CLINICAL MANAGEMENT extra

The Role of Nutrition for Pressure Ulcer Management: National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance White Paper

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This continuing educational activity will expire for physicians on April 30, 2016.

PURPOSE:

To review the 2014 *Pressure Ulcer Prevention and Treatment Clinical Practice Guideline* nutrition strategies.

TARGET AUDIENCE:

This continuing education activity is intended for physicians and nurses with an interest in skin and wound care.

OBJECTIVES:

After participating in this educational activity, the participant should be better able to:

1. Describe the risk factors for and the pathophysiology of pressure ulcers (PrUs).

2. Identify evidence-based nutrition strategies for PrU management.

ABSTRACT

Nutrition and hydration play an important role in preserving skin and tissue viability and in supporting tissue repair for pressure ulcer (PrU) healing. The majority of research investigating the relationship between nutrition and wounds focuses on PrUs. This white paper reviews the 2014 National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance Nutrition Guidelines and discusses nutrition strategies for PrU management.

KEYWORDS: pressure ulcers, nutrition assessment and wounds, nutrition guidelines for pressure ulcers, tissue repair and healing

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INTRODUCTION

Nutrition and hydration play an important role in preserving skin and tissue viability and supporting tissue repair processes for pressure ulcer (PrU) healing. The majority of research investigating the relationship between nutrition and wound prevention and healing has focused on PrUs. The 2014 (second) edition of the *Pressure Ulcer Prevention and Treatment Clinical Practice Guideline* was a collaborative effort between the National Pressure Ulcer Advisory Panel (NPUAP), the European Pressure Ulcer Advisory Panel (EPUAP), and the Pan Pacific Pressure Injury Alliance (PPPIA). The goal of this international alliance was to develop evidence-based recommendations for the prevention and treatment of PrUs that could be used by healthcare professionals globally. The 2009 research was reviewed, confirming that the previous nutrition guidelines were appropriate. Current research on the impact of malnutrition and the role of conditionally essential amino acids are included in the 2014 guidelines. The purpose of this white paper is to review the 2014 nutrition guidelines and discuss nutrition strategies for PrU management.

COMPROMISED NUTRITIONAL STATUS

Inadequate dietary intake and poor nutritional status have been identified as key risk factors for both the development of PrUs and protracted wound healing. Several studies, including *The National Pressure Ulcer Long-term Care Study*, reported that eating problems and weight loss were associated with a higher risk of developing PrUs.[1–3]

Fry et al[4] also reported that preexisting malnutrition and/or weight loss was a positive predictive variable for all undesirable surgery-related hospital-acquired conditions, including PrUs. Iizaka et al's[5] study of home care patients 65 years or older in Japan noted the rate of malnutrition was higher for those with PrUs (58.7% vs 32.6%, $P < .001$). Many acute and chronically ill adults, as well as older adults at risk or with PrUs, experience unintended weight loss.[1,6,7] Shahin et al's[8] 2010 study in German hospitals and nursing homes clearly established the significant relationship between the presence of PrUs and unintended weight loss (5%–10%). A multicenter study conducted in Australian hospitals and residential older adult care facilities also reinforced the relationship between malnutrition and PrUs.[9] Banks et al's[10] study of Queensland public hospital patients in 2002–2003 found one-third of PrUs were attributable to malnutrition at a mean cost of approximately AU $13 million. The 2014 National Pressure Ulcer Consensus Conference faculty supported the statement that individuals with malnutrition in combination with multiple comorbidities are at increased risk of developing a PrU.[11]

DEFINING MALNUTRITION

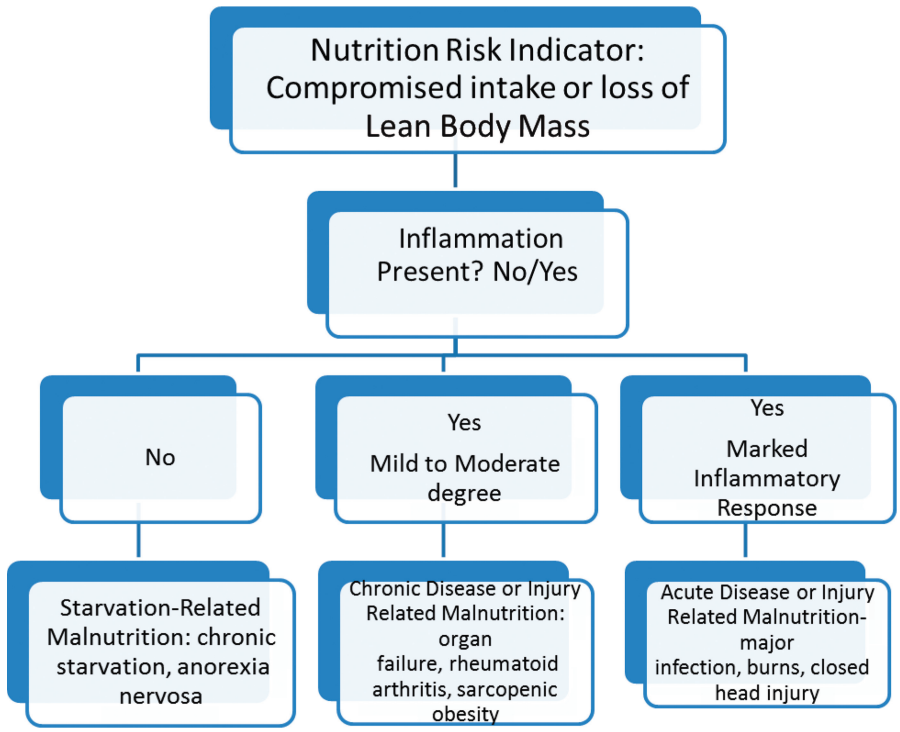
Parameters used to define malnutrition/undernutrition vary in most studies, thus underscoring the need to establish a standard set of criteria to define adult malnutrition. Historically, clinicians used serum protein levels, including albumin and prealbumin, to determine nutritional status. However, current research indicates that serum protein levels may be affected by inflammation, renal function, hydration, and other factors.[12] During periods of inflammatory stress, albumin and prealbumin levels drop because they are negative acute-phase reactants. In response, there is an increase in cytokines, including interleukin 1β, interleukin 6, and tissue necrosis factor, causing the liver to synthesize positive acute-phase reactants rather than negative acute-phase reactants. Inflammatory biomarkers, such as C-reactive protein, ferritin, and other positive acute-phase reactants, quickly rise with acute inflammation and decline as inflammation diminishes. Inflammation may be a contributing factor when C-reactive protein levels increase, and albumin and prealbumin levels decline.[12,13] Several studies reported evidence suggesting that serum hepatic proteins correlate with mortality and morbidity, are useful indicators of illness severity, and help to identify individuals at risk for developing malnutrition.[14–18] Hepatic protein levels do not accurately measure nutritional repletion[18]; thus, serum concentrations may not be markers of malnutrition or caloric repletion. As of 2012, the Academy of Nutrition and Dietetics (Academy) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) do not recommended using inflammatory biomarkers such as serum protein levels for diagnosis of malnutrition.[18]

"Adult undernutrition typically occurs along a continuum of inadequate intake and/or increased requirements, impaired absorption, altered transport, and altered nutrient utilization,"[18] states the Academy and A.S.P.E.N. Weight loss may occur at various points along this continuum. Inflammation appears to be the common thread in disease progression and concurrent declining nutritional

status.[19] Current evidence suggests that inflammation is an important underlying factor, and there are varying degrees of acute and chronic inflammation associated with injury, infection, and disease.[12,18–22] Diseases such as diabetes mellitus, cardiovascular diseases, arthritis, and cancers produce chronic inflammation that is sustained and persistent. Elevated energy expenditure and catabolism of lean body mass are associated with chronic inflammation. Individuals with a critical illness, major infection, or traumatic injury may have a condition associated with an acute inflammatory response. This acute-phase inflammatory response triggers a sequence of reactions leading to elevated resting energy expenditure and nitrogen excretion, which increases energy and protein requirements concurrently with anorexia and pathologically altered utilization of nutrients.[22] The body reacts with a suboptimal response, and nutrition interventions are not adequate to reverse the mobilization of nutrients and other cytokine-related changes in organ function. Jensen et al[22] define the point at which the severity or persistence of inflammation leads to a decrease in lean body reserves linked to impaired functional status as disease-related malnutrition. Figure 1 describes etiology–based malnutrition definitions.

In 2009, A.S.P.E.N. and the European Society for Clinical Nutrition and Metabolism convened an International Consensus Guideline Committee to adopt an etiology-based approach to the diagnosis of adult malnutrition. The definitions developed and endorsed by A.S.P.E.N. and the European Society for Clinical Nutrition and Metabolism to describe adult malnutrition were accepted by the Academy. The definitions describe adult malnutrition in a framework of acute illness or injury, chronic disease or conditions (lasting >3 months), and starvation-related malnutrition.[18] The identification of 2 or more of the following 6 characteristics is required for the nutrition diagnosis of malnutrition (also known as undernutrition): insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, fluid accumulation (that may mask weight loss), and/or diminished functional status (as measured by hand-grip strength).[18] This etiology-based nomenclature takes into account the understanding of the role of the inflammatory response on incidence, progression, and resolution of malnutrition in adults. Adapting a standardized approach to diagnose malnutrition using these characteristics will lead to early identification of declining nutritional status, which impacts PrU prevention and healing.

Figure 1.
ETIOLOGY-BASED MALNUTRITION DEFINITIONS



Adapted with permission from White.[18]

RECOMMENDATIONS FOR PRACTICE

Nutritional Considerations in PrU Prevention

According to a recently updated Cochrane review, there is inconclusive evidence regarding medical nutrition therapy for preventing PrUs.[23] The 11 studies, a subset of 23 studies, considered mixed nutritional supplements as an intervention to prevent PrUs.[6,24–33] Nutritional supplements included energy-enriched supplements of protein alone and mixed supplements of protein, carbohydrate, lipids, vitamins, and minerals. All studies compared the nutritional intervention with a standard intervention, such as a standard hospital diet, or standard diet plus placebo. The intervention was administered orally in all studies, except for 2 studies where supplementation was administered by nasogastric tube.[26,30] All included studies were prospective randomized controlled trials (RCTs), although generally small and had either an unclear or high risk of bias. Overall findings of the studies were a lower incidence of PrUs in the intervention group (except for 1 trial, Arias et al[24]); however, none of these differences were statistically significant with the exception of the study of Bourdel-Marchasson et al.[25] When 8 trials were pooled in a meta-analysis, the authors found no clear evidence of an effect of supplementation on PrU development (Research Report, 0.86; 95% confidence interval, 0.73–1.00; $P = .05$).[23] They concluded that it remains unclear whether nutritional supplementation in these studies reduced the risk of PrU development.

Malnutrition is associated with increased risk of PrUs and delayed healing; therefore, nutrition screening and assessment are essential to identify risk of malnutrition, including poor food/fluid intake and unintended weight loss. Many physical, functional, and psychosocial factors can contribute to inadequate intake, unintended weight loss, undernutrition, and/or protein energy malnutrition, such as cognitive deficits, dysphagia, depression, food-medication interactions, gastrointestinal disorders, and impaired ability to eat independently. No clear method exists to determine when nutritional status decline begins. Despite aggressive nutritional interventions, some individuals are simply unable to absorb adequate nutrients for good health.

Nutrition Screening and Assessment

Poor outcomes are associated with malnutrition, including the risk of morbidity and mortality, hence the need to quickly identify and treat malnutrition when there is a risk for development of or existing PrUs. The nutrition screening process identifies characteristics associated with nutrition risk. Any trained member of the healthcare team may complete nutrition screening.

Nutrition screening should be completed upon admission to a healthcare setting and when nutrition risk is triggered, there should be an automatic referral to the registered dietitian (RD) or the nutrition care team for a comprehensive nutrition assessment.

A cross-sectional study investigating the role of clinical guidelines in the assessment and management of individuals with PrUs found that adopting a formalized, facility-wide nutrition guideline contributes to the ongoing process of regular nutrition screening in daily practice, as well as reducing barriers to providing nutritional support.[34]

Nutrition screening tools should be validated, reliable, and relevant to the patient group being screened. The screening tool should consider current weight status and past weight to assess weight change, which may be linked to food intake/appetite and disease severity. The nutrition screening tool should be relatively quick to administer, able to detect both undernutrition and overnutrition, and capable of establishing nutritional risk in all types of individuals, including those with fluid disturbances and those in whom weight and height cannot be easily measured.[35,36]

Nutrition Screening Tools

A number of validated nutrition risk screening tools have been developed for use in different populations. In a comparison of 5 of these screening tools in a hospital population, Neelemaat et al[37] found the Malnutrition Screening Tool and Short Nutritional Assessment Questionnaire as suitable quick and easy tools for use in a hospital inpatient population. The screening tools performed as well as the more comprehensive malnutrition screening tools, the Malnutrition Universal Screening Tool (MUST) and Nutrition Risk Screening 2002. The MUST was found to be less applicable because of the high rate of missing values. However, another study comparing nutrition risk screening tools for use in older adults on hospital admission found MUST to be the most valid tool.[38] The Mini Nutritional Assessment ([MNA]; Nestle Nutrition Institute, Vevey, Switzerland) is the only screening tool validated for older adults in both community and long-term-care settings.

Langkamp-Henken et al's[39] cross-sectional study of older men with PrUs in residential care facilities examined the correlation of the MNA tool and clinical indicators and found a positive correlation. A German study comparing the nutritional status of individuals with and without PrUs found the MNA was easy to use to assess individuals with PrUs and multiple comorbidities.[40]

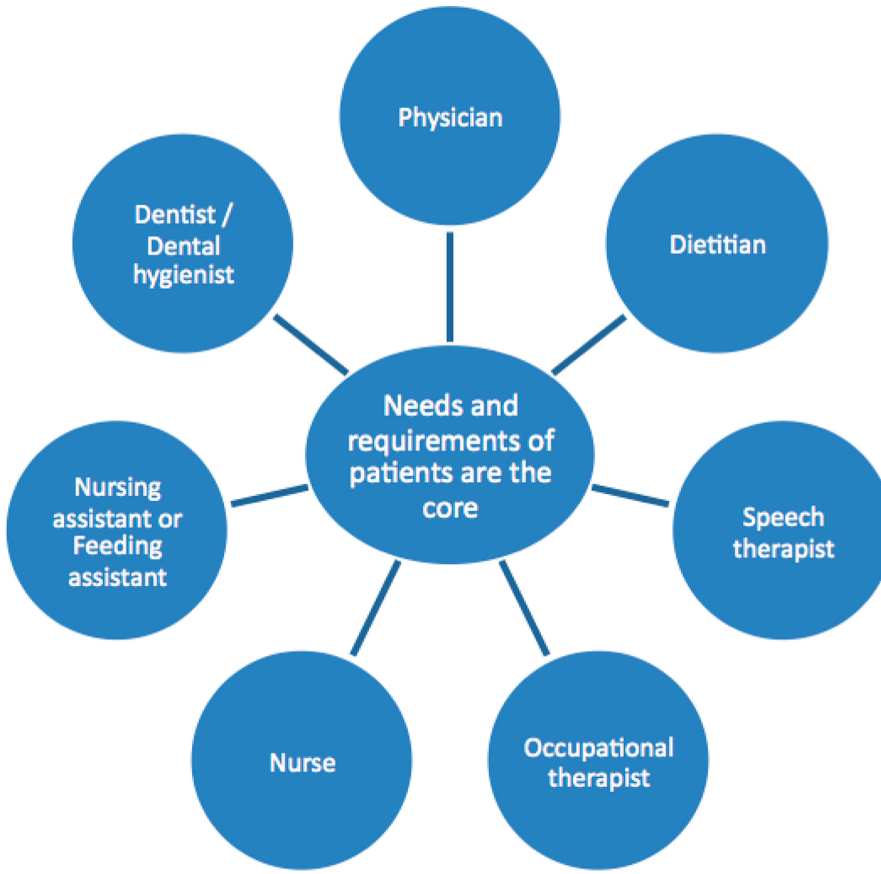
Nutrition Care Process

Individuals identified to be malnourished, at risk of PrUs, or at nutritional risk through nutrition screening should have a more comprehensive nutrition assessment by the RD. The RD in consultation with the interprofessional team (including, but not limited to, a physician, nurse practitioner, nurse, speech

pathologist, occupational therapist, physical therapist, and dentist) should complete a comprehensive nutrition assessment.[41] Figure 2 defines the role of the interprofessional team. The Academy's Nutrition Care Process, which was also adapted by the Dietitians Association of Australia, includes 4 basic steps: nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation.[42,43] The nutrition assessment process is continuous, and early intervention is critical. A comprehensive nutrition assessment involves a systematic process of collecting, verifying, and interpreting data related to nutritional status and forms the basis for all nutrition interventions.

Information obtained and analyzed includes medical, nutritional, biochemical data, and food-medication interactions; anthropometric measurements; and nutrition-focused physical

Figure 2.
NUTRITION FOR PREVENTION AND TREATMENT IS INTERPROFESSIONAL CARE



Physician and nurse practitioner:
• Diagnose medical reasons for altered/disturbed nutritional status
• Responsible for ordering all medications and treatment
Dietitian:
• Completes nutrition assessment and estimates nutrition/hydration requirements
• Provides dietary recommendations and monitors nutritional status
Speech therapist:
• Screens and evaluates chewing and swallowing ability
• Determines training compensation and recommends food/fluid consistency
Occupational therapist:
• Assesses feeding skills and/or recommends techniques to improve motor skills
Nurse:
• Monitors acceptance and tolerance of oral and/or enteral nutrition
• Alerts physician, dietitian, and patient of changes in nutritional status, such as meal refusal, changes in weight, or hydration status
Nursing assistant or feeding assistant:
• Delivers food (trays) and provides feeding assistance, if needed
• Alerts nurse and/or other team members of refusal of or decline in oral intake
Dentist/dental hygienist:
• Assesses oral/dental status (eg, inflamed gums, oral lesions, denture problems)
• Offers oral healthcare
Note: All members of the interprofessional team educate the patient and/or caregiver on the risks and benefits of specific treatment related to their role on the team.
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examination results (assessment of signs of malnutrition, oral status, chewing/swallowing ability, and/or diminished ability to eat independently). The focus of nutrition assessment should be on evaluating energy intake, weight loss, and presence of acute disease, as well as estimation of the individual's caloric, protein, and fluid requirements.

Following the comprehensive nutrition assessment, the RD identifies and determines a specific nutrition diagnosis or problem that is within the scope of practice for the RD to treat. The intervention is specific to the nutrition diagnosis or problem. The monitoring and evaluation steps determine the progress made by the individual to meet the specific goals established. The interprofessional team works with the individual and/or surrogate to develop appropriate and individualized interventions and then monitor and evaluate for needed changes to nutrition interventions.

Biochemical Data

Biochemical laboratory data may not be available or cost-effective in every clinical setting. As previously noted, serum protein levels do not correlate with nutrition status. However, the clinician should review for other concerns, which may inhibit PrU healing, such as anemia and uncontrolled blood glucose levels in people with diabetes.

MACRONUTRIENTS/MICRONUTRIENTS FOR PRESSURE ULCER MANAGEMENT

Energy

The body's first priority is for adequate energy (kilocalories) with carbohydrate and fat as the preferred sources to spare protein for cell structure and collagen synthesis. When energy from carbohydrates and fat fail to meet the body's requirements, the liver and kidney synthesize glucose from noncarbohydrate sources, such as amino acids. Gluconeogenesis occurs when the nitrogen is stripped off and excreted from the amino acid in protein, and the body uses the carbon skeleton as an energy source.

Fat is the most concentrated source of kilocalories. It transports the fat-soluble vitamins (A, D, E, K) and provides insulation under the skin and padding to bony prominences. Energy needs are assessed using several methods. Indirect calorimetry is considered the criterion standard for measuring energy expenditure; however, this method is labor intensive, requires technical skills, and may not be available in either the nutrition or respiratory therapy department. Research indicates that the Harris-Benedict equation is inaccurate for calculating energy requirements.[44] Cereda et al[44] recommend a correction factor of 10%, based on underestimation of energy needs for adults with PrUs when using this formula. A systematic review of observational studies supported the goal of 30 kcal/kg per day but noted limitations of the meta-analysis, including a small number of included studies, small sample sizes, and heterogeneity of the groups. The Miffin-St Jeor equation may be more accurate and have a smaller margin of error when used to calculate resting metabolic rate for healthy obese individuals.[45]

Protein

Protein is responsible for the synthesis of enzymes involved in PrU healing, cell multiplication, and collagen and connective tissue synthesis. Protein is essential to promote positive nitrogen balance.[46] All stages of healing require adequate protein, and increased protein levels have been linked to improved healing rates.[47,48] Nitrogen losses may occur from exudating PrUs, possibly increasing protein needs. Determining the appropriate level of protein for each individual depends on the number and severity of PrUs, overall nutritional status, comorbidities, and tolerance of recommended nutrition interventions. The Trans-Tasman Evidence-Based Guideline for Dietetic Management for Adults With Pressure Ulcers recommends 1.25 to 1.5 g protein/kg body weight daily for individuals at moderate to high risk for delayed healing of PrUs due to nutritional concerns.[49] An RCT by Ohura et al[50] investigated the effectiveness of a nutritional intervention based on a calorie calculation according to basal energy expenditure to promote PrU healing. The control group received 1092.1 ± 161.8 kcal (29.1 ± 4.9 and 1.24 g/kg per day of protein), whereas the intervention group received 1.383.7 ± 156.5 kcal (37.9 ± 6.5 kcal/kg per day) and 1.62 g/kg per day of protein.[50] A statistically significant decrease in wound size was noted after week 8 for the intervention group compared with the control group, thus supporting the higher level of protein.[50]

The Institute of Medicine's (IOM's) recommendation for protein for healthy adults is 0.8 g/kg/body weight, which may not be adequate for older adults or for individuals with PrUs.[51] Wolfe and Miller[52] noted that a protein level above the recommendation of 0.8 g/kg of body weight per day for healthy adults is appropriate under certain conditions, such as wound healing. Dietary protein is especially important in frail and older adults because of metabolic changes and the loss of lean body mass (sarcopenia) that may occur with aging and reduced activity levels. These changes, along with a decreased immune function, can lead to impaired wound healing and the inability to adequately fight infection. Sarcopenia is the loss of muscle mass and muscle strength that is associated with aging. The pathophysiology of sarcopenia is complex. There are a multitude of internal and external processes that contribute to its development. The most important internal process influences are reductions of anabolic hormones, increases in apoptotic activities in the myofibers, increases in proinflammatory cytokines, oxidative stress, and so on.

Among external influences, a deficient intake of energy and protein will contribute to loss of muscle mass and function. Acute and chronic comorbidities will also contribute to the development of sarcopenia in older persons. Comorbidities may lead to reduced physical activity and periods of bed rest, and conversely, increased generation of proinflammatory cytokines may trigger proteolysis.

For the diagnosis of sarcopenia, the European Working Group on Sarcopenia in Older People recommends using the presence of both low muscle mass + low muscle function (strength or performance).[53] Muscle wasting may also be frequently observed in obese or overweight patients exhibiting unintentional weight loss and systemic inflammatory response due to an underlying disease, such as cancer. These individuals exhibit significant muscle loss despite fat mass increasing—a condition defined as sarcopenic obesity. The Society for Sarcopenia, Cachexia, and Wasting Disease convened an expert panel to develop nutritional recommendations for prevention and management of sarcopenia. The essential components for the prevention and management of sarcopenia include both resistance and aerobic exercise in combination with 1.0 to 1.5 g/kg protein per day.[54]

The PROT-AGE Study Group evidence-based guideline recommends a protein intake of 1.2 to 1.5 g/kg per day for older adults with acute or chronic disease and suggests that those with severe illness or injury may need 2.0 g/kg per day.[55]

Amino Acids

Amino acids are the building blocks of protein. Specific amino acids, such as arginine and glutamine, become conditionally essential amino acids during periods of severe stress (eg, trauma, sepsis, PrUs).

Arginine stimulates insulin secretion, promotes the transport of amino acids into tissue cells, and supports the formation of protein in the cells. There is a growing body of moderate-quality evidence supporting the positive effect of supplementation with additional protein, arginine, and micronutrients to promote PrU healing. In an RCT conducted by Cereda et al,[56] individuals received either a standard house diet plus a 500-calorie supplement with 34 g protein, 6 g arginine, 500 mg vitamin C, 18 mg zinc, or, if on enteral nutrition (EN), a feeding enriched with arginine, zinc, and ascorbic acid. The control group received either a standard house diet with 16% of energy from protein or a standard tube feeding. The Pressure Ulcer Scale for Healing (PUSH) score became statistically significantly different between both groups at week 12 (favored treatment, $P < .05$), and the difference in ulcer area was significant by week 8 (favored treatment, $P < .05$).[56] In another RCT, van Anholt et al[57] investigated a high-protein, arginine, and micronutrient-rich supplement to improve healing in well-nourished adults with category/stage III and IV PrUs. Participants recruited from 8 healthcare centers in 4 European countries were randomized to receive either 200 mL of a high-calorie oral nutritional supplement (ONS) with 20 g of protein, 3 g of arginine, plus antioxidants, including 250 mg of vitamin C, and 9 mg of zinc 3 times a day between meals for 8 weeks (group 1), or 200 mL of a noncalorie placebo (group 2) for the same period. Supplementation with the specific ONS (group 1) accelerated PrU healing, as indicated by a significant reduction in ulcer size compared with group 2 after 8 weeks. The decrease in the severity score, PUSH, in the supplement group differed notably from the control group.[57] In a small 3-week interventional study, Desneves et al[58] noted a reduction in PUSH scores for individuals with PrUs who consumed high-calorie supplements containing arginine.

Hydration

The interprofessional team should offer and encourage individuals to consume fluids for hydration. Water is distributed throughout the body and is the transport medium for nutrients and waste products. Normally for healthy individuals who are adequately hydrated, food accounts for approximately 19% to 28% of total fluid intake.[59]

The RD should calculate individual fluid requirements and determine nutritional interventions. Various formulas have been used to calculate adequate daily fluid intake. Evidence–based guidelines recommend 1 mL/kcal consumed daily initially, with adjustments to the amount of fluid offered depending on the individual's condition.[60] Individuals consuming high levels of protein may require additional fluid.[60] Elevated temperature, vomiting, profuse sweating, diarrhea, and heavily draining wounds contribute to fluid loss, which must be replaced.[60,61]

The interprofessional team should monitor the individual's hydration status, checking for signs and symptoms of dehydration, such as changes in weight, skin turgor, urine color, urine output, elevated serum sodium, or calculated serum osmolality.[62]

Vitamins-Minerals

The IOM's National Academy of Sciences Dietary Reference Intakes indicate the level of each micronutrient needed at each stage of life for healthy individuals.[62] Although most nutrient needs can be met by consuming a healthy diet, individuals with PrUs, those who are food insecure, or those with poor nutrient absorption or metabolism may not be consuming an adequate diet to meet established nutritional reference standards.[63]

Micronutrients that are ''hypothesized'' to be related to PrU healing include vitamin C, zinc, and copper. Vitamin C is an antioxidant and is necessary for collagen formation. However, a double-blind RCT found no improvement in time to complete healing of PrUs for adults supplemented with 1 g of vitamin C daily compared with a control group receiving 10 mg of vitamin C daily.[64]

The inclusion of fruits and vegetables, such as citrus fruits, in the diet can achieve the daily recommended intake. However, vitamin C at physiological doses should be considered when dietary deficiency is diagnosed.

Zinc and Copper

Zinc is a cofactor for collagen formation, an antioxidant, and is important for the synthesis of protein, DNA and RNA, and proliferation of inflammatory cells and epithelial cells.[46] Zinc is transported through the body primarily by albumin; therefore, zinc absorption declines when plasma albumin declines, such as trauma, sepsis, or infection.

Deficiency of zinc may be the result of wounds with increased drainage, poor dietary intake over a long period, or excessive gastrointestinal losses. Zinc deficiency may cause loss of appetite, abnormal taste, impaired immune function, and impaired wound healing. Good sources of zinc include high-protein foods such as meat, liver, and shellfish. No research has demonstrated an effect of zinc supplementation on improved PrU healing. When clinical signs of zinc deficiency are present, zinc should be supplemented at no more than 40 mg of elemental zinc per day, which is the daily recommended intake upper limit, and stopped once the deficiency is corrected.[65] High-dose zinc supplementation (>40 mg/d) is not recommended[62] because it can adversely affect copper status and possibly result in anemia. High-serum zinc levels may inhibit healing, impair phagocytosis, interfere with copper metabolism, and induce a copper deficiency, because both minerals compete for binding sites on the albumin molecule. Copper deficiency may be harmful as copper is essential for collagen cross-linking.

Before recommending additional supplementation, clinicians should review any comprehensive vitamin/mineral supplements, enteral formulas, ONS, or fortified foods that contain additional micronutrients.

NUTRITIONAL CONSIDERATIONS

The 2104 Cochrane review, mentioned in the prevention section, also assessed RCTs that investigated the effect of nutritional supplementation on the healing of PrUs. Fourteen studies were evaluated: 7 examined mixed nutritional supplements, 3 protein supplementation, 2 zinc, and 2 ascorbic acid supplementation. The authors concluded there is generally no clear evidence of improved PrU healing with nutritional supplements,[23] although there is some evidence of improved healing with an arginine-enriched mixed nutritional supplement compared with a standard hospital diet.[57,58] They also stated most of the treatment studies were unclear or had a high risk of bias. It is important to note as these authors stated that this conclusion should not be interpreted as nutritional interventions having no effect on PrU healing simply because the existing evidence base is of low quality. Individuals who are receiving healthcare and who are at risk of malnutrition or are malnourished should receive expert nutritional assessment and intervention.[23]

A review by Stratton et al[66] of 4 RCTs showed that ONS with high levels of protein and calories (16%–32% energy as protein, 400–500 kcal, duration of 4–72 weeks) was associated with a significant reduction in PrU development compared with routine care.

A study conducted by Wilson et al[67] indicated that healthy older adults who consumed ONS between meals experienced better absorption of nutrients with the least interference to meal intake.

A person with a PrU should have an individualized care plan based on his/her nutritional needs, feeding route, and goals of care as determined by the nutrition assessment. The focus of the care plan is on improving and/or maintaining the individual's nutritional status, acceptance of nutrition interventions, and clinical outcomes. Monitoring and evaluation of nutritional status are an ongoing process, and the plan should be adjusted with each change in the individual's clinical condition.

Nutritional requirements should be met by a healthy diet; however, some individuals are unable or unwilling to consume an adequate diet. Overly restricted diets may make food unpalatable and unappealing and therefore reduce intake. The Academy's 2010 position statement on individualized diets emphasizes the enhancement of quality of life for older adults residing in healthcare communities by reduction in dietary restriction through individualization of nutrition approaches.[68] Thus, it is recommended that healthcare practitioners assess the risks versus benefits of overly restrictive therapeutic diets, especially for older adults. For example, a sodium-restricted diet may not be appealing to an individual, which can lead to poor food intake with resultant malnutrition and delayed PrU healing.

The type and amount of food and fluid ingested daily should be reviewed periodically to ensure that the individual actually consumes the number of calories estimated to meet nutrient needs. Oral nutritional supplements, enhanced foods, and food fortifiers can be used to combat unintended weight loss and malnutrition. Nutritional supplements include products that supply nutrients such as protein, carbohydrates, fat, vitamins, minerals, and/or amino acids.

When an individual's nutritional needs cannot be met orally and PrUs are not progressing to closure, the RD and/or the interprofessional team should recommend the consideration of EN or parenteral nutrition. The risk and benefits of EN should be discussed with the individual and/or surrogate, and the decision on whether to place a feeding tube must be consistent with the individual's goals and wishes.

As part of the individualized nutrition care plan, certain diseases or conditions should be considered. Currently, 65% of the world's

TABLE 1.
STRENGTH OF EVIDENCE

A	The recommendation is supported by direct scientific evidence from properly designed and implemented controlled trials on PrUs in humans (or humans at risk for PrUs), providing statistical results that consistently support the recommendation (level 1 studies required).
B	The recommendation is supported by direct scientific evidence from properly designed and implemented clinical series on PrUs in humans (or humans at risk for PrUs), providing statistical results that consistently support the recommendation (levels 2, 3, 4, 5 studies).
C	The recommendation is supported by indirect evidence (eg, studies in healthy humans, humans with other types of chronic wounds, animal models) and/or expert opinion.

Adapted with permission.[75]

population lives in countries in which overweight and obesity are associated with greater morbidity than being underweight. The World Health Organization defines overweight and obesity as abnormal or excessive fat accumulation that may impair health.[69] At present, there are no specific nutrition guidelines for individuals assessed as being obese (body mass index 30 kg/m^2). Nutrition care plans need to optimize nutrition for healing of wounds while supporting other goals of medical care. Because the wound healing process depends on an adequate flow of nutrients, implementing a restricted low-calorie diet could compromise wound healing by resulting in a breakdown of lean body mass.[70] The interprofessional team should monitor skin integrity and collaborate to develop a plan that achieves healing. Once the PrU is completely healed, diet restrictions may be gradually implemented for weight management if this is a desired goal.[46]

Maintenance of blood sugar levels remains an important component for individuals with diabetes who also have PrUs. Older adults who are physically functional, are cognitively intact, and have substantial life expectancy should receive diabetes care similar to younger adults. However, strict glucose control may be less important for those with life-limiting illness or who have cognitive or functional limitation.[71,72]

The nutrition care plan for individuals with chronic kidney disease (CKD) may need to be adjusted if higher protein intakes are not tolerated. The Academy's Evidence-Based Practice Wound Care Expert Work group reviewed the published research to determine the appropriate level of protein for individuals with CKD and PrUs who were either on dialysis or not on dialysis. The work group concluded that there are currently no studies to support a specific protein requirement recommendation for adults with CKD.

The diet for stage 3 or 4 kidney disease that is restricted in calories, protein, potassium, sodium, and fluids may not meet the nutrient needs of the individual with PrUs. The RD and the interprofessional team should assess the risks and benefits of the therapeutic diet and use clinical judgment when treating individuals with CKD and PrUs.[46]

Individuals with quadriplegia or paraplegia are at greater risk of developing PrUs and have different nutritional requirements than individuals who are mobile. Energy requirements and hence calorie consumption is often lower in these individuals, which may limit intake of other nutrients.[73] Groah et al[73] also reported a majority of the population with spinal cord injury (SCI) was overweight or obese. Other studies report a high prevalence of malnutrition in the SCI population.[74]

2014 GUIDELINES FOR PRESSURE ULCER PREVENTION AND TREATMENT

The NPUAP, EPUAP, and PPPIA joined forces to create an interprofessional guideline development group (GDG) and numerous small working groups (SWGs) consisting of representatives of the 3 development organizations to produce the guideline. There are 575 explicit recommendations on numerous topics including risk assessment, skin care, dressings, support surfaces, and medical devices plus guidelines for special populations, such as pediatrics, bariatrics, palliative care, and SCIs. A precise scientific methodology was used to identify and critically appraise all available research. In the absence of definitive evidence, expert opinion (often supported by indirect evidence and other guidelines) was used to make recommendations. All studies meeting inclusion criteria were reviewed for quality, summarized in evidence tables, and classified according to their level of evidence using a schema.[75] The strength-of-evidence rating identifies the strength of cumulative evidence supporting each recommendation as shown in Table 1. The SWGs summarized the evidence supporting each

TABLE 2.
STRENGTH OF RECOMMENDATION

👍👍	Strong positive recommendation: definitely do it
👍	Weak positive recommendation: probably do it
👈	No specific recommendation
👎	Weak negative recommendation: probably do not do it
👎👎	Strong negative recommendation: definitely do not do it

Used with permission from the NPUAP/EPUAP/PPPIA.[75]

TABLE 3.
2014 NPUAP/EPUAP/PPPIA NUTRITION GUIDELINES

Nutrition Screening

1. Screen nutritional status for each individual at risk of or with a PrU:
   - at admission to a healthcare setting;
   - with each significant change of clinical condition; and/or
   - when progress toward PrU closure is not observed.

Strength of evidence = C; strength of recommendation = 👍

2. Use a valid and reliable nutrition screening tool to determine nutritional risk.

Strength of evidence = C; strength of recommendation = 👍

3. Refer individuals screened to be at risk of malnutrition and individuals with an existing PrU to an RD or an interprofessional nutrition team for a comprehensive nutrition assessment.

Strength of evidence = C; strength of recommendation = 👍

Nutrition Assessment

1. Assess the weight status of each individual to determine weight history and identify significant weight loss (5% in 30 d or 10% in 180 d).

Strength of evidence = C; strength of recommendation = 👍

2. Assess the individual's ability to eat independently.

Strength of evidence = C; strength of recommendation = 👍👍

3. Assess the adequacy of total nutrient intake (ie, food, fluid, oral supplements, and enteral/parenteral feeds).

Strength of evidence = C; strength of recommendation = 👍👍

Care Planning

1. Develop an individualized nutrition care plan for individuals with or at risk of a PrU.

Strength of evidence = C; strength of recommendation = 👍

2. Follow relevant and evidence-based guidelines on nutrition and hydration for individuals who exhibit nutritional risk and who are at risk of PrUs or have an existing PrU.

Strength of evidence = C; strength of recommendation = 👍

Energy Intake

1. Provide individualized energy intake based on underlying medical condition and level of activity.

Strength of evidence = B; strength of recommendation = 👍

2. Provide 30-35 kcal/kg body weight for adults at risk of a PrU who are assessed as being at risk of malnutrition.

Strength of evidence = C; strength of recommendation = 👍

3. Provide 30-35 kcal/kg body weight for adults with a PrU, who are assessed as being at risk of malnutrition.

Strength of evidence = B; strength of recommendation = 👍👍

4. Adjust energy intake based on weight change or level of obesity. Adults who are underweight or who have had significant unintended weight loss may need additional energy intake.

Strength of evidence = C; strength of recommendation = 👍👍

5. Revise and modify/liberalize dietary restrictions when limitations result in decreased food and fluid intake. These adjustments should be made in consultation with a medical professional and managed by an RD whenever possible.

Strength of evidence = C; strength of recommendation = 👍

6. Offer fortified foods and/or high-calorie, high-protein oral nutritional supplements between meals if nutritional requirements cannot be achieved by dietary intake.

Strength of evidence = B; strength of recommendation = 👍👍

7. Consider enteral or parenteral nutritional support when oral intake is inadequate. This must be consistent with the individual's goals.

Strength of evidence = C; strength of recommendation = 👍

continues

TABLE 3.

2014 NPUAP/EPUAP/PPPIA NUTRITION GUIDELINES, CONTINUED

Protein Intake

1. Provide adequate protein for positive nitrogen balance for adults assessed to be at risk of a PrU.

Strength of evidence = C; strength of recommendation = ☝

2. Offer 1.25-1.5 g protein/kg body weight daily for adults at risk of a PrU who are assessed to be at risk of malnutrition when compatible with goals of care and reassess as condition changes.

Strength of evidence = C; strength of recommendation = ☝

3. Provide adequate protein for positive nitrogen balance for adults with a PrU.

Strength of evidence = B; strength of recommendation = ☝

4. Offer 1.25-1.5 g protein/kg body weight daily for adults with an existing PrU who are assessed to be at risk of malnutrition when compatible with goals of care and reassess as condition changes.

Strength of evidence = B; strength of recommendation = ☝

5. Offer high-calorie, high-protein nutritional supplements in addition to the usual diet to adults with nutritional risk and PrU risk, if nutritional requirements cannot be achieved by dietary intake.

Strength of evidence = A; strength of recommendation = ☝

6. Assess renal function to ensure that high levels of protein are appropriate for the individual.

Strength of evidence = C; strength of recommendation = ☝☝

7. Supplement with high protein, arginine, and micronutrients for adults with a PrU. Category/stage III or IV or multiple PrU when nutritional requirements cannot be met with traditional high-calorie and protein supplements.

Strength of evidence = B; strength of recommendation = ☝

Hydration

1. Provide and encourage adequate daily fluid intake for hydration for an individual assessed to be at risk of or with a PrU. This must be consistent with the individual's comorbid conditions and goals.

Strength of evidence = C; strength of recommendation = ☝☝

2. Monitor individuals for signs and symptoms of dehydration including change in weight, skin turgor, urine output, elevated serum sodium, and/or calculated serum osmolality.

Strength of evidence = C; strength of recommendation = ☝

3. Provide additional fluid for individuals with dehydration, elevated temperature, vomiting, profuse sweating, diarrhea, or heavily exuding wounds.

Strength of evidence = C; strength of recommendation = ☝☝

Vitamins and Minerals

1. Provide/encourage individuals assessed to be at risk of PrUs to consume a balanced diet that includes good sources of vitamins and minerals.

Strength of evidence = C; strength of recommendation = ☝☝

2. Provide/encourage an individual assessed to be at risk of a PrU to take vitamin and mineral supplements when dietary intake is poor or deficiencies are confirmed or suspected.

Strength of evidence = C; strength of recommendation = ☝

3. Provide/encourage an individual with a PrU to consume a balanced diet that includes good sources of vitamins and minerals.

Strength of evidence = B; strength of recommendation = ☝☝

4. Provide/encourage an individual with a PrU to take vitamin and mineral supplements when dietary intake is poor or deficiencies are confirmed or suspected.

Strength of evidence = B; strength of recommendation = ☝

Note: The recommendations in this section of the guideline are predominantly for adult individuals and have been derived from evidence conducted in adult populations. Recommendations for Nutritional Assessment and Treatment.

Used with permission: National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance.[75]

recommendation. Recommendations and evidence summaries were reviewed by the GDG and 986 international stakeholders with the final draft approved by the GDG.[76] In this edition of the guideline, a consensus voting process (GRADE) was used to assign strength to each recommendation. The strength of recommendation identifies the importance of the recommendation statement based on the potential to improve patient outcomes. It provides an indication to the healthcare professional of the confidence one can have that the recommendation will do more good than harm and can be used to assist in prioritizing PrU-related interventions. See Table 2 for Strength of Recommendation.

The final guideline is based on available research and the accumulated wisdom of the NPUAP, EPUAP, PPPIA, and international stakeholders. See Table 3 for Nutrition Prevention and Treatment Guidelines.

FUTURE RESEARCH NEEDS

Although a relatively large amount of research has occurred in the area of nutrition and PrUs, most of the existing evidence base is of low quality. Further research with larger numbers of individuals and sound methodology is required to procure evidence for the impact of nutrition on PrU prevention and healing. Particular consideration should be given to ensuring the achievement of predicted nutritional requirements, specifying the ingredients in nutritional supplements provided, and describing the method of application, for example, oral or tube feeding.[23]

The shortcomings of previous studies have been recently overcome in the Oligo-Element Sore Trial. This large (N = 200) randomized (1:1), double-blind, controlled trial compared a high-calorie, high-protein nutritional formula enriched with arginine, zinc, and antioxidants with an active isocaloric, isonitrogenous control formula confirming that a disease-specific support improves PrU healing, with a 20% higher reduction in PrU area after 8 weeks of intervention.[76] Research is also needed to determine the appropriate level of calories and protein for obese individuals with PrUs.

ETHICAL AND CLINICAL IMPLICATIONS FOR PRACTICE

Guidelines are systematically developed statements to assist healthcare professional and patient/consumer decisions about appropriate healthcare for specific clinical conditions. The purpose of the 2014 NPUAP/EPUAP/PPPIA recommendations is to guide evidence-based care to prevent the development of PrUs and to determine the most effective strategies to promote healing. The recommendations are based on current evidence, and the decision to adopt a specific guideline should be based on the healthcare professional's assessment of the individual. The recommendations may not be appropriate for use in all circumstances. The majority of the nutrition guidelines and the studies evaluated were based on adults.

SUMMARY

Nutrition and hydration are key to the prevention and treatment of malnutrition and PrUs. Early nutrition interventions can help to prevent and/or delay undernutrition/malnutrition and the impact on PrU risk and/delayed healing. For individuals at the end of life, however, nutrition interventions must be weighed against the burdens and individual preferences. The position of the Academy on ethical and legal issues in feeding and hydration supports the right of the individual to request or refuse nutrition and hydration as medical treatment.[77]

Each member of the interprofessional team has a distinct role in the care and treatment of the individual at risk for malnutrition and/or PrUs or with a PrU. Early referral to an RD, along with collaboration, communication, and continuity of nutrition care with the interprofessional team, are essential for the prevention and healing of PrUs.

PRACTICE PEARLS

- Screen and assess the nutritional status of individuals at risk for or with PrUs.
- Collaborate with the RD and members of the interprofessional team to determine appropriate individualized nutritional interventions.
- Implement 2014 NPUAP/EPUAP/PPPIA nutrition guidelines according to the individual's assessed needs.
- Encourage consumption of a balanced diet, which includes good sources of calories, protein, fluids, vitamins, and minerals.
- Provide enriched food and/or ONSs between meals, if appropriate and consistent with the individual's plan of care.
- Consider nutrition support (EN or parenteral feeding) if oral intake is inadequate (must be compatible with individual's goals).
- Offer palliative care based on the individual's condition and wishes.

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