American Limb Preservation Society

Nutrition Interventions in Adults with Diabetic Foot Ulcers

Expert Consensus and Guidance

- Introduction
- Screening and Assessment
- Dietary Factors in Wound Healing and Specific Nutrients
- Intervention
- For the Patient

Authors:

David G. Armstrong, DPM, MD, PhD

Joseph L. Mills, MD, FACS

Maritza Molina, RDN

Joseph A. Molnar, MD, PhD, FACS

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Prevalence

- Diabetic foot ulcers (DFU) are chronic wounds in the foot or feet associated with neuropathy and/or peripheral artery disease (PAD) of the lower limb in patients with diabetes mellitus.
- Reports from the Centers for Disease Control and Prevention show that in the United States there are nearly one in four adults living with diabetes, which indicates that a large number of Americans are at risk of DFU.
- DFUs will develop in up to 34% of patients with diabetes at some time in in their lives, and of those, approximately 15%–25% will require an amputation.
- Moderate or severe malnutrition has been identified in over half of patients with DFU, and malnutrition in DFU is correlated with increased lower-extremity amputation.
- Improvements in wound care therapy, including nutrition interventions, can reduce the financial burden of DFUs and increase life expectancy and quality of life.

Challenges and Goals

- There is no internationally agreed upon standardized definition of malnutrition, neither for protein energy malnutrition nor for micronutrient deficiency, in the context of chronic wounds or in DFU.
- There is a lack of high-quality randomized controlled trials to evaluate the benefits of nutritional supplementation in DFU, and existing studies use a wide range of outcome variables.
- Ensuring patient compliance when it comes to nutrition can be notoriously challenging.
- However, there is a clear correlation between nutritional status and healing, and as such, a balanced diet with adequate fluids, calories, proteins, and nutrients is fundamental to the healing process.
- The following guidelines are designed to assist the clinician to accomplish the difficult goal of improved outpatient nutrition to support the healing DFU wound.
- We recommend that you use your clinical judgement as every patient case is unique. The nutrition plan should be individualized based on disease state and/or risk of malnutrition.

Table 1. Comparing Various Definitions of Malnutrition

Characteristics	American Society for Parenteral and Enteral Nutrition (ASPEN)/Academy of Nutrition and Dietetics	European Society for Clinical Nutrition and Metabolism (ESPEN)	Global Leadership Initiative on Malnutrition (GLIM)
Unintended Weight Loss	×		×
Low body mass index		×	×
Loss of muscle mass	×		×
Loss of subcutaneous fat	×	×	
Localized or generalized fluid accumulation	×		
Decreased functional status	×		
Reduced food intake or assimilation	×		×
Disease burden/ inflammation			×
At risk per validated screening tool		×	
Determination of malnutrition status	Two characteristics must be present	Screening tool confirmation + one of the other two present	One phenotypic and one etiologic characteristic must be present

Care Team

- Proper management of patients with DFUs should include a multidisciplinary care team.
- The care team may consist of one or more podiatrists, dietitians/nutritionists, surgeons, primary care, endocrinologists, wound care specialists, dermatologists, experts in psychosocial care, etc.

Language Guidance for Diabetes-Related Discussions

- How clinicians talk to and about people with diabetes plays an important role in engagement, conceptualization of diabetes and its management, treatment outcomes, and psychosocial well-being. For people with diabetes, language has an impact on motivation, behaviors, and outcomes.
- Every member of the healthcare team can serve people with diabetes more effectively through a respectful, inclusive, and person-centered approach.
- Stigma that has historically been attached to a diagnosis of diabetes can contribute to stress and feelings of shame and judgment.
- Person-first, strengths-based, empowering language can improve communication and enhance the motivation, health, and well-being of people with diabetes.
- Avoid using the word "diabetic" as a noun, as well as labeling someone "a diabetic person". This gives the impression that a person is being labeled as their disease.
- This guide uses the term "diabetic foot ulcer" for simplicity, however the phrase should be avoided when speaking with patients. Instead, use "foot ulcer", "ulcer of the foot as a result of diabetes" or similar.

Initial Screening

- Patients with diabetic foot ulcers seen in ambulatory settings may be considered to be of adequate nutritional status when in reality, that is not the case and further screening and assessment would indicate this.
- Healthcare providers should develop and implement a formalized nutrition screening and assessment protocol to help identify patients with or at risk of malnutrition.
- The goal of nutrition screening is early identification of patients at risk for malnutrition.
- There are numerous validated nutrition screening tools (See Table 2).
- Selecting the appropriate tool depends upon the population and the available resources.

Table 2. Nutrition Screening and Assessment Tools

Screening	Assessment
Nutritional Risk Index (NRI)	Patient-Centered Subjective Global Assessment (PG-SGA)
Malnutrition Universal Screening Tool (MUST)	Nutrition Focused Physical Assessment (NFPA)
Mini Nutritional Assessment (MNA)	

Assessment

- If an initial screening suggests an increased risk for malnutrition, the next step should be a thorough nutrition assessment.
- In addition to the initial assessment, return visits should be scheduled regularly. These visits should include sufficient time for the care team to assess adherence and make appropriate adjustments to patient's individualized care plan.

Physical Exams

- **In addition to examination of the patients feet and ulcer, a physical exam should also concentrate on skin quality, muscle tone, obesity, or low body weight, as well as hair quality and cheilosis.**
- **At each visit, anthropometric questionnaires/measurements should be administered and/or measured, and should include the following:**
  - Current vs. normal body weight
  - % Weight loss or % weight gain over time
  - Under/overweight amount and %
  - BMI
  - Edema
  - Skin integrity

Patient History

- **Obtain information of social issues that predispose to malnutrition.**
  - Depression, living on a fixed income, living alone, and geriatric age group are all risks factors for malnutrition.
- **More detailed history of eating habits is likely to divulge a diet low in protein and high in carbohydrates — e.g., high caloric snack foods such as chips, cookies and crackers require no preparation and may dominate the diet.**
  - Specific questions should be asked regarding fruit, vegetable, and protein intake to determine adequacy of nutritional components.
- **Ensure a patient's dietary intake exceeds 75% of the estimated energy, protein, and water needed for wound healing.**
  - Some important tools than can be used to determine appropriate daily nutrition intake are:
    - Conducting 24-hour dietary recalls
    - Meal frequency questionnaire
    - Determining safe access to food and need for specialized or modified diet
    - Evaluating socioeconomic status and home dynamics

Comorbidities

- **Medical problems that interfere with eating such as bowel disorders should be identified.**
- **Other disease states such as recurrent infections or cancer increase nutritional requirements and may lead to malnutrition.**

Table 3. Risk Factors for Ulcer Development

1. **Medical history**
2. **Age**
3. **Weight**
4. **Risk assessment tool results (e.g., Braden Scale)**
5. **Current medications and comorbidities**
6. **Ability to meet nutritional needs independently**
7. **Oral problems (e.g., trouble chewing or swallowing)**

Laboratory Evaluation

Among the standard laboratory studies, several should be considered:

- **HbA1c should be obtained to determine diabetes control and carbohydrate intake.**
- **A complete blood count (CBC) may identify a nutritional anemia.**
  - Microcytic hypochromic anemia may indicate iron deficiency. Macrocytic anemia may indicate folate or B12 deficiency.
- **Total lymphocyte count may be a useful index of overall nutritional health.**
- **Albumin and prealbumin are often ignored as nutritional indicators because they are susceptible to change by metabolic stress such as infection or trauma and may therefore give confusing information about nutrition.**
  - Whatever the source of a low albumin and prealbumin, one should determine the cause and address it to optimize healing.
- **If the history and physical exam indicate micronutrient deficiencies, specific tests may be ordered.**

Overview

- Developing and implementing a personalized nutrition care plan and catering to patients caloric, protein, hydration, micronutrient needs, and need for diet modifications will ensure that patient nutrition is optimized and meeting all essential needs for wound healing.
- When poor nutrition or malnutrition is present, wound healing can be delayed, worsen, or even come to a halt.
- Hyperglycemia is a huge contributing factor for wound development and poor wound healing.
- Optimal glycemic control is essential along with ensuring the patient's HbA1c is at or near 7.0%. The exact target HbA1c should be based on age and insulin production.

Factors Involved in Healing

- Proper nutrition is fundamental to healing.
- Multiple local, systemic, environmental, and even social factors must be optimized to assure healing.
- Wounds require protein, calories, and micronutrients to provide the substrate to support neovascularization, collagen formation and epithelialization.
- Deficiency of a single nutrient such as Vitamin C are well known to cause poor wound healing.
- Care providers managing patients with traumatic wounds should be aware of the importance of metabolic support to provide nutrient substrate to heal the wound.

Table 4. Factors Involved in Healing

Local Factors	Systemic Factors
• Wound infection	• Nutrient deficiencies
• Bacterial colonization	• Diabetes mellitus
• Ischemia	• Renal disease
• Venous insufficiency	• Cardiovascular disease
• Debris or foreign bodies	• Advanced age
• Oxygen saturation	• Lack of mobility
• Mechanical trauma / pressure	• Smoking
• Neuropathy	• Certain medications

Hydration

- Hydration is essential since it helps regulate body temperature, maintains kidney function, helps deliver nutrients to cells, contributes to good skin turgor, and helps better blood flow, which are all important factors when preventing and/or treating diabetic wounds.
- Hydration requirements can be 1 mL/kcal or standard maintenance fluid requirements are 25–35 mL/kg of body weight/day for healthy adults.
- Before calculating estimated hydration needs consider the following:
  - Heart failure
  - Renal function
  - Serum sodium values
  - Dehydration
  - Altered GI function (e.g., vomiting and/or diarrhea)
  - Skin turgor
  - Edema
  - Hepatic cirrhosis
  - Pharmaceuticals (e.g., corticosteroids, diuretics)

Table 5. Kcal Recommendations

BMI Range	Kcal Recommendations
<30, or under 130% of IBW	25–30 kcal of ABW
30–50	11–14 kcal per kg of ABW
>50	22–25 kcal per kg of IBW

ABW, actual body weight; **BMI**, body mass index; **IBW**, ideal body weight

Calories

- **Caloric needs are high when a diabetic foot ulcer is present. Calories provide energy to aid in wound healing and energy demand increases with the patient's nutrition risk factors and the severity of wound(s).**
  - Adequate energy aids in collagen formation, anabolism, cell metabolism, and development of new tissue such as blood vessels.
- **Generally, the recommended daily calorie intake is 2,000 for women and 2,500 for men.**
- **Overweight patients with a BMI >30 are at risk of malnutrition, yet patients with significant unintentional weight loss over a specific amount of time are also at risk.**
- **Conducting 24-hour recalls and food frequency questionnaires should be practiced at every visit when treating a patient to ensure the patient is meeting estimated caloric needs.**
- **Utilize indirect calorimetry as the gold standard for identifying energy needs. If indirect calorimetry is not available, there are other formulas that can provide a standard starting point.**

Macronutrients

- **Carbohydrates, protein, and fats are the three essential food groups known as macronutrients.**
- **Specific macronutrient needs are high when a patient has a DFU, especially if the patient is malnourished or is at risk of malnutrition, because the body may be at or close to a catabolic state.**
- **When in a catabolic state, the body will utilize its own skeletal muscle as its energy source. This results in a loss of lean body mass and worsening of the patient's wound healing process.**

Protein

- **Protein intake is essential to provide amino acids for optimized wound healing.**
- **These amino acids build and repair muscle, skin tissues, hormones, and enzymes, and help to regulate fluid balance and promotes positive nitrogen balance.**
- **Protein is important in all stages of the healing process from hemostasis to remodeling.**
- **Increased protein levels have been linked to improved wound healing rates.**
- **Many guidelines recommend 1.25–1.5 g/kg body weight per day of protein for malnourished patients with pressure injuries.**
- **Quality of protein consumed is also important to provide adequate essential amino acids which cannot be synthesized in the human body.**
- **Protein intake is particularly important for collagen production. Collagen is the major protein of scar tissues that:**
  - Provides tensile strength in the healing wound.
  - Modifies cellular activities to optimize mitogenesis, differentiation and migration.
  - Is involved in interactions between enzymes which remodel the extracellular matrix, including matrix metalloproteinases and their tissue inhibitors.

Table 6. Protein Requirements

Patient with T2DM*	Protein Requirements
No risk of malnutrition	0.8–1.0 g/kg/d of ABW or use IBW if patient is obese
Have or are at risk of malnutrition	1.25–1.5 g/kg/ d of ABW or use IBW if patient is obese
During stress or illness	Up to 2 g/kg/d of ABW or use IBW if patient is obese
Critically ill with BMI 30–40	Up to 2 g/kg/d of IBW
Critically ill with BMI >40	Up to 2.5 g/kg/d of IBW

* In adults with chronic kidney disease who are not critically ill, it is reasonable to prescribe, under close clinical supervision, a dietary protein intake of 0.6–0.8 g/kg/d of ABW per day to maintain a stable nutritional status and optimize glycemic control.

Carbohydrate and Fats

- **Carbohydrates and fats provide a patient's energy needs.**
- **Both fats and carbohydrates help support inflammatory response, cellular activity, angiogenesis, and collagen deposition in the proliferative phase of healing process.**
- **For patients who have poor glycemic control and/or diabetes their carbohydrate requirements will require focused attention throughout treatment.**
  - In a patient with elevated BMI and poor diabetes management, one should minimize energy intake while optimizing protein intake.
  - Only in patients of low BMI will it likely be necessary to set specific minimal caloric goals.
- **Important fats to consider are mono and poly-unsaturated fatty acids that play a major role in cell membranes.**
  - Eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and arachidonic acid, are fatty acids that contribute to membrane fluidity, membrane and intracellular signals, and the modulation of apoptotic pathways.
- **Carbohydrate daily recommendations will vary from patient to patient based on maturity of T2DM, daily glycemic control and if patient is on insulin therapy or oral hypoglycemics.**
- **The average woman needs about 3–4 choices (45–60 g), while men may need 4–5 choices (60–75 g) at each meal.**
  - This number could vary more or less depending on the individual calorie needs (i.e., pregnant/nursing, ill, etc.), medication, and level of physical activity.
  - Carbohydrates are measured in grams: 4 kcal/g of carbohydrate.
  - Every carbohydrate food type has a specific serving size.
  - 1 carbohydrate serving = 15 g of carbohydrates

Table 7. Glycemic Targets for Inpatient Glycemic Control

Critically Ill	Noncritically Ill
• Glucose 140–180 mg/dL • Glucose <140 mg/dL may be appropriate in some patients • Glucose <110 mg/dL is not recommended	• Premeal glucose <140 mg/dL • Random glucose <180 mg/dL • Reassess therapy for premeal glucose <100 mg/dL • Change therapy for premeal glucose <70 mg/dL

Hydroxymethylbutyrate (HMB)

- **HMB is a metabolite of leucine, an essential amino acid, and can be acquired through both plant and animal foods such as grapefruit and catfish.**
- **HMB has been shown to:**
  - Decrease the proteolysis, increase the protein synthesis, decrease the apoptosis, and increase the cell proliferation.
  - Stabilize the muscle cell membrane and modulate protein degradation.
- **When supplementing with HMB, current evidence suggests that either 1 g of HMB should be consumed 3 times per day or 1.5 g of HMB should be consumed 2 times per day, for a total of 3 g of HMB daily (or 38 mg/kg of bodyweight).**
- **One study has shown that a combination of these three nutrients arginine, glutamine and HMB improves wound healing of DFUs in patients who have poor limb perfusion and/or low albumin levels.**

Arginine

- **Arginine is a conditional essential amino acid that can be synthesized by the body from glutamine and is a precursor of nitric oxide and proline. It plays an essential role in the inflammatory process and collagen synthesis, regulates pathways required for tissue cell growth, replication and repair and may be beneficial to enhance wound healing.**
  - Arginine can become essential in malnourished patients with DFUs or those at risk of DFUs.
- **Arginine is beneficial in larger dosages when a diabetic wound is present since it has been shown to enhance wound strength and collagen deposition.**
  - Supplemental arginine improve markers of wound healing such as greater protein and hydroxyproline in the wound bed, enhanced T-lymphocyte function, and promotion of positive nitrogen balance.
- **For patients who have existing diabetic wounds with adequate protein intake, the recommended dose of arginine supplementation is 4.5 g/day.**

Glutamine

- **Glutamine is also a conditional essential amino acid. It becomes essential when wounds are present since it helps support the immune system and helps stimulate collagen synthesis.**
- **Glutamine is also essential for wound repair. It is used by intestinal cells within wounds for cell proliferation, and inflammatory cells including lymphocytes and macrophages.**
- **When the body's immune system is affected due to illness and or infection, the demand for glutamine is high since inflammatory cells use glutamine as a leading source of fuel.**
- **Recommended glutamine doses range from 20–40 g daily depending on the condition being treated.**

Micronutrients

- **Vitamins and minerals are essential to the health of the body and should be included in all nutritional assessments.**

Other Vitamins and Micronutrients

- **Vitamin C**
  - Vitamin C is known to be an essential vitamin in the role of tissue repair.
  - Vitamin C aids in tissue regeneration and collagen formation and is required for collagen tensile strength.
  - Vitamin C plays a major role in the absorption of iron, activation of copper, protein metabolism, and plays an important role in immune function.
  - Excess Vitamin C will be excreted in the urine, and long-term excess vitamin C may cause oxalate deposits in bone or soft tissues.
  - Large doses are sometimes provided for antioxidant activity.
- **Zinc:**
  - Zinc is a trace mineral that is necessary for cell replication and growth.
  - Zinc plays a major role in immune function, protein synthesis, DNA synthesis and proliferation of inflammatory cells and epithelial cells.
  - Zinc is influenced by infection and the inflammatory process.
  - Inflammation and/or infection may falsely lower zinc serum levels. In this case serum zinc levels should not be used to determine need for supplementation.
  - Zinc levels need to be monitored by a health care professional to ensure they stay within normal range.
- **Vitamin E**
  - Vitamin E is a fat-soluble vitamin that is known to act as an antioxidant. It is responsible for normal fat metabolism and collagen synthesis.
  - Research has demonstrated a positive effect on pressure injury healing when combined with arginine and zinc in energy-dense oral supplements.
  - Recommended daily allowance for healthy adults is 15mg/day.
- **Vitamin D:**
  - Vitamin D, referred to as calciferol is a fat-soluble vitamin that is naturally present in foods, especially fortified/enriched foods, and can be generated by sun exposure.
  - Vitamin D promotes calcium absorption in the gut and maintains adequate serum calcium and phosphate concentrations to enable normal bone mineralization.
  - Vitamin D also aids in reduction of inflammation as well as modulation cell growth, neuromuscular and immune function, and glucose metabolism.

Table 8. Micronutrient Table

Nutrient	Intake	Upper Limit	Comments	Food Sources	Benefits
Zinc	Men: 11 mg Women: 8 mg	40 mg/day	Sufficient: >85 mcg/dL Marginal: >70 to less than or equal to 85 mcg/dL Low: Less than or equal to 70 mcg/dL	High quality protein, meat, fish, eggs	May help fill in the gap for any potential micronutrient imbalances
Vitamin C	Men: 90 mg/d Women: 75 mg/d	2000 mg/day	Tobacco Smokers need additional Vit C: 35 g beyond daily limit	Citrus fruits and juices, tomatoes, potatoes broccoli	Collagen formation, enhances activation of leukocytes and macrophages to wounds, improves tensile strength, aids in iron absorption
Vitamin D	<70 years: 600 mg IU/d (15 mcg) >70 years: 800 IU/d (20 mcg)	4000 IU/day	Sufficient: Above 30 ng/mL Insufficient: >20 less than or equal to 30 ng/mL Deficient: Less than or equal to 20 ng/mL	Sunlight, fish liver oils, fatty fish, fortified milk, breakfast cereal	Neuromuscular functions, bone calcification, and other important cellular processes
Vitamin E	15 mg/day	1000 mg/day	Serum concentrations depend on the liver	Wheat germ, seeds, nuts, vegetable oils, green leafy vegetables and fortified cereals	Quenches free radicals and helps maintain membrane integrity
Vitamin B12	Age 14 y+ Adult men and women: 2.4 mcg	Tolerable Upper Intake Level (UL): Maximum daily intake unlikely to cause adverse health effects	Subnormal serum or plasma values as those lower than 200 or 250 pg/mL (148 or 185 pmol/L)	Present in foods of animal origin: fish, meat, poultry, eggs, and dairy products. Fortified breakfast cereals, fortified yeast	
Vitamin A	Men: 900 µg/day Women: 700 µg/day	3000 µg/day	Inadequacy of plasma retinol concentration • In some populations ▸ <0.70 µmol/L (or 20 mcg/dL) • Marginal concentrations in some people ▸ 70–1.05 µmol/L	Beef liver, fish oils, fish, milk, eggs, fortified cereals Provitamin A: orange and yellow vegetables, tomato products, carrots, squash, cantaloupe, broccoli	Supports wound strength and healthy new tissue

Overview

- Nutrition interventions are recommended for all patients who could benefit, now or in the future, from nutritional care.
- Nutrition intervention involves many strategies, including hydration, diet, oral nutritional supplements, tube feeding, and parenteral nutrition.
- Healthcare providers should develop and implement an individualized nutrition care plan for individuals with, or at risk of, a DFU who are malnourished or who are at risk of malnutrition.
- Specific nutrition plans should be individualized and based on existing diagnoses, patient preferences, age, lab test results, pre-existing health and medical conditions, tolerance of vitamin/mineral supplements, access to professional/caregiver/family support with grocery shopping and cooking, and other available resources.
- It's important to set goals that promote improvement in or maintenance of nutritional status, prevention of infection, and optimization of nutritional intake to prevent impaired or delayed wound healing.
- Offer most individuals with nutritional and DFU risks a minimum of 30–35 calories per kg body weight per day, 1.25–1.5 g of protein per kg body weight per day, and 1ml/kcal/day of fluid intake.
  - For individuals with a high BMI, lower calorie intake while still meeting protein goals may be appropriate.
- Conducting 24-hour recall, food frequency questionnaires, and reviewing food diaries (if available) will play an essential role in helping you determine a patient's energy and protein needs.
- The goal of intervention is to help the patient consume food and fluid in amounts that meet estimated nutritional requirements, maintain, reduce, or increase body weight, depending on BMI, and prevent unintentional weight loss.

Hydration

- Hydration status affects blood volume, blood circulation, and skin turgor, all of which are important in the wound-healing process.
- Standard maintenance fluid requirements are 25–35 mL/kg/day for healthy adults.

Diet

- Dietary changes are often the best starting point when it comes to nutrition intervention in patients with DFUs.
- Patients should start by eating less unhealthy fat, such as trans-fat, saturated fat, and cholesterol, and eating more unsaturated fats.
- Priority should be given to nutrient dense foods.
- Sodium intake should be reduced to 3,400 mg or less per day to help with control of blood pressure.
- Oral nutrition supplements (ONS) can be taken between meals as needed to help provide additional protein and micronutrients.
- Patients should consider varying the types of foods and supplements taken to avoid taste fatigue.
- High-calorie, high-protein fortified foods and supplements should be offered, in addition to dietary changes, when dietary changes alone are not sufficient to meet nutritional requirements.

Oral Nutrition Supplements (ONS)

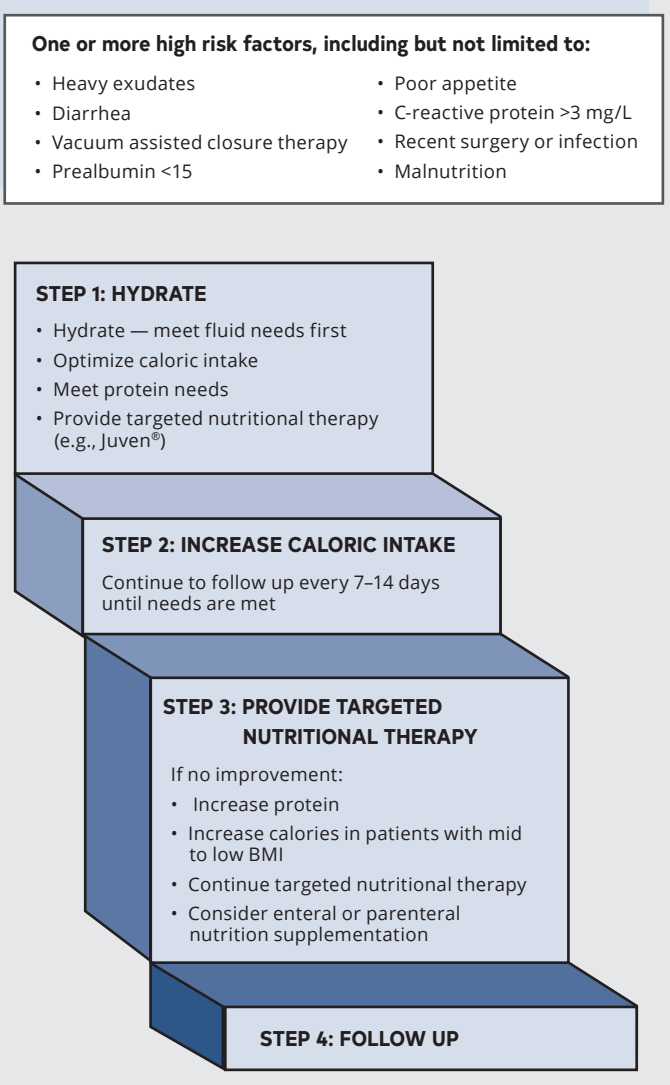
- **Oftentimes a proper diet alone will not be sufficient for optimal wound healing.**
- **Starting ONS early is especially important for patients who are at greater risk for malnutrition and for those who are already showing signs of malnutrition.**
- **ONS are liquids, semi-solids or powders that provide macro- and micronutrients needed for wound healing.**
- **For many patients with DFUs, ONS will be more effective than dietary changes alone.**
- **The addition of specific supplements such as arginine, glutamine and HMB as an adjunct to standard of care may improve healing of diabetic foot ulcers, especially in patients with poor limb perfusion and/or low albumin levels.**
  - In a study of healthy elderly subjects, supplementation with arginine, glutamine, and HMB increased collagen deposition (as reflected by hydroxyproline content) at the wound site, suggesting that supplementation may provide a safe, non-invasive, nutritional means for improving wound repair.
- **Therapeutic Nutrition Powders (e.g., Juven®) are among the most commonly used supplements.**
  - These have been shown to support wound healing by enhancing collagen production and can help replenish critical nutrients needed for wound healing such as arginine, glutamine, HMB and also other micronutrients.
- **When offering nutritional supplements discuss oral supplements available and flavor options.**
- **Encourage oral supplement intakes in-between meals.**
- **All ONS should always be administered along with proper hydration and a balanced diet.**

Table 9. ONS Options

Approach	Form	Delivery*
• Complete meal replacement • Modular • Enhanced modular • Multivitamin	• Powder • Prepared drink • Semi-solid • Tablet/pill/chewable	• Oral eaten • Oral drinks • Feeding tube • Intravenous

* Some products fall under multiple delivery mechanisms.

Figure 1. ONS Usage



Enteral and Parenteral Nutrition

- **If a patient is unable to meet estimated nutrient, energy, protein, and hydration needs despite nutrition interventions:**
  - Discuss with patient the benefits and harms of enteral or parenteral feeding to provide additional or an alternative source of nutrition support.

Special Populations

- **Overweight and Obese Patients**
  - Most diabetic patients are overweight or obese, which by definition, is malnutrition.
  - Many such patients are sarcopenic, with decreased lean body mass despite excess body weight.
  - It is possible for the overweight or obese patient to meet the metabolic needs of the healing wound while simultaneously losing weight.
  - Weight loss improves diabetes control which helps heal the wound but also decreases the pressure on the DFU in the ambulatory patient.
- **Older Adults**
  - A significant number of patients with diabetes are geriatric.
  - Geriatric patients also have a variety of social and physiologic issues that lead to decreased protein and micronutrient intake.
  - Many geriatric patients should be considered malnourished until proven otherwise.

Figure 2. Nutritional Assessment

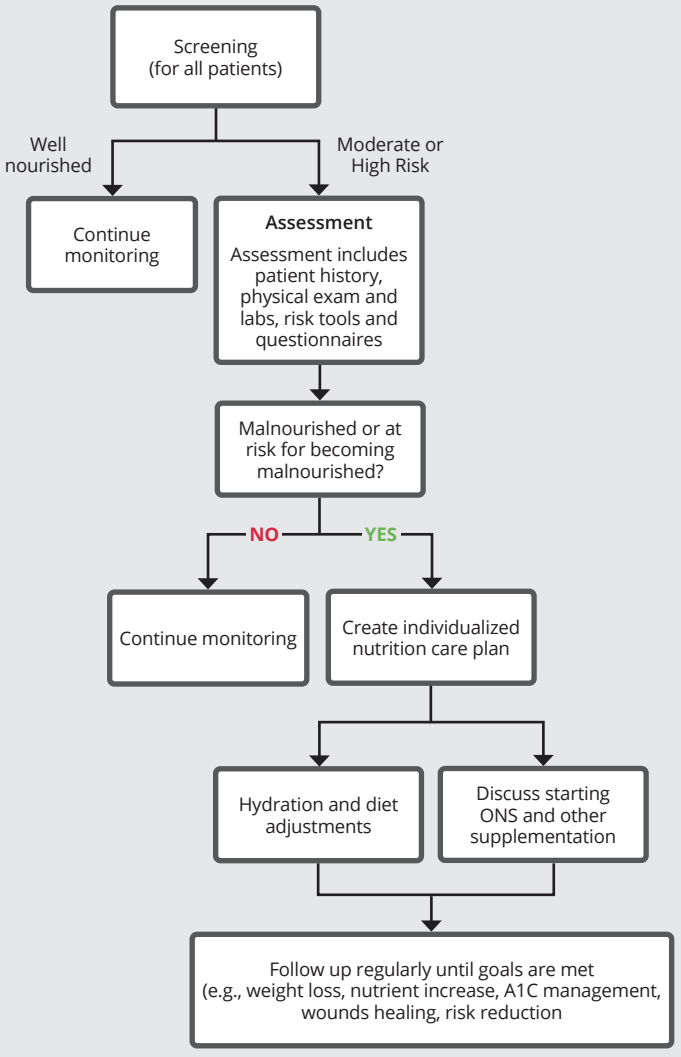
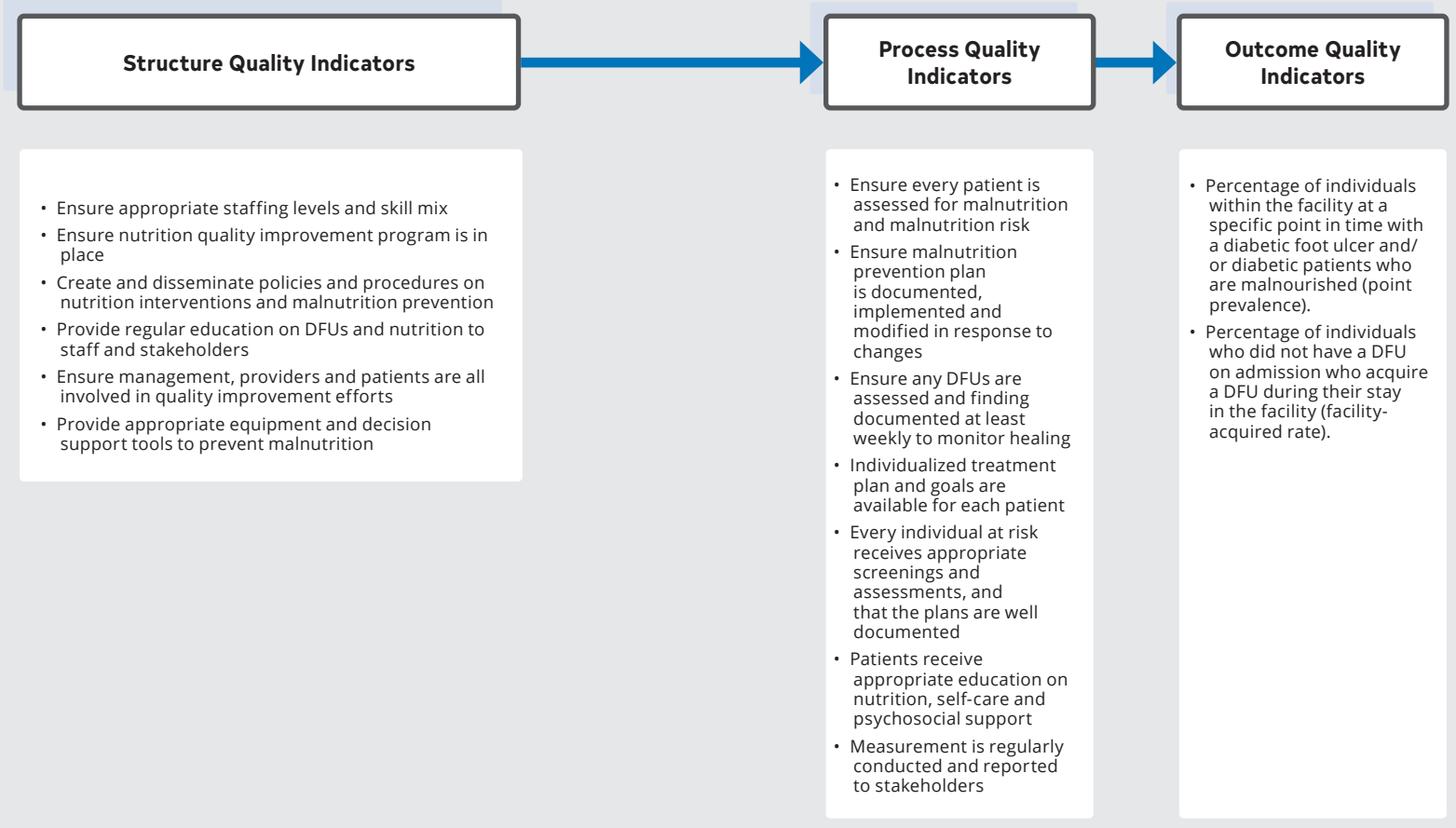


Figure 3. Quality Indicators



Patient Adherence

- Educating patients with DFUs about their increased dietary needs as well as the best dietary sources of essential nutrients involved in wound healing can lead to improved outcomes.
- Patients should be counselled on nutrition in a group or individually. It has been demonstrated that when clinicians collaborate with the patient in a meaningful exchange of information, HbA1c, quality of life and adherence is improved.
- Patients should be educated on proper hydration, tracking daily glucose targets, and consistency, including the use of reminder alarms throughout the day.
- Patients may not be able to meet estimated needs with diet alone — do not hesitate recommending oral nutrition supplements to help meet these needs.

Reminders for Patients to Help Control Blood Sugar

1. Patients should eat three meals a day and 1–2 snacks in-between meals based on blood sugar levels and goals.
2. No skipping meals!
3. Patient should try to consistently eat the same amount of carbohydrates at each meal.
4. If patient skips a meal, they should not try to make up for carbohydrates not eaten, instead they should stay around same carbohydrate recommendation for every meal.
5. Patients with T2DM should consume 20–35 g of fiber from raw vegetables and unprocessed grain per day. The FDA advocates consumption of 25 g dietary fiber per 2,000 calories consumed.
6. Diet should focus on whole grain foods, plenty of fiber, and choosing foods that are less processed to avoid rapid spikes and drops of blood sugar levels.

Patient/Clinician Discussion /FAQ

- **How often should I be screened for nutritional deficiencies?**
  - You should see your healthcare team regularly, at least 1–2 per year. In addition, if you are malnourished or at great risk for becoming malnourished, you should see your care team more frequently.
- **How important is exercise?**
  - Proper diet and exercise go hand in hand, so both are very important! Exercise is even more important when your BMI is higher than 30.
- **Do supplements taste bad?**
  - This is a common myth. There are a variety of supplements that come in many formats and flavors. If one type of flavor of supplement tastes bad to you, there are usually a handful of others that you can try until you find what tastes best for you.
- **How do I know if I am getting enough vitamins/nutrients in my diet?**
  - Your healthcare team will work with you to create an individualized care plan, and will conduct regular check-ins to ensure that your nutrition levels are where they should be. As long as you stick closely to this plan you will receive the appropriate levels. Talk to you doctor if you are having a hard time sticking to the individualized care plan.
- **Does nutritious food and/or supplementation cost a lot?**
  - No! In fact, it will cost you a lot more in the long run by not taking the right steps to keep your nutrition in check. There are many healthy and nutritious foods, as well as supplements, that are affordable.

Additional Resources for Recipes and More

1. www.cdc.gov/diabetes/managing/eat-well.html
2. www.nutrition.gov/topics/diet-and-health-conditions/diabetes
3. www.diabetes.org/healthy-living/recipes-nutrition/understanding-carbs/carb-counting-and-diabetes
4. www.diabetesfoodhub.org
5. www.eatright.org/health/diseases-and-conditions/diabetes

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Abbreviations

ABW, actual body weight; **ASPEN**, American Society for Parenteral and Enteral Nutrition; **BMI**, body mass index; **CRP**, c-reactive protein; **DHA**, docosahexaenoic acid; **DFU**, diabetic foot ulcers; **EPA**, Eicosapentaenoic acid; **ESPEN**, European Society for Clinical Nutrition and Metabolism; **GLIM**, Global Leadership Initiative on Malnutrition; **HMB**, hydroxymethylbutyrate; **IBW**, ideal body weight; **ONS**, oral nutrition supplements; **RDA**, recommended daily allowance; **REE**, resting energy expenditure; **RDN**, registered dietitian nutritionist; **T2DM**, type 2 diabetes mellitus

Disclaimer

This pocket guide should not be considered exclusive of other methods of care reasonably directed at obtaining the same results. The ultimate judgment concerning the propriety of any course of conduct must be made by the clinician after consideration of each individual patient situation.

International Guidelines Center

106 Commerce Street, Suite 105
Lake Mary, FL 32746
TEL: 407.878.7606 • FAX: 407.878.7611
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