Optimizing Nutrition Care for Pressure Injuries in Hospitalized Patients

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Significance: It is estimated that up to 50% of hospitalized patients are malnourished. Malnutrition can lead to longer hospital stays, altered immune function, and impaired skin integrity and wound healing. Malnutrition has been found to be a significant factor influencing pressure injury (PI) risk and wound healing. While PI prevention requires multidimensional complex care using a variety of evidence-based strategies, hospitalized patients benefit from interventions that focus on improving oral nutrition to reduce PI risk and enhance wound healing. Unfortunately, malnutrition is often under-recognized and inadequately managed in hospitalized patients and this can lead to higher rates of complications such as PI.

Recent Advances: Recent studies suggest that nutritional care has a major impact in PI prevention and management. Strategies, including early identification and management of malnutrition and provision of specially-formulated oral nutritional interventions to at-risk patients, optimization of electronic health record systems to allow for enhanced administration, monitoring, and evaluation of nutritional therapies, and implementation of protocol-based computerized decision support systems, have been reported to improve outcomes.

Critical Issues: Unfortunately, there are gaps in the implementation of nutritional care in hospitals. Timely identification and management of malnutrition is needed to advance quality care for hospitalized patients and reduce malnutrition and associated PI.

Future Directions: Further research on effective, evidence-based strategies for implementation of all stages of the nutrition care process is needed to reduce pressure injuries and malnutrition in hospitalized patients.

Keywords: malnutrition, pressure injury, nutrition, hospitalized patients, oral nutritional supplements

SCOPE AND SIGNIFICANCE

PRESSURE INJURIES in hospitalized patients are common.¹ A recent estimated worldwide prevalence rate of pressure injury (PI) in acute care settings was between 6% and 18.5%.¹ Unfortunately, malnutrition has also been found to be a significant problem affecting upwards of 50% of hospital-

ized patients and has been linked to PI risk.^{2,3} Early detection of malnutrition using validated screening and assessment tools⁴ and management of malnutrition by maximizing daily oral nutrition with oral nutritional supplement (ONS) have been shown to reduce development of PIs and improve healing of existing pressure injuries.⁵⁻⁷

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The purpose of this review is to describe the link between malnutrition and PIs and review current evidence-based strategies that have the potential to improve oral nutritional care for vulnerable hospitalized patients.

TRANSLATIONAL RELEVANCE

Adopting evidence-based practices for PI prevention is essential to move the needle on PI risk for vulnerable hospitalized patients.⁴ That being said, if there are barriers to successful adoption of evidence-based practices for hospitalized patients, quality of care will suffer and intended patient outcomes will not be achieved, leading to higher health care costs, morbidity, and mortality.⁸ Knowledge of strategies to improve oral nutritional care for patients with or at-risk for PI has the potential to improve care and make a positive difference for patients and health care organizations.

CLINICAL RELEVANCE

Malnutrition has been found to be negatively associated with poor patient outcomes especially impaired wound healing and impaired skin integrity.^{2,3,9,10} Recent studies have reported valuable strategies that have been shown to improve nutrition for the prevention of PI in hospitalized patients.^{5–7,11–19} Knowledge of these strategies, as well as identification of potential barriers in implementation, will empower clinicians to optimize their resources and provide the best care for hospitalized patients.²⁰

BACKGROUND/OVERVIEW

Malnutrition and PI in hospitalized patients

Malnutrition in hospitalized patients is a complex process related to factors such as reduced availability and intake of nutrients, underlying comorbidities, inflammation, and metabolic alterations related to disease states and has been found to impair wound healing.^{4,21} Malnutrition can develop in hospitalized patients due to a variety of factors, including anorexia, prescribed withholding of oral feedings, inadequate attempts at oral feeding, or prolonged support on a ventilator.⁴ Not surprisingly, malnutrition has been identified as a significant factor in PI development.³

PIs can present as intact skin or an open wound and may be painful.³ Common locations of PIs are back/sacral/coccyx areas (47%), buttock (17%), and the heel(s) (14%).³ PIs in hospitalized individuals can occur both before and during hospitalization. A hospital-acquired PI (HAPI) can be the result of several factors, some of which may be unavoidable

(age, gender, and end of life organ failure) or may be potentially modifiable (pressure or shearing forces, immobility, nutritional status, anemia, tissue perfusion, and diabetes control). In the United States, HAPI incidence was 0.57 per 1,000 patient days, 3.7 cases per 1,000 patients, and 2.2 per 1,000 episodes during the period 2013–2015.²² HAPIs have a mortality rate of 11.6%, are costly to treat, and result in Medicare reimbursement penalties.²² See Table 1 for Factors associated with PI.

Strategies to optimize PI prevention include: risk assessment, skin care, nutrition, positioning and mobilization, monitoring, and leadership support.²³ While there are many facets of comprehensive PI prevention and care, optimizing nutrition care has a direct link to PI prevention and management.²⁴ Unfortunately, malnutrition in hospitals is often underdiagnosed and managed. This article is a limited review of current literature on nutritional care strategies to reduce PIs.

DISCUSSION

Preventing pressure injuries: optimizing nutrition care in hospitals

The Academy of Nutrition and Dietetics (AND) established the nutrition care process (NCP), a four-step process of assessment, nutrition diagnosis, nutrition interventions, and monitoring/evaluation.⁴ These steps are important to care for patients at-risk for or with PI, as if any of these are missing or inadequately executed, expected clinical results will not be observed. Effective implementation of the NCP coupled with multidisciplinary team collaboration, electronic health record (EHR) solutions, and sufficient oral nutrition support have been reported to improve nutrition and decrease risks associated with malnutrition in hospitalized patients.^{4,25,26}

Unfortunately, barriers such as inadequate knowledge by health care providers and dysfunctional health system processes relating to nutrition care and PI prevention have been identified in the literature which can adversely impact their ability to identify and care for at-risk patients.^{8,24–31} See Table 2 for Barriers and Strategies for Optimal Nutrition Care to Reduce Pressure Injuries.

Some solutions have been identified in the literature, including education programs and multidisciplinary focused care teams.²⁸ Education on nutrition and PI risk for hospital staff on the importance of nutrition care has been reported to positively influence outcomes.²⁸ In fact, in a recent study of nurses, knowledge and attitude were independently associated with the practice of sharing patients' nutrition information with colleagues.³⁰

Table 1. *Factors associated with pressure injuries*

<i>Factor</i>	<i>Strategy for Improvement</i>
Nutrition Malnutrition or poor nutritional status ^{3,6,7,23}	<p>Use of NCP, early identification/intervention, continued monitoring and evaluation, and reassessment of hospitalized patients.</p> <p>Consider hospitalized individuals to be at risk for malnutrition from their illness or being NPO for diagnostic testing. Also consider obese clients who do not appear visibly malnourished.</p> <p>Use a valid and reliable screening tool to determine risk of malnutrition, such as the Mini Nutritional Assessment.</p> <p>Refer all individuals at risk for PI from malnutrition to a registered dietitian.</p> <p>Encourage all individuals at risk for PI to consume adequate fluids and a balanced diet. Assess weight changes over time.</p> <p>Assist the individual at mealtimes to increase oral intake.</p> <p>Assess the adequacy of oral, enteral, and parenteral intake.</p> <p>Provide nutritional supplements between meals and with oral medications, unless contraindicated.</p> <p>Use EMAR for nutritional therapies such as ONS, tube feedings, and parenteral nutrition.²⁵</p> <p>Use CDSS to improve timely, evidence-based care for PIs.³⁸</p> <p>Administer high calorie, high protein formula enriched with Arginine, zinc, and antioxidants as they have been found to reduce PI occurrence and PI size and improve healing.^{6,7}</p>
Impaired perfusion, activity and mobility, friction, and shear ^{3,23}	<p>Inspect the skin at least daily for signs of PI, especially nonblanchable erythema.</p> <p>Assess pressure points, such as the sacrum, coccyx, buttocks, heels, ischium, trochanters, and elbows, and beneath medical devices.</p> <p>When inspecting darkly pigmented skin, look for changes in skin tone, skin temperature, and tissue consistency compared to adjacent skin.</p> <p>Moistening the skin assists in identifying changes in color.</p> <p>Turn and reposition all individuals at risk for PI, unless contraindicated due to medical condition or medical treatments.</p> <p>Choose a frequency for turning based on the support surface in use, the tolerance of skin for pressure, and the individual's preferences.</p> <p>Consider lengthening the turning schedule during the night to allow for uninterrupted sleep.</p> <p>Turn the individual into a 30° side lying position and use your hand to determine if the sacrum is off the bed.</p> <p>Avoid positioning the individual on body areas with PI.</p> <p>Ensure that the heels are free from the bed.</p> <p>Consider the level of immobility, exposure to shear, skin moisture, perfusion, body size, and weight of the individual when choosing a support surface.</p> <p>Continue to reposition an individual when placed on any support surface.</p> <p>Reposition weak or immobile individuals in chairs hourly.</p> <p>Use heel off-loading devices or polyurethane foam dressings on individuals at high risk for heel ulcers.</p> <p>Place thin foam or breathable dressings under medical devices and assess often.</p> <p>Use a structured risk assessment, such as the Braden Scale, to identify individuals at risk for PI as soon as possible (but within 8 h after admission).</p> <p>Refine the assessment by including these additional risk factors: Fragile skin, existing PI of any stage, including those ulcers that have healed or are closed, Impairments in blood flow to the extremities from vascular disease, diabetes or tobacco use, Pain in areas of the body exposed to pressure.</p> <p>Repeat the risk assessment at regular intervals and with any change in condition.</p> <p>Assess acute care patients every shift.</p> <p>Develop a plan of care based on areas of risk.</p> <p>Support surfaces should be assessed frequently and adjusted accordingly.</p> <p>Use a pressure redistributing chair cushion for individuals sitting in chairs or wheelchairs.</p> <p>Too much pain medication may sedate patients to the point where they don't change position as often as they should.²³</p>
Moisture, incontinence, fever, sweating ^{3,23}	<p>Cleanse the skin promptly after episodes of incontinence, fever, or evidence of excess moisture. Use skin cleansers that are pH balanced for the skin.</p> <p>Use skin moisturizers daily on dry skin.</p> <p>Use a breathable incontinence pad when using microclimate management surfaces.²³</p>
Sensory perception pain, age, altered mental status, gender ^{3,23}	<p>Patients should be assessed for their ability to move while still maintaining an acceptable level of comfort.</p> <p>Assess individual risk factors in patients—age, previous/current PI, gender, mobility status, pressure, incontinence, altered mental status.</p> <p>Interdisciplinary team meetings should include clinical team and hospital administrators to evaluate length of stay, readmission rate, mortality data, and cost analysis.^{4,27}</p>
Education ^{23,27,28,30}	<p>Teach the individual and family about risk for PI. Engage individual and family in risk reduction interventions.²⁸</p> <p>Mandatory staff education on prevention and management techniques.^{6,27,28,30}</p>
Length of hospital stay ^{3,9}	<p>Reassess nutritional screening for hospitalized patients who have length of stay greater than expected. Evidence is unclear on the precise recommendation, but evidence suggests that rescreening may be warranted for patients with length of hospital stay greater than 3–5 days.^{3,4,8,9,32}</p>

CDSS, computerized decision support system; EMAR, electronic medication administration record; NCP, nutrition care process; NPO, nothing per mouth or “Nil Per Os”; ONS, oral nutritional supplement; PI, pressure injury.

To facilitate education for health care providers, health systems should sponsor robust continuing education offerings for staff regarding evidence for use of standardized clinical protocols and pathways, nutritional screening and assessment, PI

risk, and PI prevention and treatment methods, including early nutritional intervention for at-risk patients.⁴ Regular communication and collaboration among the multidisciplinary clinical team, including the Registered Dietitian, pharmacist,

Table 2. Barriers and strategies for optimal nutrition care to reduce pressure injuries

<i>Barrier</i>	<i>Strategy</i>
Nothing by mouth and feeding status and/or unable to tolerate oral intake ^{4,8}	Reassess and evaluate current feeding status daily. Institute oral feeding as soon as possible to maintain adequate nutrition. Assess need for alternative nutrition therapies, including tube feeding or parenteral nutrition.
Impaired swallowing function ^{4,8}	Assess patient swallowing function and consult with multidisciplinary nutrition team, including speech therapist, to assess patient and develop comprehensive plan to address malnutrition and PI risk. The swallowing specialist identifies foods and beverages that the patient can safely swallow. Offer those foods or food with the consistency that is safe for the patient to consume.
Patient preference and/or anorexia due to medications/disease state ^{4,8}	Provide patient counseling. Assess patient preferences, choices, likes/dislikes, and reasons for lack of appetite or undernutrition. Provide patients alternative mealtimes as they prefer or alternative food offerings to be kept on the unit for patients admitted at off-meal times.
Financial limitations, cost, lack of health insurance ²⁶	Discuss with patient financial options, limitation, and barriers. Assess and plan care using a multidisciplinary approach, including consultation with social worker. Identify resources or create protocols for reduced cost nutritional supplementation or availability of coupons for products from pharmaceutical companies or community agencies to provide patients at hospital discharge.
Knowledge deficit and/or low health literacy ^{4,8,20}	Assess literacy status and education needs. Provide patient education on current risk for malnutrition or nutrition status. Provide patient education potential consequences of malnutrition. Provide patient education on ways to improve his/her nutrition status. Provide patient external coaching to enhance nutrition intake. Provide patient education on ONS benefits. Assess patient and consult with multidisciplinary nutrition team, including psychiatrist, psychologist, or mental health professional. Involve family members in encouraging food and fluid intake.
Loneliness during mealtime, bereavement, depression, social isolation of patients ^{4,8,20}	Offer assistance to patient when eating and drinking. Provide patient a dietary helper or assistant that stays with patient during meal times. Ask family or significant others to visit during mealtimes and encourage them to eat with the patient. Consult chaplain or social worker for additional resources.
Inadequate lighting during mealtimes ^{4,8,20}	Assess hospital room lighting and assess potential areas for improvement. Ask patients/families their preferences and opinions of current hospital environment for eating.
Mealtime interruptions ^{4,8,20}	Establish regular consistent mealtimes. Limit noncritical interruptions during mealtimes. Schedule routine care before or after mealtimes. Provide encouragement and time to eat meals and encouragement and time to consume nutritional supplements.
Lack of assistance with eating ^{4,8,20}	Assess staffing patterns. Query patients and family members regarding their perspective of adequacy of mealtime resources. Provide support, assistance, or companionship at mealtimes. Ask family to assist loved ones during mealtimes. Use of dietary aids or mealtime assistants at mealtimes. Assess patients at risk for undernutrition and who may need assistance or reinforcement when eating.
Nutrition preferences ^{4,8,20}	Assess patient's preferences (type or form of ONS <i>i.e.</i> , beverage, hot vs. cold, pudding, cookie, flavor, and so on) Offer a variety of high-energy density food, low volume/small portions, palatability, appetizing appearance, and variety of flavors and textures. Provide energy-containing liquids between meals. Offer fluids with flavoring to enhance palatability. Encourage patient to drink more water especially with large draining wounds or fistulas, encourage eating foods that have high water content (cucumbers, watermelon, and celery). Offer patients a variety of hot and cold beverages. Encourage patients to drink all fluids with medications and meals. Offer small amount of fluids regularly. Provide refillable water bottle and add cup holder to wheelchair to encourage drinking. Provide convenient, accessible food and nutrition sources. Stock high quality food and nutrition sources on hospital inpatient units that are easily accessible to staff, including fresh fruits and vegetables, whole grain, and protein sources.
Delays or inconsistent screening, assessment, monitoring of nutrition ^{4,8,20,25}	Assessment daily and when clinical condition changes or progress is not met. Assess all patients using a reliable tool, including those with obesity or no obvious signs of undernutrition. Document and evaluate assessment and make recommendations and changes to plan of care promptly. Use of standardized daily assessment tool in the EHR for nursing, physicians, and dietitians utilizing a standardized nutrition assessment tool. Perform assessment within 24 h of admission to acute care facility. Institute a nutrition plan of care for all patients who have increased metabolic needs, risk of malnutrition, or documented diagnosis of malnutrition. Initiate step-wise approach to nutrition interventions and feeding; if not tolerating or able to take oral intake or not tolerating tube feeding. Automated implementation of nutrition protocols for at-risk patients to reduce delays in beginning interventions.

(continued)

Table 2. (Continued)

Barrier	Strategy
Nutrition may be a low priority for organization or health care provider ^{4,8,20,32}	Create a culture where nutrition is valued as an essential medical intervention that reduces length of hospital stay, pressure injuries, falls, infection, depression, health care costs, morbidity, and mortality. Active and regular communication among interdisciplinary care teams for nutrition care. Engagement of hospital administrators in interdisciplinary workgroups for nutrition care.
Fragmented ordering, administration and documentation of nutritional supplements, errors of omission of nutritional orders ²⁵	Utilize EHR effectively to standardize ordering, administration and documentation of nutrition supplements, nutritional medications, tube feeding, and parenteral nutrition. Utilize protocol-driven CDSS for nutrition care. Utilize EMAR or standardized method for administration and documentation of nutrition medications such as nutritional supplement, protein and micronutrient supplements, tube feedings, and parenteral nutrition to improve the administration and documentation of nutritional interventions.
Nutrition supplement process and workflow ^{20,23,38}	Perform quality and process improvement to evaluate current processes and needs for improvement. Devise system to assess, intervene, and monitor nutrition status in a streamlined consistent manner. Use automated CDSS solutions to enhance NCP.
Malnutrition diagnosis ^{4,8,38,39}	Verify at least two of the six ASPEN characteristics to confirm malnutrition diagnosis: Insufficient energy intake, weight loss, loss of muscle mass and subcutaneous fat, localized or generalized edema, and diminished functional status as measured by hand grip strength. Incorporate nutrition screening and assessment as part of CDSS in EHR. Diagnosing health care providers should use "Six Key Elements for Documenting Malnutrition" to provide complete documentation, including: History and clinical diagnosis, clinical signs and physical examination, anthropometric data, laboratory indicators, dietary data, and functional outcomes.
Provider education and knowledge ^{8,20,27–29}	Assess health care provider's knowledge and opinion of nutrition as an important aspect of patient care and improving outcomes. Mandatory education for front-line health care providers who provide direct clinical care for patients. Education on risks of malnutrition, costs and benefits of early initiation of nutrition, and benefits of nutritional supplements.

ASPEN, American Society for Parenteral and Enteral Nutrition; EHR, electronic health record.

Registered Nurse, nurse practitioner, clinical nurse specialist, physician, wound care specialist, and speech therapist, have also been shown to promote better patient outcomes for patients with or at-risk for malnutrition or PI.^{4,7,27,31} These teams should meet on a consistent basis (*i.e.*, interdisciplinary daily rounds and weekly to monthly team strategy meetings) to tackle issues such as implementing nutrition protocols, performing quality improvement (QI) and assessing outcomes, monitoring data trends, and providing staff education related to comprehensive nutrition care.^{25,27,31}

Optimizing nutrition screening and assessment

Screening for nutritional deficiencies is often completed during hospital admission by Registered Nurses in collaboration with the health care team using standardized, paper or electronic, nutrition screening forms that can trigger a consult to the Registered Dietitian if the patient is deemed to be at high risk of malnutrition.²⁶ All patients in the hospital have a potential to decline in health and should be monitored and rescreened for malnutrition throughout their hospitalization (daily or as condition warrants) using validated tools.^{9,32}

Unfortunately, it has been reported that nutrition screening and assessment are not consistently applied within hospital systems.²⁷ Furthermore,

patients may decline through lengthy hospital stays, and rescreening for malnutrition is not generally a standardized practice in many hospitals.⁹ The Joint Commission requires that a nutritional screening is performed when warranted by the patient's condition (or hospital policy) and must be completed, when applicable for the patient's condition, within 24 h after inpatient admission.³³

To assist clinicians, several nutritional screening tools have been validated for use in acute care settings, including: the Malnutrition Screening Tool (MST), the Malnutrition Universal Screening Tool (MUST), the Nutrition Risk Screening (NRS) tool, Subjective Global Assessment (SGA), Patient-Generated SGA (PG-SGA), Mini-Nutritional Assessment (MNA), MNA-Short Form (MNA-SF), and the NUTRIC (Nutrition Risk in the Critically Ill) score.^{4,34–36} The Global Leadership Initiative on Malnutrition (GLIM) Criteria is a newer assessment tool that is currently being validated for use in acute care settings.³⁷

Screening tools can be completed by any member of the health care team. Identifying patients with or at-risk-for malnutrition will warrant a comprehensive nutrition assessment by a Registered Dietitian. Unfortunately, the utilization and application of these nutrition screening tools vary across clinical situations or specifically in patients with PI.²⁷

Promising strategies to enhance systematic use and communication of this clinical screening and assessment information with complex patients are the use of computerized decision support system (CDSS). CDSS has been found to improve application of complex evidence-based protocols and clinical decision-making and be a positive impact on complicated health issues, such as PI and malnutrition.^{38,39} At the current time, CDSS has not been widely implemented in hospitals even though they have been found to improve a variety of health care outcomes, including PI.^{38,39}

Optimizing nutrition diagnosis, coding, and reimbursement

The AND and the American Society for Parenteral and Enteral Nutrition (ASPEN) recommend that a standardized set of diagnostic characteristics be used to identify and document adult malnutrition in routine clinical practice.⁴ Furthermore, these bodies identified the following six criteria to determine the patient's nutritional status. Patients are considered to be nutritionally compromised when they exhibit at least two of the following six criteria: (1) insufficient energy intake; (2) weight loss; (3) loss of subcutaneous fat; (4) loss of muscle mass; (5) localized or generalized fluid accumulation that may sometimes mask weight loss; and (6) diminished functional status.⁴

Despite these recommendations, malnutrition continues to be underidentified, coded, and reimbursed in hospitals.^{2,40,41} In fact, it has been reported that only 3% to 5% of hospitalized population are diagnosed with malnutrition, although it is estimated that 30–60% of the hospitalized population are malnourished.^{2,41}

To enhance coding and reimbursement of malnutrition-related diagnosis, physicians should include at least the six elements of documentation of malnutrition into their standardized documentation. These include: (1) History and clinical diagnosis (presence of inflammatory processes or nutritional impairments); (2) Clinical signs and physical examination (inflammation, fever, hypothermia, tachycardia, tachypnea, edema, and weight gain/loss); (3) Anthropometric data (height, weight, BMI, weight loss history, and body composition metrics); (4) Laboratory indicators for inflammation and severity of illness (elevated C-reactive protein, low albumin, low pre-albumin, low or high WBC count, elevated glucose, negative nitrogen balance, and elevated metabolic rate); (5) Dietary data (modified diet history or 24-h diet recall); and (6) Assessment of functional outcomes (strength/physical performance).⁴

If warranted, malnutrition should be included in the patient's coded diagnosis; a multidisciplinary nutrition care plan and prescribed nutrition interventions should be implemented within 48 h of identification of malnutrition.³² Appropriate coding of malnutrition diagnosis allows for reimbursement for care-related expenses to maintain resources for delivery of quality care. Examples of ICD-10 Diagnosis codes related to malnutrition are included in Table 3. See Table 3 For ICD-10 Diagnosis Codes for Malnutrition Related Diagnoses.^{40,41}

Optimizing oral nutrition care

In an optimal setting, oral nutrition is the preferred route for nutrition, and it is obtained in adequate amounts to sustain and maintain the body's physiological demands during extended periods of immobility, stress, inflammation, and illness.

Table 3. ICD-10 diagnosis codes for malnutrition related diagnoses^{40,41}

ICD-10	Criteria/Description
E40	Kwashiorkor Nutritional edema with depigmentation of skin and hair.
E42	Marasmic Kwashiorkor.
E41	Nutritional Marasmus. Nutritional atrophy; severe malnutrition otherwise stated, severe energy deficiency.
E43	Unspecified severe protein-calorie malnutrition Nutritional edema without mention of dyspigmentation of skin and hair.
E44.0	Moderate protein-calorie malnutrition.
E44.1	Mild protein-calorie malnutrition.
E45	Retarded development following protein-calorie malnutrition.
E46	Unspecified protein-calorie malnutrition.
E46	Unspecified Protein-calorie malnutrition. A disorder caused by a lack of proper nutrition or an inability to absorb nutrients from food. An imbalanced nutritional status resulted from insufficient intake of nutrients to meet normal physiological requirement. Inadequate nutrition resulting from poor diet, malabsorption, or abnormal nutrient distribution. The lack of sufficient energy or protein to meet the body's metabolic demands, as a result of an inadequate dietary intake of protein, intake of poor quality dietary protein, increased demands due to disease, or increased nutrient losses.
E64	Sequelae of protein-calorie malnutrition.
E66.01	Morbid (severe) obesity due to excess calories.
R63.6	Underweight. Use Additional code to identify body mass index (BMI), if known (Z68.-) Type 1 Excludes abnormal weight loss (R63.4) anorexia nervosa (F50.0-) malnutrition (E40–E46).
R63.4	Abnormal weight loss.
R64	Cachexia. Applicable To Wasting syndrome Code First underlying condition, if known Type 1 Excludes abnormal weight loss (R63.4) nutritional marasmus (E41).
Z68.1	Body mass index (BMI less than 19, adult).

Patients who have impaired oral tolerance or difficulty swallowing may require feeding through enteral tube or intravenous nutrition in the form of parenteral nutrition.⁴

All hospitalized patients should receive a well-balanced diet and maintain adequate nutrition while being hospitalized.⁴ Adequate energy sources (carbohydrates and fats), protein sources (*e.g.*, animal or vegetable proteins), amino acids (leucine), hydration (water, fluids, and food within fluids), and vitamins and minerals are important for skin integrity and enhancing wound healing.^{4,20,30,40–42}

Optimal nutrition, including sufficient energy, carbohydrate, protein, amino acid, and fat and micronutrient intake in patients, has been found to facilitate prompt and effective skin integrity maintenance and wound healing.^{3,4,24,42,43} When designing any individualized nutrition care plan for a patient with malnutrition and/or PI, health care providers should provide a variety of foods to ensure that carbohydrates, fats, and proteins, as well as micronutrients and adequate hydration, are sufficient to meet estimated requirements.²⁴ Vitamins such as Vitamin A, Vitamin C, Zinc, and Copper have all been implicated in wound healing and immune system function.^{24,44}

Ideally, patients at risk of or with PIs should obtain adequate vitamins and minerals from dietary sources such as those listed below. The 2014 International Guidelines for Prevention and Treatment of PI recommend providing and encouraging an individual assessed to be at risk of a PI to take vitamin and mineral supplements when dietary intake is poor or deficiencies are confirmed or suspected.⁴ Furthermore, other sources provide recommendations on supplementation of Vitamins for the treatment of PIs, although evidence is limited and more research is needed.^{24,43}

Vitamin C

Vitamin C in wound healing may impact collagen formation, immunomodulation, and antioxidant functions; however, evidence is limited and supplementation is only indicated in a documented deficiency.^{21,24,43} The recommended dietary allowance (RDA) for Vitamin C is 90 mg/day for adult men and 75 mg/day for adult women. The tolerable upper limit (UL) for Vitamin C is 2,000 mg (11,360 μ mol)/day.⁴³ Vitamin C deficiency may result in impaired immune response during the inflammatory phase with increased capillary fragility and reduced collagen tensile strength, which can impact PI risk and healing. Doses between 250 and 1,000 mg/day of

Vitamin C in divided doses have been recommended for patients who have poor dietary intake to enhance wound healing for PI.^{4,24} Up to 1,000 to 2,000 mg/day for Stage 3 or 4 PI and for highly stressed, malnourished, or seriously injured patients has also been recommended.²⁴ However, giving high dosages of Vitamin C may be contraindicated in individuals with a history of calcium oxalate kidney stone formation.⁴³ Dietary sources of Vitamin C include: oranges, red pepper, kale, Brussel sprouts, broccoli, strawberries, grapefruit, and guava.^{21,24,43}

Vitamin A

Vitamin A may be helpful in wound healing especially in patients who have a documented deficiency or who have inadequate intake of foods rich in Vitamin A.^{24,44,45} The RDA for Vitamin A for healthy adult males is 900 μ g retinol activity equivalents (RAE) and for females is 700 μ g RAE.⁴⁵ The tolerable UL for preformed Vitamin A is 3,000 μ g RAE/day.⁴⁵ Vitamin A dosing for PI management (all stages) has been recommended to be 3,000–15,000 μ g RAE per day orally for injured or severely malnourished persons.²⁴ Molnar recommends oral Vitamin A at 6,000–7,500 μ g RAE per day to enhance wound healing in patients receiving corticosteroids.⁴⁴ Dietary sources of Vitamin A include: Liver and fish oils, green leafy vegetables, orange and yellow vegetables, and tomatoes.^{24,45}

Zinc

Zinc supplementation has been found to be helpful in wound healing for patients who have zinc deficiency due to poor dietary intake or increased losses of zinc.^{6,7,24} The RDA of Zinc for healthy males is 11 mg/day and for females is 8 mg/day.⁴⁵ The tolerable UL for Zinc is 40 mg/day.⁴⁵ Zinc toxicity is associated with impaired neutrophil and lymphocyte function and calcium and copper binding. Excess zinc supplementation is associated with gastrointestinal track irritation, nausea, vomiting, and diarrhea. Chronic intakes of zinc can result in a copper deficiency because they compete for the same receptor sites.⁴⁵ Dietary sources of zinc include: Oysters, beef, crab, lobsters, chickpeas, nuts, cheese, yogurt, pork, fish, and fortified breakfast cereals.⁴⁵

Copper

Copper is an essential nutrient required for collagen cross-linking and it may play a role in angiogenesis and promote wound healing, although exact mechanisms are unclear. Copper is destructive to bacterial strains, and it may be helpful in immune

function, evidence is limited. Recommended daily intake of Copper for adult males and females is 900 $\mu\text{g/day}$.⁴⁵ The tolerable UL for adults is 3,000 RAE/day (10,000 IU/day).⁴⁵ Critical adverse effect of copper toxicity is liver toxicity and there is reduced Copper absorption when Zinc is supplemented.⁴⁵ Dietary sources of Copper include: Oysters, dark chocolate, liver, and sesame seeds.^{24,45}

Optimizing Oral Nutritional Supplements

An ONS is a product designed to meet macro and micronutrient needs of individuals who cannot meet their nutritional requirements through their current dietary intake.⁴⁶ FDA defines “dietary supplements” in global terms to include both ONSs and vitamin mineral supplements. In health care settings, there is a distinction between products that contain energy and replace or fortify food (ONSs) versus micronutrient (vitamin and mineral supplements) or herbal supplements.⁴⁶

Nutritional (also referred to as dietary) supplements are supplied as tablets, capsules, powders, energy bars, and liquids and are widely available in the United States and on the Internet.⁴⁶ The National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP), and the Pan Pacific PI Alliance (PPPIA) Nutrition Guidelines for 2014 recommend offering fortified foods and/or high-energy, high protein, ONS between meals if nutritional requirements cannot be achieved by dietary intake alone.⁴ The strength of evidence is rated as “B” (the recommendation is supported by direct scientific evidence from properly designed and implemented clinical series on PI in humans or humans at risk for PI, providing statistical results that consistently support the recommendation (levels 2, 3, 4, 5 studies). The strength of this recommendation is rated as a “strong positive recommendation: definitely do it.”⁴

Studies show that consumption of specialized, nutrient-enriched ONS improves outcomes for malnourished hospitalized patients who are either at risk for PI or who have PI, although the studies are of limited quality and size.^{5–7,11–19} Recently, Cereda *et al.* published a systematic review of randomized control trials from January 1997 to October 2015 and found that compared to control interventions, ONS enriched with arginine, zinc, and antioxidants resulted in significant reduction in wound area (–15.7% [95% confidence interval, CI: –29.9 to –1.5]; $p=0.030$; $I^2=58.6\%$) and a higher proportion of subjects had a 40% or greater reduction in PI size (odds ratio=1.72 [95% CI: 1.04 to 2.84]; $p=0.033$; $I^2=0.0\%$) at 8 weeks. This meta-

analysis found that the use of ONS enriched with arginine, zinc, and antioxidants as oral supplements and tube feeds for at least 8 weeks was associated with improved PI healing compared with the use of standard nutritional ONS.⁷

Furthermore, studies show that positive outcomes (reduced costs, mortality, length of hospital stay, and complications such as PI) have been found when malnutrition was identified promptly (within 24 h) and nutrition intervention (using ONS) was initiated early and in a standardized manner.^{4,10,25,47} For example, the Cleveland Clinic in Akron, Ohio conducted a QI project to assess the impact of prompt nutrition care on health care outcomes.⁴⁷ This retrospective study reviewed 20,000 hospitalized records and found decreased HAPI prevalence by 50% (from 40 PIs to 20 PIs) from quarter to quarter after implementing automated screening and intervention protocol (ONS) for at-risk patients.⁴⁷

A brief review of literature of the current understanding of the use of ONS and PI is presented in Table 4. Literature from PubMed and CINAHL database from 2014 to 2019 was reviewed using keywords: nutrition, PI, malnutrition, and ONS. Considering the evidence, there may be significant benefits that patients and hospital systems may see when nutrition care is optimized using specialized formulations of ONS.

Optimizing nutrition monitoring

Nutrition monitoring (and evaluation) are essential steps that are often incomplete or missing within hospital EHRs and this leads to poor outcomes such as PI and malnutrition, among others.^{4,25,47} Effective monitoring and evaluation require the complete evaluation of food and nutrient intake, food and nutrient administration, complimentary/alternative medication use, knowledge/belief, food and supplies available, physical activity, and nutrition quality of life.⁴

According to the Agency for Health Care Research and Quality in 2008, supplements such as herbals, vitamins, and nutritional supplements should be part of the patient’s medication history and be reconciled with other medications listed on the medication administration record (MAR).⁴⁸ Inadequate administration and documentation of nutrition therapies, including ONS, has been found to be a significant problem in hospitals and has been identified as a barrier in the implementation and evaluation of nutritional care and prevention of pressure injuries.^{25,27,49,50} In fact, in many hospitals, nutrition therapies are often documented as volume-only in the intake

Table 4. Disease-specific oral nutritional supplements and pressure injury outcomes (2014–2019)

Reference	Study Type, Aim, Sample Size, Study Setting, Study Duration	Active Intervention	Control Intervention	Outcome Measures	Results/Limitations
Cereda, <i>et al.</i> ⁶	Randomized controlled trial. Two-group (parallel assignment), randomized, controlled, blinded clinical trial (February 2010 to November 2012). <i>n</i> =200 malnourished patients Location: seven long-term and home care sites in Italy Study Duration: 8 weeks	<i>n</i> =101 Standard diet plus two specific ONS per day (27.5 kcal/kg/day; 1.5 g/kg/day)	<i>n</i> =99 Standard diet plus two isocaloric, isonitrogenous ONS/day (27.0 kcal/kg/day; 1.5 g/kg/day)	Pressure ulcer healing using wound perimeter tracing using VISTRAKTM system	Supplementation with the enriched formula (<i>n</i> =101) resulted in a greater reduction in pressure ulcer area (mean reduction, 60.9% [95% CI: 54.3 to 67.5]) than with the control formula (<i>n</i> =99) (45.2% [95% CI: 38.4 to 52.0]) (adjusted mean difference, 18.7% [95% CI: 5.7 to 31.8]; <i>p</i> =0.017). A more frequent reduction in area of 40% or greater at 8 weeks was also seen (OR: 1.98, [CI: 1.12 to 3.48]; <i>p</i> =0.018). No difference was found in terms of the other secondary end points. Limitations: small study, one country, lost ~25% to follow-up
Pouyssegur, <i>et al.</i> ¹⁶	Randomized controlled trial Aim: To evaluate the impact of a solid nutritional supplement on the weight gain of institutionalized older adults >70 years with protein-energy malnutrition. The innovation of these high-protein and high-energy cookies was the texture adapted to edentulous patients <i>n</i> =175 elderly participants Location: seven nursing homes Study Duration: 6 weeks	<i>n</i> =88 Standard diet plus eight high-protein, high-energy cookies per day (11.5 g protein; 244 kcal) for 6 weeks. Each cookie weighed 6.5 g and contained 1.44 g of protein, 30.5 kcal, and 22% of weight in proteins. Total energy content in proteins was 19% with an animal/vegetable protein ratio of 3.5 and a glycemic index of 46.1. Eight cookies were distributed in the breakfast and/or in the snack (total 52 g of cookies: 11.5 g of protein and 244 kcal as daily supplementation).	<i>n</i> =87 Standard diet	Five measurements over 6 week period Percentage of weight gain in kg Appetite (numerical scale 1–10), frequency of diarrhea, and pressure ulcers	Significant increase in weight in the intervention group (<i>n</i> =88) compared to that of the control group (<i>n</i> =87), which lacked cookie supplementation (+1.6 vs. –0.7%, <i>p</i> =0.038). Weight gain persisted 1 month (+3.0 vs. –0.2%, <i>p</i> =0.025) and 3 months after the end of cookie consumption (+3.9 vs. –0.9%, <i>p</i> =0.003). Subgroup analysis confirmed the positive impact of cookie supplementation alone on weight increase (<i>p</i> =0.024), appetite increase (<i>p</i> =0.009), and pressure ulcer reduction (<i>p</i> =0.031). Limitations: small sample size, variety of diets between facilities and participants, may not have controlled for other supplements taken.
Wong, <i>et al.</i> ¹⁷	Randomized, controlled clinical trial Aim: To compare pressure ulcer healing rates in patients supplemented with a specialized amino acid mixture containing HMB, arginine, and glutamine and standard ONSs versus patients supplemented with ONSs and a placebo mixture. <i>n</i> =23 patients (inpatient acute care hospital) with stage I, II, or IV pressure injuries Location: Acute inpatient hospital Singapore Study Duration: 2 weeks	<i>n</i> =11 Randomized to receive either standard diet plus a HMB, arginine, and glutamine mixture twice daily alongside ONSs	<i>n</i> =12 Standard nutritional care alongside ONSs/placebo mixture	Pressure ulcers were measured weekly for area, depth, and Pressure Ulcer Scale for Healing (PUSH) scores. The proportion of viable tissue was determined based on area of wound tracing. Weekly measurements of C-reactive protein and pre-albumin levels.	The proportion of viable tissues increased within 2 weeks on HMB, arginine, and glutamine supplementation (<i>p</i> =0.02). PUSH scores showed significant improvement within 1 week of supplementation for the experimental group (<i>p</i> =0.013). No difference between anthropometrical measurements, biochemical parameters, and nutritional intake pre- and poststudy. Wound area did not decrease significantly in the short term for both groups. Limitations: small sample, one location, short duration, variety of pressure ulcer stages and locations.

(continued)

Table 4. (Continued)

Reference	Study Type, Aim, Sample Size, Study Setting, Study Duration	Active Intervention	Control Intervention	Outcome Measures	Results/Limitations
Neyens, <i>et al.</i> ¹¹	Descriptive literature review To evaluate the effects of arginine-enriched oral nutritional supplementation in pressure ulcers. Reviewed seven randomized controlled trials and four controlled trials, published between January 2001 and October 2015 and conducted in different settings: hospital, long-term care, and home care. The duration of follow-up of the studies varied from 2 weeks to complete healing and the sample size varied from 16 to 245 patients aged from 37 to 92 years and with pressure ulcer stages II, III, or IV.	The wound-specific ONS servings varied from one to three times per day, and contained 3–9 g of arginine per ONS.	N/A	Pressure ulcer healing, time needed for complete wound closure, reduction in wound surface area, nursing time, and the number of dressings used.	10/11 studies showed a beneficial effect of the arginine-enriched oral nutritional supplementation on the healing of pressure ulcers. Limitations: Studies available were small, different populations, variety of interventions, dosages, duration, and follow-up.
Neyens, <i>et al.</i> ¹⁴	Quasi-experimental study. Aim: To explore the effects of a specific arginine-enriched ONS on the healing of chronic wounds in nonmalnourished patients. $n=27$ patients with arterial leg ulcers, venous leg ulcers, diabetic foot ulcers, and pressure ulcers Location: three clinical centers in the Netherlands Study Duration: 12 weeks	Participants consumed a specific ready to drink arginine-enriched ONS daily, in addition to their regular diet and standard wound care, for a maximum of 12 weeks	None	Pressure ulcer healing, wound surface area, compliance, and rating with specific nutritional supplement	Seventeen females and 12 males with a mean age of 73.7 years were included. Within 2 to 12 weeks, complete healing occurred in 8/12 ulcers, 13 ulcers had decreased wound surface area ranging from 25% to 88% reduction. 3/12 ulcers were unchanged. Overall, the daily ONSs, on average two servings per day (=400 mL), were almost fully consumed (99.5%), and the patients' rating of the ONS was good. Limitations: small study, no control group, subjects regular diet not controlled, multiple types of wounds evaluated.
Cereda, <i>et al.</i> ⁷	Systematic review of publications between January 1997 and October 2015 Reviewed randomized controlled trials from January 1997 to October 2015 and found three studies that met the inclusion (formula with arginine, zinc, and antioxidants given for at least 4 weeks duration in patients with pressure ulcer)	N/A	N/A	Assessed effects of high calorie disease specific nutrition support given at least 4 weeks duration compared to control in patients with pressure ulcers. Pressure ulcer healing, pressure ulcer size	Formulas enriched with arginine, zinc, and antioxidants resulted in significant reduction in ulcer area (-15.7% [95% CI: -29.9 to -1.5]; $p=0.030$; $I^2=58.6\%$) and a higher proportion of subjects having a 40% or greater reduction in PU size (OR = 1.72 [95% CI: 1.04 to 2.84]; $p=0.033$; $I^2=0.0\%$) at 8 weeks. Limitations: Small number of studies evaluated (3), studies evaluated had small sample sizes and short duration, variety of dosages, formulations, and durations of therapy for each study

CI, confidence interval; HMB, beta-hydroxy-beta-methylbutyrate; N/A, not applicable; OR, odds ratio.

Figure 1. Scheduled MAR—Nutrition Supplement Order. MAR, medication administration record. AMB, ambulatory; PRN, as needed. Color images are available online.

flowsheet of the medical record, and often hospitals do not have a process for scheduled administration and documentation. Furthermore, in many acute care institutions, if the ONS is not ingested or is refused, it is not documented.^{25,49,50}

Solutions that allow for standardized ordering, administration, and documentation of nutritional therapies within the medication administration process have been identified recently in the literature.^{25,49} For example, Citty, *et al.* reported on a hospital systems' efforts to develop an electronic nutrition medication record (ENAR) within an existing EHR to improve ordering, administration, documentation, and evaluation of ONS within the medication record. The authors found that this improved the process and workflow of the system, as well as improved the documentation of nutritional medications. Although more studies are needed, this study showed positive gains and may be a potential solution for hospital systems. Because the strategy of including nutri-

tional therapies as part of electronic MAR (EMAR) is not widely utilized in many U.S. hospitals, examples of ENAR administration and documentation screens in the EHR are provided in Figs. 1–3.²⁵

SUMMARY

PIs and malnutrition are common in hospitalized patients.^{2,3} Although PIs often occur due to multifactorial causations, malnutrition was the most significant factor in PI incidence in a recent evaluation of over seven million inpatient admissions.³ To facilitate prompt assessment, diagnosis, intervention, and monitoring of nutrition, CDSS infused with evidence-based protocols should be implemented in hospitals.^{32,38,39}

When patients are identified as at-risk for or having malnutrition or PI, prompt referral to a Registered Dietitian is warranted. In addition, health care providers should assure provision of

Figure 2. EMAR—Oral Nutritional Supplement Administration Screen. EMAR, electronic MAR. Color images are available online.

Medication

X **1 Can ORAL NUTRITION : Oral : 3 TIMES DAILY (between meals)**

Frequency: 3 TIMES DAILY (between meals)
Route: Oral
Pharmaceutical Class: Dietary Products
Order Start Time: Today 03/31/17 at 0900
References: Micromedex Drug Info

Mixture Components

Component	Dose	Amount
1 Can	1 Can	237 mL

Action: Given
Date: 3/31/2017
Time: 0856
Route: Oral
Site:

Associated Flowsheet Rows:

User taken by: **INPATIENT, NURSE**
New Value: **1 Can ORAL NUTRITION**
Date: 3/31/2017
Time: 0856
Volume:

Restore Responsible

Figure 3. EMAR—Embedded Intake Flowsheet Rows Linking Administration and Intake Volume Automatically. Color images are available online.

mealtime assistance to increase oral intake. Collectively, evidence suggests that giving patients high energy, high protein ONS enriched with arginine, zinc, and antioxidants is helpful in reducing PI occurrence, PI size, and improving healing.^{6,7,11–17}

Studies show that effective strategies that optimize oral nutritional care are those that are evidence based, timely, standardized, scheduled, and consistent with maximization of the EHR and CDSSs.^{31,32,38,39,47}

FUTURE DIRECTIONS

Further discovery of evidence-based practices for nutrition optimization (therapeutic approaches as well as enhanced systems) to reduce PIs is needed to improve care of the vulnerable hospitalized patient. More quality research studies on best practices (type, amount, formulation, and frequency of interventions) for prevention of PI using ONS is needed.

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TAKE-HOME MESSAGES

- It is estimated that up to 50% of hospitalized patients are malnourished, and malnutrition is significantly associated with PI risk.
- HAPIs, PIs, and malnutrition increase health care costs, length of hospital stays, and hospital readmission rates.
- Early and frequent screening and assessment of nutrition, skin integrity, and PI risk (within 24-h of hospital admission and rescreening daily or more frequently if condition or intervention changes or patient deteriorates) while patients are hospitalized are recommended.
- Evidence suggests that giving patients high energy, high protein ONS enriched with micronutrients and antioxidants within 24–48 h after identification of risk is helpful in reducing length of hospital stay, readmission rate, health care costs, PI occurrence, and PI size and improves healing.
- Utilize EMAR for documenting nutritional therapies to enhance standardized ordering, administration, documentation, evaluation, and medication reconciliation and safety.
- Multidisciplinary team-based care, performance and quality improvement/monitoring, and staff knowledge have been found to impact nutrition outcomes and PI prevention for hospitalized patients.
- Automated CDSS solutions to standardize timely, protocol-driven practices have been found to reduce PI.
- Further research on best practices (type, amount, formulation, and frequency of interventions) for prevention of PI using ONS is needed.

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Abbreviations and Acronyms

AND	= Academy of Nutrition and Dietetics
ASPEN	= American Society for Parenteral and Enteral Nutrition
CDSS	= computerized decision support system
CI	= confidence interval
EHR	= electronic health record
EMAR	= electronic medication administration record
ENAR	= electronic nutrition administration record
HAPI	= hospital-acquired pressure injury
NCP	= nutrition care process
ONS	= oral nutritional supplement
OR	= odds ratio
PI	= pressure injury
QI	= quality improvement
RAE	= retinol activity equivalents
RDA	= recommended dietary allowance
UL	= upper limit