CHAPTER 6

Nutritional Assessment and Planning in Clinical Care

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For much of the past century, the role of nutrition in health care was eclipsed by achievements that transformed medical intervention. Greater knowledge of micronutrient requirements and advances in public health eradicated most nutrient deficiencies. At the same time, pharmacologic and surgical "cures" relegated nutritional care to a minor position among treatment options (Feldman, 2000). As a result of these and other technologic breakthroughs, nutritional assessment assumed a low priority in patient care. Today, however, a better understanding of the complex interplay between nutrition and health has restored nutritional assessment to a position of key importance in patient care.

DEFINITIONS

Malnutrition, a designation used frequently in discussions of nutritional assessment, is a broad and at times misleading term. In general, *malnutrition* refers to a condition caused by a deficiency of nutrient intake or impaired nutrient absorption. Some definitions of malnutrition include states of overnutrition in addition to conditions marked by nutritional deficits (American Society for Parenteral and Enteral Nutrition [ASPEN], 1995). In hospitals, clinicians describing patients as malnourished often include individuals whose present nutritional intake is less than optimal, even when no obvious nutritional disturbances are present (Allison, 2000). By recognizing potential, as well as actual, nutritional deficits, this more inclusive definition serves a practical purpose when applied to the acutely ill.

Box 6-1 lists diagnostic categories for common nutritional disorders. *Marasmus* and *kwashiorkor* are terms that were once commonly used in clinical practice, but these labels generally apply more accurately to conditions associated with famine than with illness. *Obesity*, on the other hand, has become the most common nutritional problem seen in this country. The poor clinical outcomes associated with excessive body weight justify the inclusion of obesity as a significant nutritional disorder.

BOX 6–1 Diagnostic Categories for Nutritional Disorders

Marasmus: A nutritional disorder caused by a deficit of energy intake, characterized by a cachectic appearance, with extreme muscle wasting and loss of subcutaneous tissue.
Kwashiorkor: A form of malnutrition resulting from an extreme deficiency of dietary protein. Symptoms include hypoalbuminemia, edema, ascites, and fatty liver.
Protein-calorie malnutrition: A severe condition featuring elements of both marasmus and kwashiorkor, caused by a combined deficit of both energy and protein.
Morbid obesity: Excessive body weight that interferes with normal physiologic processes such as breathing. Morbid obesity is associated with an increased incidence of morbidity.

NUTRITIONAL ASSESSMENT IN CLINICAL CARE

Nutritional Assessment for Acutely Ill Patients

The 1970s saw a resurgence of interest in the role of nutrition in health care that first focused on hospitalized patients. A series of studies published at that time provided solid evidence of a problem clinicians had long suspected: nutritional problems and illness frequently appear in tandem. Surveys conducted in hospitals of various patient populations placed the incidence of malnutrition between 30% and 55%, with estimates for elderly hospitalized and institutionalized patients being even higher (Sullivan, Sun, and Walls, 1999; Vellas et al, 2001). This renewed interest in nutrition coincided with important advances in the ability to provide parenteral and enteral nutrition. With the advent of effective methods for nutritional support came the need to identify malnourished patients and recognize risk factors for developing malnutrition during illness.

Morbidity and mortality increase when malnutrition accompanies acute illness. A series of metabolic alterations and physiologic changes takes place, unfavorably affecting the course of illness and recovery. Box 6-2 lists the negative effects of malnutrition during acute illness in more detail. Appropriate nutritional intervention plays a role in offsetting the complications associated with malnutrition and improving clinical outcomes.

Nutritional Assessment in Primary Care

Growing evidence of clear links between dietary factors and chronic disease has also renewed interest in nutritional intervention as a therapeutic modality in primary care. As discussed in Chapter 5, nutritional factors figure prominently in many chronic medical conditions, including coronary heart disease, cancer, diabetes, hypertension, and osteoporosis. In addition, the current epidemic of obesity among all age-groups represents a major health crisis facing this country. The substantial risks for chronic disease and

BOX 6–2 Negative Effects of Malnutrition on Clinical Outcomes

Increased infectious complications
Reduced immune competence
Poor skin integrity
Delayed wound healing
Increased surgical complications
Prolonged length of stay, higher health care costs

increased mortality associated with obesity demands the close attention of primary care practitioners.

GOALS OF NUTRITIONAL ASSESSMENT

Regardless of the clinical setting, the obvious objective of nutritional assessment is to identify patients with poor nutritional status. Every nutritional assessment begins by taking into consideration the age-specific nutritional requirements and developmental issues discussed in Unit I. Beyond that, the intermediate goals and even the method of assessment can vary, depending on the clinical status of the patient and the setting in which the assessment takes place.

Nutritional assessment in primary care, for example, centers on promoting optimal health and preventing nutrition-related disease. This process places emphasis on recognizing dietary and lifestyle factors that affect health. Another key function of nutritional assessment in primary care is to determine the need for therapeutic dietary adjustments for patients with chronic disease. For hospitalized patients the focus shifts toward identifying ways in which acute illness influences nutritional status and the impact of nutritional status on clinical outcomes. Information gathered through nutritional assessment in hospitalized patients should distinguish between the causes and consequences of malnutrition and help in selecting patients most likely to benefit from nutritional support (Jeejeebhoy, 2000).

In all health care settings, nutritional assessment serves as a means for tracking individual trends in nutritional status over time. This capability depends not on any single indicator but on information gathered from a variety of sources. To be truly useful, nutritional assessment must also form the framework for a therapeutic plan and provide a way to evaluate the response to therapy. Table 6-1 provides more detail regarding the goals of nutritional assessment in both primary care and acute care settings.

METHODS OF NUTRITIONAL ASSESSMENT

Initial efforts to bring nutritional assessment to clinical settings relied heavily on assessment techniques used to document the incidence of malnutrition

TABLE 6–1
Goals of Nutritional Assessment

Nutritional Assessment in Primary Care	Nutritional Assessment for Hospitalized Patients
Identify patients with poor nutritional status.	Identify patients with poor nutritional status.
Detect dietary habits that increase the risk for chronic disease.	Detect risk factors for developing malnutrition as a result of illness.
Evaluate impact of existing medical problems on nutritional intake.	Uncover barriers to adequate intake.
Assess patient's level of physical activity.	Evaluate absorption and metabolism of nutrients.
Track trends in growth and body weight.	Predict risk of morbidity related to alterations in nutritional status.
Detect evidence of nutrition-related chronic disease.	Identify clinical consequences of poor nutrition.
Ascertain need for a therapeutic diet.	Recognize patients who will benefit from specialized nutritional support.
Determine need for specific nutrient supplements.	Assess impact of illness on protein and energy requirements.
Detect potential drug-nutrient interactions.	Determine illness-based changes in requirements for specific nutrients.
Evaluate use of herbal dietary supplements.	Detect potential drug-nutrient interactions.
Appraise impact of ethnic, cultural, and religious influences on dietary habits.	Identify need for discharge planning and patient teaching related to nutritional care.
Identify need for nutritional education.	Establish a framework for a nutritional plan of care.
Establish a framework for a nutritional plan of care.	Provide means for serial evaluations to track trends.
Provide means for serial evaluations to track trends.	

in groups, such as the population of a developing nation. These traditional nutritional assessment techniques often proved poorly applicable during illness, however. Some traditional indexes still commonly used as nutritional markers, such as serum albumin, actually better reflect severity of illness than nutritional status (Allison, 2000). Relying too heavily on serum albumin levels can lead to patients being classified as malnourished when in fact disease-related factors account for the abnormal laboratory values.

Comprehensive approaches to nutritional assessment that combine objective data with relevant clinical information are optimal. By drawing on information from a number of sources, clinicians are able to identify nutritional problems accurately and recognize barriers to optimal nutritional intake. Data gathered in the assessment process then serve as the groundwork for incorporating nutritional care into the patient's treatment plan.

Nutritional Screening

In most health care settings, nutritional assessment takes place in two steps: an initial nutritional screening followed by a more formal nutritional assessment when indicated. Routine history and physical examinations incorporate many components for nutritional screening, such as height, weight, blood pressure, blood glucose levels, and lipid profile. In addition, primary care also includes screening for cancer and osteoporosis, conditions in which nutrition or body weight plays a prominent role.

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) also requires that nutritional screening be performed for patients in all types of health care settings. The objective of this mandated screening is to detect actual or potential nutritional deficits rather than determine the risk for nutrition-related disease. The screening process assigns a level of nutritional risk to patients that is based on their answers to a series of simple questions about general health, eating habits, weight loss, physical symptoms, functional status, and social factors.

Health care facilities may use a published screening tool that has been validated through research (see Chapter 4, Figure 4-1, for one example) or develop a screening questionnaire that is more specific to the population served by the facility. Screening tools for neonates and pediatric patients require further development and testing (ASPEN, 2002).

In many cases responsibility for nutritional screening falls to nurses who gather baseline information about patients in hospitals, long-term care, physicians' offices, and home care. The results of the initial nutritional screening determine the need for a more detailed assessment and help prioritize intervention for patients with the most urgent need for nutritional support. Nutritional screening should be repeated at regular intervals, or whenever there is a change in clinical status, in order to detect changes in risk factors over time.

Nutritional Assessment

Nutritional assessment is a comprehensive process that combines objective measurements, a focused history and physical examination, and clinical judgment to arrive at a decision regarding a patient's nutritional status. In multidisciplinary care the various components of the nutritional assessment may be divided among several disciplines or may be carried out by a single individual. Registered dietitians are frequently the most experienced in nutritional assessment, but their availability may be limited in some health care environments such as primary care or in long-term care facilities.

Objective Measurements

The objective data gathered as part of a nutritional assessment include measurements of body composition as well as laboratory values. Evaluation of body composition encompasses a wide variety of diagnostic studies, some of which are relatively sophisticated and costly. Many of these techniques are useful in research studies but have only limited applicability as clinical tools (Shopbell, Hopkins, and Shronts, 2001). Some of the more common techniques for evaluating body composition appear in Table 6-2. Of all the measures of body composition included in nutritional assessment, however, body weight stands out as the best indicator for identifying malnutrition (Shronts, Fish, and Hammond, 1998).

Body Weight

Weighing patients is a simple and inexpensive procedure that serves as a reliable index of nutritional status. In contrast to other techniques for evaluating body composition, measurements of body weight give only general information regarding lean muscle mass or fat stores. Body weight, however, has a strong correlation with the development of disease and, in some cases, prognosis. Deviation of weight from ideal levels, changes in weight over

TABLE 6–2

Evaluation of Body Composition

Method	Description	Uses/Limitations
Body weight	Evaluation of weight in relation to height and changes from usual weight	Accuracy of measurements are affected by frame size and alterations in body water
Anthropometric measurements	**General:** For adults, determination of skinfold thickness in triceps and subscapular area and measurement of midarm muscle circumference (used as an indicator of fat stores and muscle mass); for infants, measurements include length, head circumference, and chest circumference	Requires precision in technique for accurate measurements Available reference tables are not widely applicable to disabled persons or hospitalized patients
	Waist-hip ratio (WHR): A newer technique used to evaluate distribution of body fat; desirable WHR: 0.8 for women and 1.0 for men	Elevated WHR, an indicator of abdominal obesity, is associated with increased health risks
Bioelectrical impedance analysis (BIA)	Analysis of fluid volumes and fat-free body mass based on differences in resistance to an electrical current	May have use in athletics; not fully validated for use in disease states
Dual-energy x-ray absorptiometry (DEXA)	Originally developed for measurement of bone density; may help determine fat and lean body compartments	No available data suggesting DEXA can predict clinical outcomes

time, and the relationship of weight to height all provide useful information regarding current nutritional status. Besides being a key factor in identifying nutritional disorders, body weight helps fulfill two additional objectives of nutritional assessment: determination of energy and protein requirements and evaluation of response to therapy.

IDEAL BODY WEIGHT. A weight that is 20% over or under ideal levels places patients at nutritional risk (ASPEN, 1998). This simple comparison of current weight with desirable weight allows clinicians to judge the degree of overnutrition or undernutrition and to set targets for weight gain or loss. Published standards of ideal body weight are available, but lack of ready access to the tables limits their usefulness in clinical practice. As an alternative, many clinicians use the Hamwi formula, found in Box 6-3, to determine ideal body weight. The calculation is simple and easy to remember. The primary limitation of this formula is its inability to account for differences in frame size, requiring instead that a subjective estimate of frame size be added to the calculation. Despite this shortcoming, the formula is a quick and practical way of obtaining a reasonably accurate estimate of ideal body weight.

Ethnic and cultural differences influence views regarding ideal body weight. African-Americans, for example, generally display a willingness to accept a larger body type, whereas Caucasian Americans tend to place greater emphasis on thinness (Baskin, 2001). This information carries important implications for clinicians who must tailor messages and develop interventions for patients who are overweight or, as is the case with most eating disorders, severely below ideal body weight.

WEIGHT CHANGES. Because the degree of obesity and distribution of body fat are key indicators of health risks, much attention in primary care focuses on maintaining a healthy weight. Patients should be weighed at each office visit, and results should be documented in a way that allows trends to be tracked easily. The growth charts used for pediatric patients serve this purpose, but a similar standardized tool does not exist for adults. Using a separate flow sheet to record body weight can prevent these measurements from being "lost" among the progress notes in the patient's chart.

BOX 6–3 Formula for Determining Ideal Body Weight

Male: 106 pounds/5 feet plus 6 pounds for every inch over 5 feet ± 10% based on frame size

Female: 100 pounds/5 feet plus 5 pounds for every inch over 5 feet ± 10% based on frame size

Data from Hamwi GJ: Therapy: changing dietary concepts: In Danowski TS, editor: *Diabetes mellitus: diagnosis and treatment,* vol 1, New York, 1964, American Diabetes Association.

Counseling and intervention should begin early, as soon as a trend toward excessive weight gain is detected. A detailed discussion of the evaluation and treatment of obesity in school-age children and adolescents appears in Chapter 3, and similar guidelines for adults appear in Chapter 5.

Regardless of whether body weight is over or under ideal standards, changes in weight from usual levels carry important prognostic value. For adults, unintentional weight loss is more serious than weight gain during illness, and for infants and children a downward shift in percentile ranking is cause for concern even if weight gain continues. Both the amount of weight lost and the time frame in which the weight loss occurred are significant variables. Guidelines such as those found in Table 6-3 aid in interpreting the significance of weight loss. Involuntary weight loss typically carries a greater nutritional risk than intentional weight loss, provided that the patient followed a weight loss plan based on sound nutritional practices. The current popularity of some fad diets raises the likelihood that even intentional weight loss may be associated with nutritional deficits and poor clinical outcomes.

BODY MASS INDEX. Body mass index (BMI), a ratio of weight to height, is another way of evaluating body weight that is coming into wide use in clinical practice. Current guidelines for weight gain in pregnancy, for example, are based on the woman's prepregnancy BMI. BMI provides an indication of the degree of adiposity present. The formulas for calculating BMI appear in Table 6-4, along with ranges for interpreting the results. However, numerous BMI calculators, such as the one listed at the end of this chapter, can be found online to make quick work of this somewhat cumbersome calculation. An elevated BMI has a strong correlation with cardiovascular disease and other chronic diseases, including diabetes, cancer, hypertension, and osteoarthritis.

BMI is used differently in children than in adults to account for gender- and age-related variations in body fat that occur as children grow. BMI does not increase in a direct linear fashion in children. Instead, BMI declines in the preschool years and then increases through adolescence and adulthood. Therefore BMI for children is plotted on a chart similar to the commonly used growth charts and expressed as a percentile ranking (examples appear

TABLE 6–3

Interpreting Involuntary Weight Loss

Time Frame	Severe Weight Loss (% of Body Weight)
1 week	>2
1 month	>5
3 months	>7.5
6 months	>10

in Chapter 3). These percentile rankings can be used for adolescents through puberty to the age of 20 (Centers for Disease Control and Prevention, 2001).

Although BMI is an improvement over standard weight-for-height measurements, the calculation does have some shortcomings. BMI correlates well with adiposity but cannot be interpreted as a precise percentage of body fat. Gender and body type influence BMI calculations. BMI tends to overestimate body fat for muscular athletes, for example, and underestimate fat stores in older persons and others who have experienced significant muscle wasting. In addition, BMI does not take into account ethnic variations in body composition and the impact that this has on health risk. For instance, a 10% increase in mortality occurs for Caucasian women with a BMI of 25 to 28, but no elevation in risk occurs for African-American women with a BMI in this range (Baskin, 2001). Further research may lead to BMI formulas for specific patient populations or to the development of cutoff points for overweight and obesity that more closely reflect health risks for a given ethnic group.

Laboratory Values

In primary care settings the lipid profile is perhaps the most frequently ordered laboratory test with nutritional implications. Other routine laboratory tests such as a complete blood count, blood glucose, and electrolyte levels also provide valuable nutritional information. These measures remain important for hospitalized patients, but nutritional assessment during acute illness also places much emphasis on evaluating the status of serum protein concentrations.

SERUM PROTEIN CONCENTRATIONS. The laboratory tests most widely used in the nutritional assessment of hospitalized patients are measurements of serum protein concentrations, specifically albumin, transferrin, and prealbumin. These circulating proteins are often referred to as visceral proteins to distinguish them from muscle protein mass. Visceral proteins

TABLE 6–4

Calculating Body Mass Index

Formula	Interpretation (Ranges)	
Metric: $\text{BMI} = \dfrac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$	18.5	Underweight
	18.5-24.9	Normal
	25-29.9	Overweight
English: $\text{BMI} = \dfrac{\text{Weight (inches)}}{\text{Height (pounds}^2\text{)}} \times 703$	30-39	Obese
	>40	Morbid obesity

Data from National Heart, Lung, and Blood Institute: *Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report*, NIH Pub No 98-4083, Washington, DC, 1998.

are synthesized by the liver and act as transport proteins in a variety of metabolic processes. Of the three proteins, albumin has been the focus of the most extensive research.

Studies show a strong association between low serum albumin levels and increased risk of complications and mortality. Unfortunately, serum albumin is not a reliable indicator of nutritional status during illness. Numerous clinical variables such as hydration status, organ function, infection, and metabolic stress influence serum albumin levels, making this protein a better marker of severity of illness than of nutritional status (Jeejeebhoy, 2000). The long half-life of albumin (14 to 20 days) prevents the use of this protein in monitoring response to intervention. Transferrin has received less study than albumin, but it has a shorter half-life (8 to 10 days), which may improve its usefulness as a nutritional marker, particularly in patients with liver disease (Shopbell, Hopkins, and Shronts, 2001).

Prealbumin, the third protein often used in nutritional assessment, is a transport protein for thyroid hormones. Prealbumin has a very short half-life, only 2 to 3 days, potentially increasing its role in monitoring changes in nutritional status. Although prealbumin levels respond to variations in nutritional intake, concentrations are also strongly influenced by clinical factors, an issue that makes interpretation of laboratory results difficult (Jeejeebhoy, 2000).

Serum levels of visceral proteins fall in response to an inflammatory process regardless of nutritional status. During inflammation the liver preferentially produces acute-phase proteins, reducing synthesis of visceral proteins. Some investigators have suggested that comparing the level of an acute-phase protein, such as C-reactive protein, with visceral protein values can help determine whether low protein levels are related to an inflammatory process or are the result of poor nutritional status (Manelli et al, 1998; Vehe et al, 1991). This technique requires further study, however, before moving into routine clinical use (Jeejeebhoy, 2000).

NUTRIENT LEVELS. Although nutritional assessment does not routinely include measurement of nutrient levels, clinical circumstances may warrant a more in-depth investigation of the status of specific nutrients. Iron studies, for example, may be in order for patients with microcytic anemia. Similarly, the presence of peripheral neuropathy warrants an evaluation of vitamin B_{12} levels. An evaluation of zinc levels may be in order for patients with chronic diarrhea. In each case, information gained from the patient's history and findings of the physical examination guide the decision regarding the need for further laboratory testing.

Health History

Although laboratory tests help detect nutrient deficiencies, thoughtful questioning of the patient often uncovers the mechanisms underlying the problem. The patient interview provides an opportunity to gather historical information and to explore the patient's perception of any health or nutritional problems that are present. This process is an indispensable aspect of the nutritional assessment, perhaps even the most important aspect. A health history focused on nutritional assessment includes medical, social, and nutritional components, each providing insight into the causes and contributing factors of nutritional problems. As Table 6-5 shows, many of the categories included in the history component of a nutritional assessment are similar to those asked in any patient interview. In this case, however, the focus of the questioning shifts to gaining specific information about actual or potential nutritional deficits and to gauging the impact of alterations in nutritional status on clinical outcomes.

Diet History

A detailed diet history serves as a valuable tool that can provide much information about eating habits, nutritional imbalance, potential deficiencies, and reasons for inadequate intake during illness. In acute care settings a registered dietitian is the member of the health care team most skilled in this process. Unfortunately, few primary care settings have this resource available. At a minimum the patient interview should include questions aimed at detecting dietary habits closely associated with increased health risks. Table 6-6 lists key areas of attention for a focused diet history. By comparing responses with recommendations outlined in Nutritiion and Your Health *Dietary Guidelines for Americans* (USDA, USDHHS, 2000) (see Chapter 5), clinicians gain a sense of the quality of the patient's diet. Answers to general questions will not yield specific numerical values regarding nutrient consumption but will help identify areas that need improvement, as well as educational needs. To use office visit time most efficiently, this information could be gathered using a questionnaire that the patient completes in the waiting room (Hark and Deen, 1999). The specific nutritional information gathered varies somewhat, depending on the age and developmental stage of the patient population.

Interactive Healthy Eating Index

Motivated patients with access to a computer can make use of the Interactive Healthy Eating Index (IHEI), an online dietary assessment tool sponsored by the U.S. Department of Agriculture. Participants provide 1 day's worth of dietary information and receive a "score" on the overall diet quality for that day. The tool evaluates total fat, saturated fat, cholesterol, and sodium consumption. Food items listed include ethnic and vegetarian foods, as well as brand names and processed foods. Participants are encouraged to obtain an IHEI score over a period of several days to improve the accuracy of the diet evaluation. The site accommodates up to 20 daily scores for each participant. In addition to providing feedback concerning diet quality, the IHEI also includes nutritional messages and links to nutritional information, making this a valuable educational resource. The Internet address for the IHEI appears in the list of Internet Resources at the end of this chapter.

TABLE 6–5

Incorporating Nutritional Assessment Into the Patient History

Category	Pertinent Nutritional Information
Medical History	
Diagnosis	Disease states with nutritional influences, including coronary heart disease, diabetes, and cancer, as well as those that carry a high nutritional risk, such as cancer, AIDS, and neuromuscular disorders
Organ function/comorbid conditions	Conditions that affect nutrient absorption and metabolism, including gastrointestinal disorders, diabetes, renal insufficiency, and hepatic failure
Previous surgery	Procedures that affect nutrient absorption, such as gastrectomy or ileal resection
Nutritional requirements	Age-related factors, as well as those that increase energy and protein needs, such as fever, wounds, or conditions associated with nutrient losses
Medication profile	Gastrointestinal side effects that interfere with appetite; drug-nutrient interactions
Alternative treatments	Use of herbal remedies or dietary supplements with potential for adverse side effects, or interaction with nutrients or conventional drugs
Symptom management	Complaints, such as anorexia, nausea, vomiting, pain, or fatigue, that can have negative effects on food intake if not effectively managed
Physical activity	Routine exercise habits versus sedentary lifestyle; indicates level of cardiopulmonary fitness and degree of muscle mass
Functional status	Indication of muscle strength and ability to carry out activities of daily living (Inability to eat without assistance presents a high risk.)
Social History	
Substance abuse	Direct effects on nutritional status by reducing food intake or indirect impact by altering nutrient absorption
Financial status	Resources for purchasing and preparing food; availability of community support, such as food stamps, Meals on Wheels, school lunch programs
Support systems	Social support versus social isolation
Nutritional History	
Changes in body weight	Percent change from usual weight; deviation from ideal weight
Barriers to nutrition	Impact of symptoms related to illness; food intolerance
Eating patterns	Recent change in appetite; need for therapeutic diet; vegetarian diet; fad diets; idiosyncratic eating behavior
Food records/intake diary	Calorie counts; analysis of intake to identify nutrient deficiencies; dietary habits associated with increased risk for chronic disease
Oral hygiene	Condition of teeth, gums, and mucous membranes
Swallowing ability	Risk of aspiration; need for diet modification or tube feeding
Ethnic and religious influences	Recognition of food taboos; ability to accommodate food preference in clinical settings

TABLE 6–6

Conducting a Focused Diet History

Area of Focus/Guideline	Dietary Habits Associated With Increased Health Risk
Total fat, saturated fat, cholesterol, and *trans*-fatty acids: Older than 2 years of age—total fat, 30% of kcal; saturated fat, <10%; cholesterol, 300 mg	Frequent consumption of red meat, poultry with skin, and processed meats such as bacon, sausage, and cold cuts; >2 daily servings Use of full-fat dairy products Frequent consumption of fried foods and salad dressings Frequent use of egg yolks and whole eggs (213 mg cholesterol) High intake of partially hydrogenated vegetable oils, including margarine, solid shortenings, and processed baked goods
Fruit and vegetables: 2 fruit, 3 vegetable servings daily	Consumption of less than "5 a day" (minimum level) Lack of variety in fruit and vegetable consumption
Calcium: Based on RDA	Dislike, intolerance, or avoidance of dairy products Low intake of nondairy sources of calcium
Sodium: 2400 mg of sodium daily, equivalent to 1 teaspoon of table salt	Reliance on processed food and packaged meals Use of sodium-rich condiments: soy sauce, ketchup, pickles, olives Preference for salty snacks High frequency of meals consumed away from home
Fiber: Older than 2 years of age—age + 5 g; adults—20-30 g daily	Low intake of fruits and vegetables, dry beans, and peas Preference for refined grain products rather than whole-grain foods
Beverages	Daily alcohol consumption >1 drink for women, 2 drinks for men High consumption of fruit juice and soft drinks
Food preparation	Use of saturated fat for frying and baking Preference for salted, pickled, or smoke-cured foods Frequent consumption of charbroiled food High intake of foods containing nitrite preservatives

Data from US Department of Agriculture, US Department of Health and Human Services: *Nutrition and your health: dietary guidelines for Americans*, ed 5, Home and Garden Bull No 232, Washington, DC, 2000, US Government Printing Office.
RDA, Recommended Dietary Allowance.

Physical Examination

Standard physical assessment procedures are used in evaluating nutritional status. Although the process of the physical examination does not change, the examiner must learn to interpret findings within the context of the nutritional assessment. Severe malnutrition produces a variety of physical manifestations (Shopbell, Hopkins, and Shronts, 2001). The most notable effects occur on the skin, mucous membranes, and hair. Rashes, petechiae, bruises, and other lesions of the skin; changes in the lips, gums, and tongue; and alterations in the appearance of the hair may all be evidence of nutrient deficiencies. These signs of malnutrition are often nonspecific. Therefore the appearance of suspicious physical signs requires correlation with the patient's history and clinical condition and, whenever possible, confirmation through diagnostic tests (ASPEN, 2002).

Physical manifestations of nutrient deficiencies typically indicate a state of advanced depletion. In clinical settings, signs of deficiency for specific nutrients occur far less frequently than evidence of a more general deficit of protein and energy intake. Many individuals who eat poorly take multivitamin supplements regularly, preventing vitamin and mineral deficiencies even as severe protein-calorie malnutrition develops. As a result, the focus of the physical examination often rests less with identification of specific nutrient deficiencies than with acquiring a more global impression of the patient's current nutritional status and the impact of nutritional factors on the patient's medical condition. Muscle wasting, poor skin integrity, and loss of subcutaneous tissue are typical findings associated with long-standing protein and energy deficits. Obesity, an increasingly common condition, is strong evidence of a nutritional imbalance, as well as an increased health risk. Table 6-7 lists signs of these nutritional alterations with examples of the clinical implications these problems carry.

Subjective Global Assessment

Subjective global assessment (SGA) is a form of nutritional assessment proposed as a simple, practical method for evaluating nutritional status in clinical settings. As the name implies, SGA draws on subjective information obtained through the history and physical examination without using objective data such as laboratory tests or anthropometry (Detsky et al, 1987). SGA focuses on five key areas of information to determine nutritional status as outlined in Table 6-8. The aim of SGA is to detect patients for whom nutritional status is likely to affect clinical outcomes and to identify patients who would benefit from nutritional intervention. Research has validated SGA as a good predictor of complications in some clinical settings, highlighting the importance of clinical judgment in detecting significant nutritional problems. SGA requires further research to establish its applicability to a broader range of patient populations (ASPEN, 2002).

ESTABLISHING ENERGY AND PROTEIN REQUIREMENTS

Establishing measurable nutritional goals and incorporating these goals into the patient's plan of care constitute the final phase of nutritional assessment. The nutritional plan of care must be congruent with broader therapeutic goals and with the wishes and beliefs of the patient. To be truly useful, the nutritional plan must include an outline of nutritional interventions aimed at achieving the established goals. Dietary modifications, requirements for specific nutrients, routes and methods for nutritional support, and educational needs are examples of items included in a comprehensive nutritional

TABLE 6–7

Physical Signs of Alteration in Nutritional Status

Physical Sign	Examples	Clinical Implications
Muscle wasting	Loss of bulk and tone of muscle groups Concave appearance of temporal region of face (provides evidence of marked muscle wasting even in presence of edema)	Causes weakness, reducing stamina and functional status May impair respiratory effort and ability to cough forcefully to clear secretions
Poor skin integrity	Poor turgor; friable; delayed healing Edema associated with severe hypoalbuminemia	Increases risk of developing pressure ulcers, wound dehiscence, and anastomotic leaks
Loss of subcutaneous tissue	Loose, elongated skinfolds, most apparent on abdomen and in triceps area of arm Prominent appearance of ribs, scapulae, vertebrae, and pelvis	Depletion of adipose tissue represents long-standing energy deficit Loss of reserves that normally serve as an energy source for acute nutritional shortages during illness
Obesity	Excess accumulation of body mass and adipose issue	Increases risk for chronic illness Risk varies with pattern of distribution of adipose tissue; truncal obesity carries a more serious risk than fat deposits located primarily on hips and buttocks

TABLE 6–8

Elements of Subjective Global Assessment

Category	Focus
Weight	Change in weight over previous 6 months Pattern of weight change: stabilization versus ongoing change
Dietary history	Deviation of intake from usual eating patterns; duration and degree of change
Gastrointestinal symptoms	Complaints of anorexia, nausea, vomiting, or diarrhea Persistent symptoms (longer than 2 weeks)
Functional capacity	Range from full energy to bedridden
Physical examination	General appearance Muscle wasting Subcutaneous tissue loss Edema, ascites Condition of skin, hair, mucous membranes

Data from Detsky AS: Is this patient malnourished? *JAMA* 272(1):54-58, 1994.

plan. The plan should also state whether weight gain, reduction, or maintenance is expected, identifying a target for body weight when possible. Of all the details provided in a nutritional plan of care, however, the most basic, and in some ways most important, information is the estimation of the patient's caloric (energy) and protein requirements. In healthy states this process is fairly straightforward. Published recommendations, as discussed in Unit I, are available to guide this process. However, these standards are poorly applicable to hospitalized patients, for whom metabolic stress alters nutritional requirements.

Determining Caloric Requirements

The process used to set goals for caloric intake begins with determining baseline, or resting, energy expenditure. The next step takes into account factors that influence energy expenditure. The patient's current body weight, activity level, disease state, and degree of metabolic stress influence energy expenditure in clinical settings. Goals for energy intake must also reflect the additional calories needed for patients who are pregnant, lactating, or growing. The need to promote weight gain or loss also comes into play. Taken together, these factors create much individual variability in energy expenditure during illness, adding to the difficulty of setting goals for caloric intake.

Numerous methods for determining energy expenditure exist, although none are ideal in all situations. The options include a technique known as indirect calorimetry, regression equations for calculating metabolic rate, and using simple weight-based calculations to establish a general range for caloric intake. The clinical setting and patient characteristics determine which of these methods is most appropriate to use. A key factor in choosing a method to establish energy expenditure is the degree of accuracy required. Each technique relies on professional judgment to account for clinical variables that affect energy expenditure, a factor that influences the accuracy of each method available for determining energy expenditure.

Weight-Based Calculations

Many clinicians rely on a simple "rule of thumb" that gives a general range for caloric intake that is based on body weight. For adults in clinical settings, a range of 25 to 30 kcal/kg of body weight provides a reasonable estimate of energy expenditure. Although this approach is convenient and easy to use, the calculation makes no attempt to account for variations in age, gender, or body composition and may have a wide margin of error for individuals who are not at ideal weight or who are undergoing a high degree of metabolic stress. Despite these drawbacks, this simple calculation provides a reasonable starting point for determining energy goals. The calculation should always be used in combination with other techniques whenever the circumstances of the patient's illness raise uncertainty regarding the accuracy of the general range for caloric intake.

Infants and growing children require a much higher energy intake per kilogram of body weight than adults. Table 6-9 shows examples of recommended energy intake based on age and weight. Energy requirements for healthy children vary widely, with more pronounced fluctuations occurring during illness. At best, recommendations for energy intake for children serve only as a general guide. Satisfactory growth provides the best indication of the adequacy of energy intake in children (American Academy of Pediatrics [AAP], 1998).

Harris-Benedict Equations

Although numerous formulas for predicting energy expenditure exist, the Harris-Benedict equations (Harris and Benedict, 1919) remain the most widely used method for calculating resting energy expenditure (REE). The number obtained using a Harris-Benedict equation must be multiplied by factors designed to adjust for activity and the stress of illness (Box 6-4). Research has shown that the Harris-Benedict equations tend to overestimate energy expenditure by as much as 15% (Frankenfield, 2001). However, alternative equations developed in an effort to correct for this problem also contain unexplained error. Clinicians must use professional judgment in applying stress factors and in establishing energy goals based on the Harris-Benedict equations.

Indirect Calorimetry

Indirect calorimetry provides the most accurate method for determining energy expenditure. Although this technique has limited use in primary care settings, indirect calorimetry helps to establish energy needs for critically ill patients and in situations where the impact of illness is difficult to gauge. With indirect calorimetry an instrument known as a metabolic cart measures oxygen consumption and carbon dioxide production to provide a measure

TABLE 6–9

Recommended Dietary Allowances for Energy for Children

Age	RDA (kcal/kg)	RDA (kcal/24 hours)
0-12 months	110-95	400-1200
1-3.9 years	105-100	900-1900
4-7.9 years	92-83	1300-2400
8-9.9 years	69	1400-2500
10-11.9 years (male)	61	1700-2900
12-17.9 years (male)	47	2000-3600
10-14.9 years (female)	50	1700-2900
15-17.9 years (female)	41	1700-3000

Modified from Food and Nutrition Board, Institute of Medicine: *Recommended dietary allowances*, ed 10 Washington, DC, 1989, National Academy Press.
RDA, Recommended Dietary Allowance.

BOX 6–4 Harris-Benedict Equations

Male: REE = 66 + 13.75 (W) + 5.0 (H) – 6.78 (A)
Female: REE = 655 + 9.6 (W) + 1.8 (H) – 4.68 (A)

Activity factor	REE × 1.25
Simple starvation	REE × 0.85
Sepsis	REE × 1.2 to 1.4
Multiple trauma	REE × 1.40
Systemic inflammatory response	REE × 1.50

Data from Sax HC, Souba WW: Nutrient goals and macronutrient requirements. In Merritt RJ et al, editors: *The A.S.P.E.N. nutrition support practice manual*, Silver Spring, Md, 1998, American Society for Parenteral and Enteral Nutrition.
REE, Resting energy expenditure; *W*, weight in kilograms; *H*, height in centimeters; *A*, age in years.

of energy expenditure. The primary advantage of indirect calorimetry in clinical settings is that the measurement reflects the changes in metabolic rate produced by illness. In most cases the study is performed for a fixed period of time, with the patient in a fasting state and at rest. Under these conditions indirect calorimetry measures the patient's REE. Clinicians must multiply the REE by factors designed to account for variations in metabolic rate that occur outside the study period. Activity and changes in body temperature associated with illness account for much of the fluctuation in metabolic rate that takes place throughout the day. Food consumption also boosts a person's metabolic rate by 5% to 10%. Indirect calorimetry captures this diet-induced increase in metabolic rate for patients receiving enteral or parenteral nutrition during the study.

In measuring gas exchange, indirect calorimetry also generates a value known as the respiratory quotient (RQ), a ratio of carbon dioxide produced to oxygen consumed. The RQ supplies specific details regarding nutrient metabolism and reflects the degree to which energy intake meets energy needs. In critically ill patients this measurement acts as a guide for judging the appropriateness of nutritional support regimens, especially during weaning from ventilators.

Because oxidation of each substrate requires a different amount of oxygen and produces a different amount of carbon dioxide, the RQ is an indication of the primary fuel being used (Shopbell, Hopkins, and Shronts, 2001). For example, the RQ for protein is 0.8, the RQ for fat is 0.7, and the RQ for carbohydrate is 1.0. An RQ exceeding 1.0 indicates that the patient is being overfed and that excess energy is being stored as fat. The high RQ associated with carbohydrate metabolism and fat deposition can have negative effects on respiratory function, especially in patients with pulmonary insufficiency. An RQ of 1.0 signals a need to limit calories provided as carbohydrate, whereas an RQ greater than 1.0 reflects overfeeding. Although indirect calorimetry enhances patient care in specific clinical situations, the cost of the equipment and the need for specially trained personnel limit the use of this technique. When indirect calorimetry is not available, clinicians turn to formulas or published tables to estimate energy expenditure.

Protein Requirements

Requirements in Health and Illness

Protein plays a vital role in maintaining body structure and function, metabolic activity, tissue integrity, and competence of the immune system. Because injury and illness can dramatically alter protein needs, accurately determining protein requirements is a key aspect of planning nutritional care during illness. Establishing goals for protein intake is also the starting point for designing nutritional support regimens. Once protein needs are determined, the allocation for nonprotein calories can be made more easily.

Current guidelines recommend that healthy adults with normal renal function receive protein in the amount of 0.8 g/kg/day, although protein needs may decline somewhat with age. On the other hand, the metabolic stress associated with illness and injury can greatly increase protein requirements. Table 6-10 provides guidelines for protein intake for various clinical conditions. When protein intake is increased to meet elevated metabolic demands, a corresponding boost in energy intake must also occur to allow the protein to be used effectively. During severe illness, experts recommend giving 150 kcal for every gram of nitrogen (6.25 g of protein yields 1 g of nitrogen) to prevent protein from being metabolized primarily for energy.

Protein requirements for children change with age. As Table 6-11 shows, the highest requirements for protein occur early in life and then gradually decline during the preschool and school years (AAP, 1998). Protein needs increase during periods of catch-up growth and during illness. Protein requirements for critically ill or injured children generally are approximately 1.5 g/kg (ASPEN, 2002).

TABLE 6–10

Guidelines for Protein Intake for Adults

Clinical Condition	Recommended Intake (g/kg/day)
Healthy adult, normal organ function	0.8
Postoperative	1.0-1.5
Sepsis	1.2-1.5
Multiple trauma	1.3-1.7
Major burn	1.8-2.5

Data from Sax HC, Souba WW: Nutrient goals and micronutrient requirements. In Merritt RJ et al, editors: *The A.S.P.E.N. nutrition support practice manual*, Silver Spring, Md, 1998, American Society for Paternal and Enternal Nutrition.

TABLE 6–11

Guidelines for Protein Intake for Healthy Children

Age	Recommended Intake (g/kg/day)
Full-term infant	2-3
Ages 1-10 years	1.0-1.2
Male adolescent	0.9
Female adolescent	0.8

Data from American Society for Parenteral and Enteral Nutrition, Board of Directors: Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients, *JPEN J Parenter Enteral Nutr* 26(1 suppl):15A–138SA 2002.

Nitrogen Balance

Nitrogen balance provides an indication of the adequacy of protein intake by comparing nitrogen intake with nitrogen excretion. Positive nitrogen balance is a state in which nitrogen intake exceeds nitrogen excretion, suggesting that nutritional intake is sufficient to promote anabolism and to preserve lean body mass. Negative nitrogen balance, on the other hand, is characterized by nitrogen excretion that exceeds intake. In this situation the excess nitrogen output reflects erosion of muscle tissue. Ideally, patients should be in positive nitrogen balance, although achieving this goal may not always be possible for critically ill patients. Nitrogen intake is determined by dividing protein intake (in grams) by 6.25. Ascertaining nitrogen output requires a lab test known as UUN, an analysis of a 24-hour urine collection for urea nitrogen content, which accounts for most of the body's nitrogen losses. An additional 4 g of nitrogen is added to the urinary nitrogen output to account for nonurea nitrogen losses. The formula for calculating nitrogen balance appears in Box 6-5. Because nitrogen excretion varies with severity of illness, nitrogen balance studies are most helpful when repeated at regular intervals.

ASSESSING NEEDS FOR NUTRITIONAL EDUCATION

Besides providing an appraisal of nutritional status and dietary quality, nutritional assessment reveals many opportunities for nutritional education. As discussed in Chapters 5 and 9, the need for therapeutic diets presents an

BOX 6–5 Calculating Nitrogen Balance

$$\text{Nitrogen } (N_2) \text{ balance} = \frac{\text{Protein intake (grams)}}{6.25} - (\text{grams urine urea } N_2 \text{ output} + 4 \text{ g } N_2 \text{ nonurea } N_2 \text{ losses})$$

obvious need for nutritional counseling. However, nutritional assessment also gives clinicians the opportunity to discover a need for more basic nutritional information. For instance, many consumers have only a vague appreciation of the eating habits most closely associated with health risks, such as those presented in Table 6-6. Others lack complete knowledge of good food sources of specific nutrients such as calcium and iron or, conversely, remain unaware of the fat or sodium content of certain foods. At each patient encounter, clinicians should also take the opportunity to provide information specific to the patient's age or developmental stage. Examples of this type of teaching include promotion of breastfeeding, the importance of folic acid supplementation for women of childbearing age, the problems associated with excessive fruit juice and soft drink consumption in children and teenagers, and the benefits of physical fitness for all age-groups. The role of vitamin and mineral supplementation and use of herbal dietary supplements is another topic of interest for many patients. Finally, at a time when consumers receive much conflicting and confusing advice about diet, helping patients separate nutritional quackery from sound advice stands out as an educational responsibility of the entire health care team. Thoughtful questioning and careful listening to patients' answers during nutritional assessment help to identify learning needs and set priorities for nutritional education.

SUMMARY

As the interplay between nutrition and illness becomes better understood, assessing the nutritional status takes on greater importance in patient care. In primary care settings, nutritional assessment provides information regarding the quality of the patient's diet and the patient's risk for developing chronic disease. During acute illness the focus of nutritional assessment places less emphasis on measuring degrees of malnutrition than on identifying the causes of nutritional problems and developing strategies to improve clinical outcomes. Nutritional assessment provides a fuller understanding of the risks for unfavorable clinical outcomes and forms the framework for developing a therapeutic plan. The educational needs uncovered during nutritional assessment present a challenge that demands the attention of the entire health care team.

INTERNET RESOURCES

Body Mass Index Calculator
http://www.cdc.gov/nccdphp/dnpa/bmi/calc-bmi.htm

Interactive Healthy Eating Index: An Online Dietary Assessment Tool
http://www.forcevbc.com/good/food.htm

National Heart, Lung, and Blood Institute: Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III)
http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm

National Heart, Lung, and Blood Institute: The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults
http://www.nhlbi.nih.gov/guidelines/obesity/practgde.htm

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