed EN (compared to PN) have significantly fewer major non-infectious complications (RR=0.73, 95% CI 0.59-0.91).[126]

Lower Risk of Death

- **Acute pancreatitis.** Traditionally, patients with severe acute pancreatitis were given PN in order to allow the inflamed pancreas to rest and repair itself. However, Yi and colleagues recently conducted a meta-analysis of results from 8 feeding trials for patients with acute pancreatitis; results showed that patients given EN had reduced risk of death by more than 60% compared to those given PN (RR = 0.37, 95% CI 0.21-0.68).[114] Enteral feeding also cut risk of other serious complications by more than 50%: multiple organ failure (RR=0.44, 95% CI 0.22-0.88), further surgical interventions (RR=0.41, 95% CI 0.23-0.74), and occurrences of infectious complications (RR = 0.46, 95% CI 0.27-0.78). Cochrane researchers likewise conducted a meta-analysis and got similar results; they concluded that EN should be considered the standard of care for patients with acute pancreatitis requiring nutrition therapy.[113]

Evidence of Benefits in Specific Populations

Patients hospitalized for many different reasons have been shown to benefit from enteral nutrition:

- **Trauma.** Enteral nutrition is the first choice for feeding most trauma patients when the GI tract is functional. For patients with gastroparesis, post-pyloric feeding is preferred.[37, 138]

- **General surgery.** Malnourished patients undergoing surgery benefit from pre- and post-operative enteral feeding;[138] Malnourished cancer patients who received pre- and post-operative EN have been shown to have fewer infectious complications and shorter lengths of hospital stay.[139] Patients who are severely malnourished and unable to be fed enterally can benefit from PN given preoperatively, though they are likely to have greater benefit when nutrients are delivered to the GI tract when that is possible.[138]

- **Burns.** Experts agree that EN is usually well tolerated and should be the primary nutrition therapy for patients with burns.[37, 138] Starting EN as early as possible reduces risk of developing gastroparesis later.[138]

- **Crohn's Disease.** Patients with Crohn's disease have been shown to benefit from enteral feeding, especially feeding with oligomeric diets, as long as bowel obstruction is not an issue.[138]

- **Pancreatic fistula.** EN is associated with improved post-surgical healing in patients with pancreatic fistulae; benefits were measured as higher rates of fistula closure and shorter time to closure after surgery. In a recent randomized clinical trial (n=38 patients fed only PN; n=40 patients fed only EN), the patients fed EN had a probability of fistula closure more than twice as high as that in patients fed PN.[140]

Cost Comparisons for Enteral and Parenteral Nutrition

Parenteral nutrition is widely recognized to be more expensive than enteral nutrition. The direct costs of PN are high because PN requires management at multiple levels. For example, PN requires a professional to insert a central catheter infusion line (or peripherally inserted catheter line), pharmacy personnel time and ingredients to compound the PN solution, and costs for delivery of intravenous supplies and equipment.[117] Further, indirect costs of PN results from the extra expenses of longer hospital stays, and the costs for preventing or managing the greater number of health complications.

Direct Costs

According to reports from hospitals in Europe and the US, the direct cost of parenteral feeding formulas can be 4 to 5 times (and in some locations, 30 times) higher than that of commercially available enteral nutrition.[141, 142] One recent study in a regional US hospital found the cost of providing 5 days of parenteral nutrition is $5,000 per patient, or $1000 per patient per day.[142] The costs associated with surgical placement and monitoring of lines, and any costs of treating infectious complications further elevate this high cost.

Costs of Complications

Cangelosi and colleagues recently performed a meta-analysis, which assessed the economic impact of PN compared to EN.[126] For both types of nutrition therapy, the analysis included the rates of adverse health events (mortality, infectious and non-infectious complications), the length of time on nutrition therapy, and the length of stays in the hospital and ICU **(Figure 4.10)**. The 31 RCTs in this meta-analysis included surgical and oncology patients, those suffering burns and trauma, and other critically ill patients. Analyses found that EN-fed patients (compared to PN-fed) had reduced risk of adverse health outcomes and lower use of resources. There were 40% fewer major potentially life-threatening infections (RR = 0.58); and 25% fewer major potentially life-threatening non-infectious complications (RR = 0.73) and minor infections (RR = 0.75).[126]

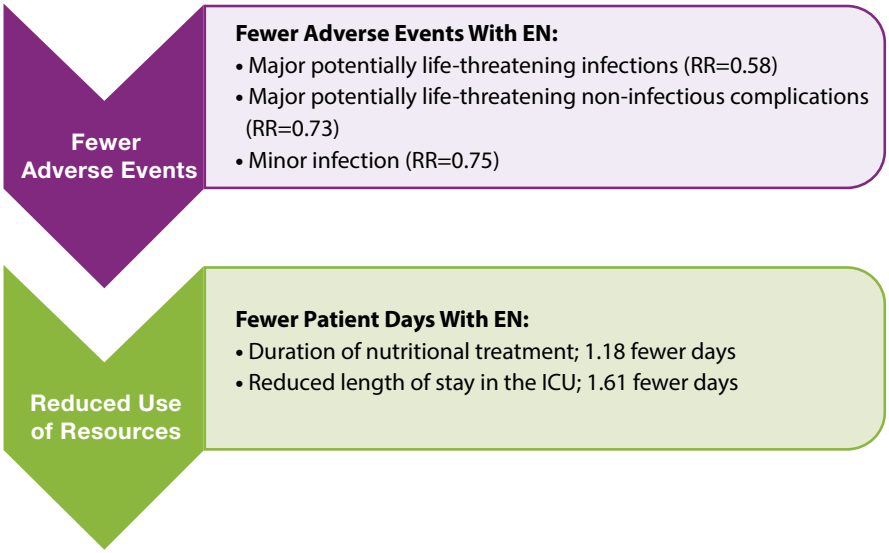

Figure 4.10 *Compared to PN, EN Reduced Risks of Adverse Health Outcomes (Relative Risk [RR] <1) and Lowered Use of Resources*[126]

The costs of providing enteral or parenteral nutrition therapy, treating specific complications, and covering hospital and ICU stays were based on average US cost data at the time of the study.[126] Since adverse events affected only some patients, the costs for those who actually experienced the infection or adverse event ('cost per event') were spread across all patients. With such calculations, the absolute reduction in risk and the cost associated with treating adverse events were also translated to the patient level. Taken together, results of the study showed an aggregate cost savings per patient using EN rather than PN was about $4,000, with about $1,500 of that total due to fewer adverse events and $2,500 due to shorter hospital stays **(Figure 4.11)**.[126]

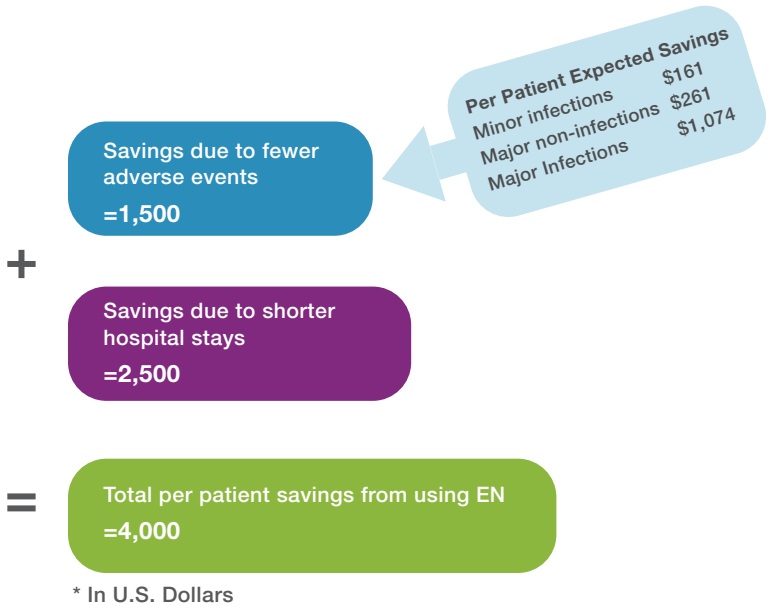

Figure 4.11 *Substantial Savings From Using EN Rather Than PN is a Result of Fewer Adverse Events and Shorter Hospital Stays*[126]

Take-home Messages for Advanced Nutrition Care

- Most hospitalized patients who cannot eat enough food to meet nutrient needs are able to use enteral nutrition, and are thus able to benefit from reduced risk of adverse events, shorter hospital stays, and in some cases reduced risk of death.
- Parenteral nutrition remains a life-saving therapy for patients who do not have a functional or accessible gut or for whom it would be unsafe to use enteral feeding.
- The cost benefits of using therapeutic nutrition are clear, with major savings derived from patients suffering fewer serious complications and being able to leave the hospital or ICU sooner.

FEEDM.E.: OVERALL TAKE-HOME MESSAGES

- Scientific rationale, clinical evidence, and practice guidelines support preferential use of enteral over parenteral nutrition for most hospitalized patients. Parenteral nutrition is properly used only for patients whose GI tracts are not intact or functional.
- Educational tools and programs, practice "champions", repeated and reinforced messages, and monitored outcomes are all strategies to help overcome barriers to change in nutrition practice.
- Validated tools are available to screen and assess nutritional status in hospitalized patients; practice algorithms and pathways guide how, when, how much, and what nutrition interventions to use.
- Use of best-practice nutrition care improves patient outcomes and lower costs of care—for basic nutrition in the hospital and community and for ICU patients with complicated nutrition needs.


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