ABSTRACT

Malnutrition is a common and debilitating condition in the acute hospital setting that is associated with many adverse outcomes, including prolonged length of hospital stay, increased readmission rates, and increased mortality. However, malnutrition by definition may be an abnormality in either under- or overnutrition. With obesity rates rising, many patients admitted to the hospital may be overnourished from unhealthy eating habits. Unhealthy eating habits and obesity increase a patient’s risk for cardiovascular events and complications in the hospital setting.

Nutrition risk screening or nutrition reconciliation is an underutilized tool in the hospital that would identify patients with over- and undernutrition. Nutrition intervention or nutrition prophylaxis initiated in the hospital may help reduce hospital days, readmissions, and mortality. Nutrition reconciliation is a new term developed to increase the awareness of nutrition in total health. Nutrition reconciliation means that all patients have their nutritional status reconciled on admission and discharge from the hospital. Nutrition reconciliation is defined as the process of maximizing health by helping align an individual’s current diet to the diet prescribed for him or her by the health care team. Nutrition prophylaxis is a proactive intervention to prevent a medical complication.

Mandatory nutrition reconciliation and nutrition prophylaxis is not widely performed in most hospitals. Such an intervention may help our patients by improving their short- and long-term health. In addition, nutrition reconciliation and nutrition prophylaxis may allow for a more effective use of resources to prevent a preventable disease.

INTRODUCTION

The nutritional status of Americans has been studied and shows some disturbing trends, with some Americans being undernourished while most Americans are overnourished. In addition, there are Americans who eat unhealthy diets that, if not modified over time, may lead to overnutrition, obesity, and chronic disease. A startling number of patients admitted to the hospital suffer from protein energy malnutrition and obesity. These conditions are associated with unhealthy eating habits and food insecurity. Nutrition assessment and intervention during an admission to the hospital may represent an opportunity to educate all patients about the importance of healthy eating and increase awareness of interventions to help treat short-term effects of undernutrition and long-term effects of overnutrition.

Reducing avoidable readmissions to the hospital has been a focus of Medicare as a target for cost reduction. Researchers have shown that nine of the top ten primary diagnosis-related groups causing readmission were associated with malnutrition. Therefore, a focus on nutrition may be a new approach in addressing avoidable hospital readmission rates. Although most of the care that prevents readmission to the hospital occurs after discharge, the process to prevent readmission starts in the hospital. We have previously reported that a bundle of elements initiated before and after discharge from the hospital is correlated with reduced readmission rates. Examples include medication reconciliation and venous thromboembolism prophylaxis.

Medication reconciliation has been shown to be an important intervention to reduce avoidable readmissions. Schnipper et al reported that pharmacist medication review and counseling were associated with a lower rate of preventable adverse drug events after hospital discharge. The adverse effects of not reconciling medications at the time of discharge from the hospital have been well documented. Other studies have shown that medication reconciliation decreased readmission rates at 7, 14, and 30 days after discharge, with statistical significance at 7 and 14 days.

Deep vein thrombosis and pulmonary embolism after hospitalization is an example of an avoidable high-cost and potentially life-threatening readmission to the hospital. Venous thromboembolism prophylaxis is now a national guideline intervention to prevent thrombosis and embolism during hospitalization. On admission to the hospital, patients are risk stratified for deep vein thrombosis risk. If the risk is high they are given blood-thinning agents to prevent deep vein clots during their hospital stay. A recent study showed that venous thromboembolism prophylaxis was associated with a decrease in readmissions to the hospital.

Hospital readmission is a frequent and costly event that is associated with gaps in care. Rates of readmission can be reduced with the implementation of more reliable systemic interventions. Information learned from bundling elements such as medication reconciliation and venous thromboembolism prophylaxis to reduce readmission rates could be applied to nutrition. Recent meta-analysis suggests that readmission rates can be significantly reduced by prophylactic identification and treatment of older patients who have been diagnosed to have protein energy malnutrition.

Education, screening, and nutrition intervention may be the most cost-effective and efficient way to reduce avoidable readmissions to the hospital. However, for adequate nutrition to have an impact on health, one must also address food...
availability, food choice, and eating habits as separate but complementary aspects of over- or undernutrition. Nutrition prophylaxis is an important preventive activity that would be appropriate for adaptation to most chronic illness or prevention treatment regimens.

Nutrition reconciliation and nutrition prophylaxis in the hospital and at discharge may lead to both decreased hospital costs and improved patient care. However, few hospitals are looking at nutrition as a cost-effective intervention to prevent an avoidable return to the hospital. A hospital-based program aimed at screening and treating patients with nutrition issues could follow the programs that have been instituted for medication reconciliation and venous thrombosis prophylaxis. These programs used two basic concepts: 1) screen for high-risk patients and 2) provide prophylaxis treatment to prevent complications. In the next sections we will define malnutrition and then propose two interventions to be performed on all patients admitted to the hospital: 1) nutrition reconciliation and 2) nutrition prophylaxis.

MALNUTRITION

Malnutrition is common and by definition is any imbalance in nutrition. There are several International Classification of Diseases codes for malnutrition including mild, moderate, and severe protein-calorie malnutrition. Although typically thought of as a lack of something, current thoughts include the fact that malnutrition can develop as a consequence of under- or overnutrition. In the hospital, undernutrition is associated with increased morbidity and mortality. In the outpatient setting, overnutrition can result in chronic diseases such as obesity, diabetes, high blood pressure, and coronary artery disease. Obesity is now a major public health preventable disease, and efforts to screen and educate the general public are an important first step to preventing negative consequences of this disease.

The nutritional status of older Americans reflects disturbing trends, especially in the Medicare population. A study by Meals on Wheels of America indicates that 5.7% of older Americans are at risk for food insecurity, hunger, and malnutrition. Other studies have shown that undernutrition is present in up to 72% of elderly patients admitted to the hospital. In 2011, researchers reported that body mass index (BMI) showed a relationship with readmission for patients both above and below the normal weight range. The authors concluded that pre- and posthospital interventions should consider targeting nutritional status.

The causes and types of malnutrition in the elder population are varied, both physiologic and psychological in nature, and may lead to protein energy malnutrition. The phrase anorexia of aging has been used by many to describe the decreased food intake of old age. Compromised metabolism caused by underlying chronic disease, natural processes, and immobility contribute to poor nutrition among this population. The presence of protein energy malnutrition has been shown to be a risk factor for elderly admitted to the hospital and for subsequent readmission. In effect, if a patient has protein energy malnutrition at hospitalization, their overall outcome has been shown to be poor. Malnutrition can affect every system in the body, resulting in impairment of wound healing, in increased risk of infections and pressure ulcers, in decreased respiratory and cardiac function, in poorer outcomes of chronic lung diseases, in increased risk of cardiovascular and gastrointestinal disorders, in poorer physical function, and in mortality.

Patients who leave the hospital in an undernourished state also have a high mortality rate. Patients with a history of weight loss and low BMI were found to have a 1-year post-discharge mortality risk of 24% compared with 7% in the control group. Similar findings were reported for undernourished patients discharged from the hospital with a diagnosis of stroke. Several meta-analyses have also demonstrated reduced mortality in patients receiving optimized nutrition care. An analysis of 11 studies found significantly lower mortality rates among hospitalized patients receiving oral nutritional supplements compared with control patients. In addition, nutrition intervention that provides nurse visits and free meals to elderly patients upon discharge reduced readmission rates from 23% to 7.6%.

NUTRITION RECONCILIATION

Despite the high prevalence of undernutrition in geriatric patients and overnutrition in the general adult population, nutrition-related problems are rarely recognized and treated in the hospital. To improve outcomes, routine screening and

<table>
<thead>
<tr>
<th>Table 1. Screening tools available on the Internet</th>
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<tr>
<td><strong>Tool</strong></td>
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<tr>
<td>Mini Nutritional Assessment—Short Form</td>
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<tr>
<td>Malnutrition Universal Screening Tool (MUST)</td>
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<tr>
<td>Short Nutritional Assessment Questionnaire (SNAQ)</td>
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<td>Nutrition and Physical Activity Screen</td>
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Nutrition reconciliation will occur on admission and continue after discharge from the hospital. In the future, nutrition may be a vital sign of health just as we currently use exercise as a vital sign of health. Most nutrition screening tools focus on undernutrition because undernutrition poses the greatest risk for complications during the current hospital visit and after discharge from the hospital (Table 1). The majority of nutrition assessment and screening tools do not evaluate overnutrition or healthy eating habits. The new paradigm is that nutrition reconciliation will screen for patients at high risk for under- and overnutrition. In this article we suggest the creation of a screening tool for Total Health that will identify patients who need more nutrition and those who may need more healthy nutrition. Nutrition reconciliation can use existing tools (Table 1) and add to these a few questions on healthy eating (Table 2). After completing steps one to five as outlined in Table 2, we can then risk stratify a patient into one or more risk groups as shown in Table 3. This will then set the stage for nutrition prophylaxis of patients identified as undernourished, overnourished, or eating an unhealthy diet.

**NUTRITION PROPHYLAXIS**

Systematically identifying patients who are malnourished and intervening before they develop a preventable disease, get admitted to the hospital, or develop nutrition-related complications during a hospital visit will reduce overall cost of care.
After the patient has completed nutrition reconciliation we can begin nutrition prophylaxis.

Nutrition prophylaxis is a proactive intervention to prevent medical complications from malnutrition. Nutrition prophylaxis is designed to screen and treat preventable disease. As mentioned above, the three risk groups outlined in Table 3 represent potential risk groups for interventions that may prevent complications inside and outside the hospital while helping to reverse or prevent a chronic disease.

**Undernutrition**

Nutrition intervention for malnourished patients is a low-risk, cost-effective strategy to improve quality of care, prevent preventable disease, and lower overall health care costs. It is estimated that more than one-third of medical patients in the hospital are undernourished.18 If the nutrition problem is not addressed, undernourished patients may experience a further decline in nutrition and further progression of an illness before discharge from the hospital. Undernutrition is associated with many adverse outcomes, including depression of the immune system, impaired wound healing, muscle wasting, longer lengths of hospital stay, higher treatment costs, and increased mortality.18

Many of the adverse outcomes influenced by undernutrition are potentially preventable. Data from several recent studies show that undernutrition can influence hospital readmission rates and reduce health care costs.15,44,45 Undernourished patients may benefit from oral nutritional supplements. A large Cochrane systematic review of 24 studies involving 6225 patients aged 65 years and older at risk for malnutrition demonstrated fewer complications (eg, pressure sores, deep vein thrombosis, and respiratory and urinary infections) among patients receiving oral nutritional supplements compared with routine care.46 In a prospective study conducted at the Johns Hopkins Hospital, nutrition screening involving a team approach to address malnutrition and earlier intervention reduced the length of hospital stay by an average of 3.2 days in severely malnourished patients.47

A recent retrospective analysis used information from more than 1 million adult inpatient cases found in the 2000-2010 Premier Perspectives Database maintained by the Premier Healthcare Alliance—representing a total of 44 million hospital episodes from across the US or approximately 20% of all inpatient admissions in the US.48 Within this sample, oral nutritional supplements reduced length of hospital stay by an average of 2.3 days.48

One of the commonly used treatments for undernutrition is oral nutritional supplements. Systematic reviews and meta-analyses have documented the effects of oral nutritional supplements on clinical outcomes. In 2013, Stratton et al15 reported the results of systematic review of nine randomized controlled studies and meta-analysis on the effects of oral nutritional supplements on hospital readmissions. This study showed that oral nutritional supplements significantly reduce hospital readmissions, particularly in older patient groups. Although oral supplementation is one avenue for improvement of nutritional status, providing adequate and appropriate food in the form of meals can also be a sustainable method for enhancing patient nutrition at home.

**Overnutrition and Unhealthy Eating**

Although less of a risk for complications during an admission, identification of and treatment of patients who eat an unhealthy diet may prevent short- and long-term complications. Obesity and unhealthy eating are risk factors for chronic diseases. Many of the adverse outcomes influenced by overnutrition are preventable and may be minimized through dietary intervention. Overnutrition and unhealthy eating are potential risk groups for initiatives that may prevent complications inside and outside the hospital while helping to reverse or prevent a chronic disease.

### Table 4. Solutions for lower-income individuals

<table>
<thead>
<tr>
<th>Program</th>
<th>URL</th>
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<tbody>
<tr>
<td>Older Americans Act Nutrition Program</td>
<td><a href="http://nutritionandaging.fiu.edu/DANP_Toolkit/toolkit%20update%2012.2.06.pdf">http://nutritionandaging.fiu.edu/DANP_Toolkit/toolkit%20update%2012.2.06.pdf</a></td>
</tr>
<tr>
<td>Home-delivered meals (Meals on Wheels and Mom’s Meals)</td>
<td><a href="http://www.mowaa.org/">www.mowaa.org/</a> <a href="http://www.momsmeals.com">www.momsmeals.com</a></td>
</tr>
<tr>
<td>Medicaid waiver and other government programs</td>
<td><a href="http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Waivers/Home-and-Community-Based-1915-c-Waivers.html">www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Waivers/Home-and-Community-Based-1915-c-Waivers.html</a></td>
</tr>
<tr>
<td>Managed Long-Term Services and Supports</td>
<td><a href="http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Delivery-Systems/Medicaid-Managed-Long-Term-Services-and-Supports-MLTSS.html">www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Delivery-Systems/Medicaid-Managed-Long-Term-Services-and-Supports-MLTSS.html</a></td>
</tr>
<tr>
<td>Program of All-Inclusive Care for Elderly</td>
<td><a href="http://www.medicare.gov/your-medicare-costs/help-paying-costs/pace/pace.html">www.medicare.gov/your-medicare-costs/help-paying-costs/pace/pace.html</a></td>
</tr>
<tr>
<td>Supplemental Nutrition Assistance Program (SNAP) food stamps</td>
<td><a href="http://www.fns.usda.gov/snap/supplemental-nutrition-assistance-program-snap">www.fns.usda.gov/snap/supplemental-nutrition-assistance-program-snap</a></td>
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</tbody>
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We recommend that hospital leadership consider developing a culture of healthy eating for all patients admitted to the hospital. Hospital food should be aligned with the food we are asking our patients to eat when they leave the hospital.

Nutrition prophylaxis should follow immediately after nutrition reconciliation has been completed and a nutrition diagnosis has been obtained. Nutrition prophylaxis could follow the steps outlined in the Sidebar: Steps in a Nutrition Prophylaxis Plan. Nutrition prophylaxis should be person focused and address particular issues related to the importance of the diet and health of the individual. Most patients admitted to the hospital suffer from a chronic disease. A general diet that has reported health benefits is the Dietary Approach to Stop Hypertension (DASH) diet; this could be a universal healthy diet for all patients admitted to the hospital.9 This general diet can be used to teach patients the benefits of healthy eating. Additional teaching could also help patients with disease-specific dietary needs such as diabetes (low carbohydrate diet) and kidney disease (low phosphorus and low potassium diet).

While in the hospital, patients are in a controlled environment. Once they leave the hospital, they are at risk for returning to their unhealthy eating habits. This is why nutrition reconciliation will be required at the time of discharge and also when the patient returns to a primary care physician for a posthospital follow-up appointment. After discharge from the hospital it is important to ensure that the nutrition discharge plan meets the health condition needs the patient learned about in the hospital. This plan should be convenient, tailored to patient preferences, and affordable. If patients are not able to prepare healthy meals when they return home, they may want to consider paying for meals that are healthy and meet their nutrition needs, such as a home meal delivery service (see Sidebar: Mom’s Meals NourishCare Program). Other options for low-income individuals include government- or managed-care-funded programs that provide supplemental nutrition to low-income individuals (Table 4). Some states include funds for home-delivered meals as part of their Medicaid package.

**DISCUSSION**

With policy changes in the US health care system pushing for a greater focus on high-quality and affordable care, there’s an urgent need to address the ongoing issue of avoidable readmissions to the hospital. Addressing hospital malnutrition and ensuring that medical nutrition therapy intervention occurs should play a critical role in patient care.16

Physicians and nurses should initiate the nutrition reconciliation process at the time of admission so dietitians can start evaluation and treatment shortly after admission. This process requires little time if questions are clearly outlined in the EMR, as we currently do for venous thromboembolism prophylaxis. In the hospital, the decision point for reconciliation is primarily focused on undernutrition to identify patients who may benefit most from nutrition supplementation. Patients identified as overnourished or who have unhealthy eating habits may benefit from education. We recommend that hospital leadership consider developing a culture of healthy eating for all patients admitted to the hospital. Hospital food should be aligned with the food we are asking our patients to eat when they leave the hospital.51

The proposed nutrition reconciliation screening tool outlined in Table 2 has not been validated. The questions in Table 2 were taken from the many validated tools outlined in Table 1. However, the basic questions are a tool to help physicians identify patients admitted to the hospital who may benefit from nutrition prophylaxis. For example, not all patients with an elevated BMI are unhealthy.52 Some obese patients may eat a healthy diet and exercise regularly. These patients may have a lower incidence of chronic disease and
In March 2014, the Tulane University School of Medicine in New Orleans, LA, announced that the university was adding an unconventional course to its curriculum. Medical students now take cooking classes in addition to their usual training. The idea behind this “culinary medicine” program is to encourage physicians to use food to prevent or to cure illnesses. Most medical students in the US receive on average 20 hours of nutritional education even though diet may be the cause of many modern Western diseases. Lifestyle management, including a healthy diet, may be able to prevent diseases such as diabetes while significantly reducing overall health care costs. Training physicians to cook, however, takes nutritional education to a whole new level. Not only will physicians be able to explain which foods are best to eat, but they will also understand how to prepare them. Tulane medical students prepare for teaching future patients by offering free cooking classes to New Orleans residents—a mutually beneficial arrangement for everyone who shares that food. Fortunately, the culinary medicine model seems to be catching on. Two other medical schools have licensed the curriculum and are adding it to their courses. Ideally all medical schools will adopt this best practice.

CONCLUSION

Social issues play a key role in health and are also a very important cause of under- and overnutrition. During hospitalization, the physician must also consider reversible nutrition concerns and nutrition issues that may occur as part of natural aging. Social workers, dietitians, and nurses must advocate together for policy changes in their hospitals and Regions to resolve community issues related to food insecurity and overnutrition. In addition, end-of-life issues are also important when looking at malnutrition in the sick elderly. Physicians can help patients and families understand that undernutrition associated with comorbidities may be an opportunity to discuss end-of-life issues and advance care planning. In summary, malnutrition is a preventable disease that can be cured by an organized systemwide program of nutrition reconciliation and nutrition prophylaxis that focuses not just on a disease but on the person with a disease.

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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