Impact of a Nutrition-Focused Quality Improvement Intervention on Hospital Length of Stay
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ABSTRACT
Background: Despite its high prevalence, malnutrition in hospitalized patients often goes unrecognized and undertreated.
Local Problem: A hospital system sought to improve nutrition care by implementing a quality improvement initiative. Nurses screened patients upon admission using the Malnutrition Screening Tool and initiated oral nutrition supplements for patients at risk.
Methods: We retrospectively reviewed the medical records of 20,697 adult patients to determine whether early initiation of nutrition therapy had reduced hospital length of stay and 30-day readmission rates.
Results: We found the average time from hospital admission to oral nutrition supplement initiation was reduced by 20 hours (20.8%) after the quality improvement initiative was introduced ($P < .01$). Length of stay decreased 0.88 days ($P < .05$) more for patients at nutritional risk than patients not at nutritional risk; the probability of 30-day hospital readmission did not differ between groups.
Conclusion: These results highlight the importance of adequate nutrition screening, diagnosis, and treatment for hospitalized patients.

Keywords: malnutrition, Malnutrition Screening Tool, nutrition, nutrition screening, oral nutrition supplements

Malnutrition is a common yet overlooked condition in hospitalized patients. As many as 30% to 50% of patients show risk of malnutrition at admission, and many of these patients experience further nutritional decline during the course of a hospital stay. Malnutrition is of particular concern in older patients and those with critical illness; also, large numbers of patients are discharged with malnutrition. Many studies found malnutrition was a major contributor to increased morbidity and mortality, decreased quality of life, longer hospitalizations with more frequent readmissions, and increased resource utilization, and led to higher health care costs. Thus, early nutrition screening and proper intervention is important to prevent and treat malnutrition as well as to mitigate its inherent complications.

Nutrition screening aims to identify patients who are at risk and would benefit from further nutrition assessment and intervention. The nutrition care plan should be implemented early in the hospital course, as even patients with normal nutrition status risk becoming malnourished quickly when acutely ill. However, delays and
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gaps in screening, consultation, assessment, and intervention are widespread, leading to delays in care. Some hospitals have taken advantage of nurses’ frontline contact with patients to more quickly identify those with malnutrition and expedite their treatment.

In health care, a quality improvement (QI) initiative or program seeks to improve patient outcomes by systematically developing and testing changes to practice, and then evaluating outcomes before and after the change was instituted. Three hospitals were involved in this nutrition QI initiative, which called for all patients to be screened for nutrition risk at hospital admission using the Malnutrition Screening Tool (MST) and ordering oral nutritional supplements (ONS) for patients with evidence of malnutrition risk (score $\geq 2$ on the MST) without waiting for further assessment by a dietitian.

The MST demonstrated validity with high sensitivity and moderate specificity (sensitivity $>90\%$, specificity $\geq 60\%$, depending on the population and comparator tool). Consisting of 2 questions evaluating weight change and appetite, the MST can be implemented easily in the clinical setting without the need for patient blood samples or anthropometric measurements (see Supplemental Digital Content, the Figure, available at http://links.lww.com/JNCQ/A517).

Hospitalized patients at an elevated risk of malnutrition are given ONS designed to increase weight and lean body mass, and to promote recovery from illness, injury, and surgery. The use of ONS has been shown to reduce 30-day readmissions, hospital length of stay (LOS), and costs associated with hospitalization. Moreover, ONS administration as part of a comprehensive nutrition-focused QI initiative, including nutrition screening, dietitian assessment, and nutrition support with ONS and postdischarge follow-ups, led to an approximate 27% relative risk reduction in 30-day readmission and 25% reduction in LOS.

The current study is a retrospective analysis of more than 20,000 medical records of adult patients from 3 hospitals in the United States. It evaluated the impact of a real-world nutrition QI initiative on the health outcomes of patients with or at risk for malnutrition. The main objective of this study was to assess whether this early nutrition intervention program reduced LOS and 30-day readmission rates. In addition, the medical diagnosis of malnutrition was compared before and after implementation of the initiative.

METHODS

The year after the QI initiative was implemented, we conducted a retrospective cohort study using the medical records of adult patients from the 3 hospitals to determine whether early initiation of nutrition therapy had reduced hospital LOS and 30-day readmission rates.

Nutrition QI

Nurses screened patients on admission using the MST, requested a consult with a dietitian, and initiated ONS twice per day for patients at risk for malnutrition based on the MST score. ONS was provided as soon as malnutrition risk was identified, thereby eliminating the time lapse that occurs while waiting for a registered dietitian to confirm the patient’s need for intervention. Products administered were selected based on patient medical condition or personal preference: Ensure Clear (for pre and post surgical patients, those on fat-restricted diets, or for personal preference), Ensure Enlive (for those requiring high protein formulation), TwoCal HN (energy dense for patients on fluid-restricted diets), Abbott Laboratories, Abbott Park, Illinois; Magic Cup (thickened for patients with swallowing difficulties), Hormel Health Labs, Hormel Foods, Austin, Minnesota.

In addition, the Sodexo Comprehensive Malnutrition Platform was implemented by registered dietitians to help determine the type and severity of malnutrition for improvement of care and clinical outcomes. This platform helped improve clinical documentation and assist physicians in assessing the type and severity of malnutrition. Specifically, dietitians were trained onsite in a physical assessment workshop to identify malnourished patients using evidence-based standards and specific diagnostic criteria. If applicable, patients received an ONS. Dietitians would recommend other nutrition interventions as appropriate for individual patients. Instructions for a healthy diet and supplement recommendations were provided to patients at discharge. To strengthen program implementation and interprofessional collaboration, all stakeholders were trained in the program, including hospital administrators, physicians, physician assistants, nurse practitioners, nurses, dietitians, and information technologists including coders.
Study population
The retrospective cohort study examined the medical records of adult patients from 3 hospitals of KentuckyOne Health, part of the Catholic Health Initiatives’ nonprofit health care system: Jewish Hospital in Louisville, Kentucky, and Saint Joseph Hospital and Saint Joseph East in Lexington, Kentucky. Patients were included if they were (1) 18 years or older and (2) admitted to 1 of the 3 selected hospitals during the study period. This retrospective study was exempt from review by the institutional review board.

Study design and statistical analyses
Electronic medical records for 20,697 adult patients (age ≥18) admitted between September 2014 and February 2015 (pre-QI) were compared with those admitted between September 2016 and February 2017 (post-QI). We compared similar periods to control for potential seasonal differences. The primary outcome evaluated was LOS; the secondary outcome was the 30-day all-cause unplanned readmission rate; and the rate of malnutrition diagnosis was an exploratory outcome.

The sample was divided into 2 groups. Patients who met any of the following criteria were placed in the group of patients considered at nutritional risk: patients with an MST score of 2 or more,19 who received ONS, or had 1 of the International Classification of Diseases (ICD) malnutrition codes (ICD-9 or ICD-10) documented during their hospital stay. All others were placed in the group of patients not at nutritional risk (MST score <2, who did not receive ONS, or were not diagnosed as malnourished).

We hypothesized that if this QI initiative was successful, we would see a greater change in the group at nutritional risk than in the group not at nutritional risk. In addition, the average and median time from hospital arrival/admission/MST screen to ONS initiation in hours as well as the rate of malnutrition diagnosis were compared before and after the QI initiative began.

A difference-in-difference statistical technique was used to assess the impact of the QI initiative on LOS and 30-day readmission rates and to control for potential confounders. The difference-in-difference statistical technique is designed to compare the average change over time in an outcome variable (LOS and readmissions in this study) for a treatment group, compared with the average change over time for a control group.

Descriptive statistics for continuous data (mean ± standard deviation) and categorical data (n [%]) were calculated for relevant patient characteristics. Between-group comparisons were performed via independent t tests. Statistical differences were determined by independent t tests. Analyses were performed with Stata 14.0 (StataCorp LP, College Station, Texas), and P values ≤ .05 were considered statistically significant.

RESULTS
Patients
The average (±standard deviation) patient age was 58.9 (±16.3) years, and 49.4% of patients were women. On average, 18.7% of patients were classified as at nutritional risk and placed in that group (Table 1).

Increased detection and treatment of malnutrition
Prior to QI initiative implementation, 17.7% of patients were at nutritional risk, while post-QI, 19.7% of patients were at nutritional risk (Table 1). Based on ICD codes, 3.1% of patients were diagnosed with malnutrition pre-QI, compared with 6.8% of patients post-QI (n = 310 and n = 740, respectively). Regarding ONS administration, 11.6% versus 12.2% of all patients received ONS in the pre- and post-QI study periods (1145/9879 vs 1317/10 818, respectively). These results show that the QI initiative led to a more than doubling of patients who were diagnosed with malnutrition and modestly increased the number of patients who received ONS.

More rapid administration of ONS
After implementation of the QI initiative, the average time to ONS initiation from hospital arrival, admission, and MST screen to ONS initiation in hours as well as the rate of malnutrition diagnosis were compared before and after the QI initiative began.

The median time to ONS initiation from hospital arrival, admission, and MST screen was significantly reduced by 22.0, 20.1, and 16.6 hours, respectively (all P values < .01) (Table 2). The median time to ONS initiation from hospital arrival, admission, and MST screen was also significantly reduced after QI initiative implementation, with reductions of 7.8, 13.8, and 18.9 hours, respectively (all P < .01) (Table 2). Therefore, when a nurse ordered ONS, the average delay between admission and supplementation was reduced by 20 hours.
Effect of the QI initiative on LOS and readmission

The LOS for patients not at nutritional risk was 3.8 days pre-QI and 3.5 days post-QI, a significant decrease of 0.28 days (7.4%) (Table 3). Before the QI initiative, patients at nutritional risk experienced an average LOS of 9.7 days, which was reduced to 8.5 days post-QI, a significant decrease of 1.16 days (12%). Comparing these 2 patient groups, LOS declined more for patients at nutritional risk than for patients not at nutritional risk, by a margin of 0.88 days (1.16 decrease in LOS for patients at nutritional risk, compared with 0.28 decrease in LOS for those not at nutritional risk, $P < .05$) (Table 3). The probability of readmission did not decline significantly for either group (−0.18% for patients not at nutritional risk, differences not significant).

DISCUSSION

Following implementation of the QI initiative, we detected the following: (1) a significant decrease in the average time to ONS administration from hospital arrival (a reduction of 19.2%, $P < .001$); (2) a significant reduction in average LOS among patients at nutritional risk (1.2 fewer days, $P = .026$); and (3) more than doubling of the rate of malnutrition diagnoses (3.1% to 6.8%, a 3.7-percentage point increase from baseline). Thus, the QI initiative helped focus attention on hospital nutrition care, and the results show how prompt intervention can shorten length of hospital stay.
Table 3. Summary of QI Initiative Outcomes

<table>
<thead>
<tr>
<th>Measure by Patient Group</th>
<th>Pre-QI Value (SE)</th>
<th>Post-QI Value (SE)</th>
<th>Decrease Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS, mean, d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At nutritional risk b</td>
<td>9.67 (19.94)</td>
<td>8.51 (11.21)</td>
<td>1.16 (12.0)c</td>
</tr>
<tr>
<td>Not at nutritional risk d</td>
<td>3.78 (12.97)</td>
<td>3.50 (3.86)</td>
<td>0.28 (7.4)c</td>
</tr>
<tr>
<td>Readmission probability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At nutritional risk</td>
<td>14.77% (0.35)</td>
<td>14.59% (0.35)</td>
<td>0.18% e</td>
</tr>
<tr>
<td>Not at nutritional risk</td>
<td>11.63% (0.32)</td>
<td>11.60% (0.32)</td>
<td>0.03% e</td>
</tr>
</tbody>
</table>

Abbreviations: LOS, length of stay; QI, quality improvement; SE, standard error.

a Group at nutritional risk: n = 1747 pre-QI; n = 2131 post-QI. Group not at nutritional risk: n = 8132 pre-QI; n = 8687 post-QI.

b At nutritional risk: patients with an MST score of 2 or more, who received ONS, or who had one of the malnutrition codes documented during their hospital stay.

c P < .05.

d Not at nutritional risk: all other patients (MST score < 2, did not receive ONS, or not diagnosed as malnourished).

e P value is not significant.

Among patients at nutritional risk, mean LOS decreased significantly by more than a full day (9.7 days to 8.5 days, 12% reduction) after QI initiative implementation; this decrease was 0.88 days greater than that observed in the group not at nutritional risk post-QI. This positive impact on LOS of malnutrition detection and treatment with ONS is consistent with the results of previous studies. A recent systematic review of the literature showed that 10 of the 12 included studies had a mean or median LOS that was shorter in the ONS group.27 Also, in a meta-analysis of 5 studies conducted on surgical patients, the ONS group showed a reduced LOS of 2 days (13% reduction),27 which is similar to the results of the current analysis.

Twice as many patients were diagnosed with malnutrition as a result of this QI initiative, increasing from 3.1% pre-QI to 6.8% post-QI. This study’s pre-QI diagnosis rate is in line with previous studies, documenting that as few as 3% of patients hospitalized in the United States are diagnosed with malnutrition.28 Meanwhile, other studies find 30% to 50% of patients show risk for or evidence of malnutrition at hospital admission.1,3 Patient care and clinical outcomes can only be optimized if malnutrition is recognized and diagnosed promptly.5 To address this gap between prevalence and diagnosis of malnutrition, the screening approach needs to be easy to implement and applicable to a variety of clinical settings.16

We did not find a statistically significant difference in 30-day readmission post-QI. This finding is in contrast with previous reports showing significantly reduced readmission rates following prompt ONS use.23,26,29,30 This lack of a difference in readmissions may be due to various factors, such as the duration of follow-up, nutrition treatment modality, discharge to various care settings, and ONS compliance. Indeed, ONS compliance has been estimated to range from 67% to 81% and is negatively associated with age.31 Patients and caregivers should be educated about individual nutrition needs and the significance of continuing proper nutrition postdischarge, and QI initiatives that include postdischarge follow-up may help reduce 30-day readmissions.26

Both health and economic outcomes among malnourished hospitalized patients can be significantly improved through nutrition-focused QI intervention.24,25 Although we do not report the actual cost savings associated with implementing our QI initiative, our results likely indicate a cost savings due to the observed reduction in LOS. Indeed, a prior study demonstrated that a reduced hospital stay in malnourished patients translated into a significant cost savings per patient.3 Using data from our study, we can estimate the potential savings could be about $2000 per patient, based on the latest data available for hospital costs per day32 and the number of days that the hospital stay was shorter for patients at nutritional risk compared with those not at nutritional risk ($2253 cost per hospital day × 0.88 days shorter LOS). Comparing that savings to the minimal cost of providing ONS over the course of the hospital stay ($88 from a study
with a comparable hospital LOS,$^{23}$ it is clear that nutrition-focused QI initiatives offer a low-risk way to reduce costs by shortening LOS.

Several limitations of this study should be noted. First, the study may have limited generalizability because it represents a hospitalized population from a small number of hospitals located in a single US state. Because only this hospital system was analyzed, it is possible that some readmissions occurring outside of the included hospitals were lost. Also, the LOS in absolute days for the patients not at nutritional risk was small relative to that of the patients at nutritional risk, although the reduction in LOS from pre- to post-QI was significant for both groups. Furthermore, we did not collect data on ONS consumption and compliance or nutrition after discharge. However, it should be noted that our study included a large number of hospitalized patients to capture the real-world effects of a QI initiative using a difference-in-difference statistical technique, which overcame the ethical limitations inherent to experimental studies investigating ONS treatment in malnourished subjects.

**Recommendations**

Experts recommend a number of measures to ensure effective nutrition care in hospitals$^{26}$: (1) develop an institutional culture of good nutrition care that extends to all stakeholders; (2) clarify and define roles for each clinician; (3) use routine screening to identify the patient’s nutrition risk, with a screening tool that has been validated, is easy to implement, and simple to use; (4) start nutrition intervention promptly for patients at risk for malnutrition; (5) prepare and implement individualized nutrition plans; (6) monitor patients’ nutrition status throughout their hospital stay; and (7) create a postdischarge nutrition plan.

**SUMMARY**

In summary, our results in this retrospective cohort study show that implementation of a nutrition-focused QI initiative in hospitalized patients shortened the time to diagnosis and treatment of malnutrition and significantly reduced hospital LOS. We also showed how including nurses in nutrition screening and ONS prescription could accelerate the delivery of nutrition care. Furthermore, the savings on reduced LOS in this study can be estimated to far exceed the cost of treatment with ONS. Thus, interventions focused on improving nutrition in hospitalized patients represent a low-risk, cost-effective strategy to improve the quality of hospital care. These results provide a rationale for building on the strengths of the QI initiative used in our study and expanding this approach to additional hospitals.

**REFERENCES**


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