Journal of Parenteral and Enteral Nutrition
Volume 41 Number 3
March 2017 384–391

DOI: 10.1177/0148607116681468
journals.sagepub.com/home/pen

A Comprehensive Nutrition-Focused Quality Improvement Program Reduces 30-Day Readmissions and Length of Stay in Hospitalized Patients

Krishnan Sriram, MD, FCCM, FRCS(C), FACS[1]; Suela Sulo, PhD[1,2]; Gretchen VanDerBosch, RD, LDN[1]; Jamie Partridge, PhD, MBA[2]; Josh Feldstein, BA[3]; Refaat A. Hegazi, MD, PhD[2]; and Wm. Thomas Summerfelt, PhD[1]

Abstract

Background: Although screening patients for malnutrition risk on hospital admission is standard of care, nutrition shortfalls are undertreated. Nutrition interventions can improve outcomes. We tested effects of a nutrition-focused quality improvement program (QIP) on hospital readmission and length of stay (LOS). *Materials and Methods:* QIP included malnutrition risk screening at admission, prompt initiation of oral nutrition supplements (ONS) for at-risk patients, and nutrition support. A 2-group, pre-post design of malnourished adults with any diagnosis was conducted at 4 hospitals: QIP-basic (QIPb) and QIP-enhanced (QIPe). Comparator patients had a malnutrition diagnosis and ONS orders. For QIPb, nurses screened all patients on admission using an electronic medical record (EMR)–cued Malnutrition Screening Tool (MST); ONS was provided to patients with MST scores ≥2 within 24–48 hours. QIPe had ONS within 24 hours, postdischarge nutrition instructions, telephone calls, and ONS coupons. Primary outcome was 30-day unplanned readmission. We used baseline (January 1–December 31, 2013) and validation cohorts (October 13, 2013–April 2, 2014) for comparison. *Results:* Patients (n = 1269) were enrolled in QIPb (n = 769) and QIPe (n = 500). Analysis included baseline (n = 4611) and validation (n = 1319) comparator patients. Compared with a 20% baseline readmission rate, post-QIP relative reductions were 19.5% for all QIP, 18% for QIPb, and 22% for QIPe, respectively. Compared with a 22.1% validation readmission rate, relative reductions were 27.1%, 25.8%, and 29.4%, respectively. Similar reductions were noted for LOS. *Conclusions:* Thirty-day readmissions and LOS were significantly lowered for malnourished inpatients by use of an EMR-cued MST, prompt provision of ONS, patient/caregiver education, and sustained nutrition support. *(JPEN J Parenter Enteral Nutr.* 2017;41:384-391)

Keywords

outcomes research/quality; nutrition support practice; nutrition; nutrition assessment; nutrition-focused interventions; nutrition education

Clinical Relevancy Statement

Although a large percentage of patients are at nutrition risk upon hospital admission, their nutrition needs are not always addressed in the hospital setting. The clinical implications of our findings are (1) demonstrating that validated malnutrition risk screening and immediate oral nutrition supplement use can improve outcomes in at-risk hospitalized patients (lowered readmission rates and shorter length of stay) and (2) highlighting how a real-world pragmatic quality improvement program can provide a scalable model for evidence-based improvements in nutrition care.

Introduction

Although hospital malnutrition has been a chief cause of concern for more than 40 years, malnutrition continues to go unrecognized and undertreated in hospitals in the United States and globally.[1–3] Findings over the past decade show that 30%–50% of patients are malnourished on admission to the hospital.[4,5] Many patients experience deteriorating nutrition status during their hospital stay, including those who were adequately nourished on admission,[6] as well as those who entered the hospital malnourished.[7] Poor nutrition status is associated with poor functional and clinical outcomes for patients and with increased costs to healthcare systems.[8,9] To improve health

From [1]Advocate Health Care, Downers Grove, Illinois, USA; [2]Abbott Nutrition, Columbus, Ohio, USA; and [3]Center for Applied Value Analysis, Great Barrington, Massachusetts, USA.

Financial disclosure: Financial support for the study was provided by Abbott Nutrition. Dr Sriram has received consultancy fees from Abbott Nutrition outside the present work.

Conflicts of interest: None declared.

Received for publication August 2, 2016; accepted for publication November 1, 2016.

This article originally appeared online on December 6, 2016.

Download a QR code reader on your smartphone, scan this image, and listen to the podcast for this article instantly. Or listen to this and other *JPEN* podcasts at http://journals.sagepub.com/page/pen/podcasts.

Corresponding Author:
Krishnan Sriram, MD, FCCM, FRCS(C), FACS, Advocate Health Care, eICU Department, 1400 Kensington Ave, Oak Brook, IL 60521, USA.
Email: krishnan.sriram@advocatehealth.com

outcomes and reduce cost burdens to healthcare systems, it is important to take a systematic and comprehensive approach to increasing awareness of malnutrition and improving management of nutrition in hospitals and beyond.

Expert recommendations for effective nutrition care strategies are to (1) build an institutional culture where all stakeholders value nutrition; (2) have clear definitions of clinicians' roles for delivering nutrition care; (3) use routine screening of all patients for malnutrition risk; (4) start nutrition interventions promptly when risk is identified; (5) develop and apply individualized, in-hospital nutrition care plans; (6) continue to monitor each patient's nutrition status; and (7) create postdischarge nutrition education and care plans.[7]

Furthermore, hospitals are now penalized financially for excessive readmission rates in accord with the Readmission Reduction Program of the Centers for Medicare & Medicaid Services (CMS).[10] Malnutrition is often treated by giving oral nutrition supplements (ONS). ONS provide calories, protein, and micronutrients that help stem weight loss and enhance recovery of lost lean body mass.[11–13] Although ONS use has been shown to reduce readmission rates and cut healthcare costs,[9] nutrition intervention is often overlooked as a potential readmission reduction strategy.

In Advocate Health Care (AHC) hospitals, we tested a real-world nutrition care program that could be scaled up for broad use by other healthcare systems.[14] We developed a nutrition-focused quality improvement program (QIP) that included (1) malnutrition risk screening conducted by nursing staff at admission by way of an electronic medical record (EMR)–cued Malnutrition Screening Tool (MST; see Supplementary Figure S1 for full tool),[15] (2) follow-up consultation by a dietitian, (3) prompt provision of ONS, and (4) patient and caregiver nutrition education on in-hospital and postdischarge nutrition care.

Materials and Methods

Study Design

This multisite, 2-group, pre-post QIP was approved by the AHC institutional review board (IRB). Two hospitals implemented the QIP-basic program (QIPb), while 2 hospitals implemented a QIP-enhanced program (QIPe). Study participants were enrolled between October 13, 2014, and April 2, 2015.

Participants

Eligible participants were hospitalized patients with any diagnosis, 18 years of age or older, at risk for malnutrition (MST score ≥2) at admission, and able to consume foods and beverages orally. Exclusion criteria included pregnancy, intubation, tube feeding or parenteral nutrition (PN), advanced cancer with brain metastases, neurological or psychiatric disorders, and other conditions that could interfere with ONS consumption. All patients provided consent through an IRB-approved process.

Setting

As a 12-hospital system, AHC is the largest provider in Illinois. Four hospitals were selected for the study. Hospitals were grouped and categorized as QIPb and QIPe; each group included 1 teaching and 1 community hospital. Selection of QIPb and QIPe hospitals was based on similar demographic and clinical characteristics of patients and hospitals, including annual admissions, average patient age, length of stay (LOS), race, and historic all-cause 30-day readmission rates.

Interventions

The MST was selected to screen for malnutrition risk because it is a validated, easy-to-use tool with favorable psychometric properties.[15–17] MST incorporates criteria of the Participative Global Assessment, recently shown to be the single best predictor of LOS and readmission rates.[18] An AHC system-wide EMR upgrade integrated the MST for nutrition screening. Bedside and informatics nurses helped develop the EMR format of the MST. MST replaced an internally developed, non-validated nutrition assessment tool used previously. The EMR upgrade was also designed to trigger appropriate follow-up dietitian consultations and selection of standard or disease-specific ONS for all at-risk patients.

Clinical staff (including nurses, dietitians, and physicians) at the QIP hospitals received education and training. An educational video (with a pre-post learning test) was developed to inform nurses about use of the EMR-cued MST, ONS for nutrition care in at-risk patients, and nutrition care documentation. Implementation of the QIP included a 2-week run-in period for troubleshooting start-up issues; no patient data collected during this period were included in the analysis. To support engagement and compliance, staff nutrition education activities (emails, brochures, meetings, flyers) were used during the QIP interval. Dietitians rechecked MST scores for patients identified on admission to have malnutrition risk; excessive false-positive MST scores were considered a flag for additional nurse training on screening. Only patients with a dietitian-confirmed MST ≥2 were eligible for study inclusion.

QIPb vs QIPe Procedures

QIPb and QIPe procedures are compared in Table 1. All patients at QIP hospitals were screened with the EMR-cued MST by the admitting nurse. QIPb patients with MST scores ≥2 were seen by a dietitian within 24 and 48 hours of the initial malnutrition risk screening. For those with dietitian-confirmed scores ≥2, the QIP program was introduced, and consent to participate was documented in the EMR. ONS was ordered manually by the dietitian, and first delivery occurred up to 48 hours postscreening. The treatment protocol provided 2 bottles of ONS daily, delivered with meals. Dietitians educated patients on the importance of ONS consumption. At the time of

Table 1. QIPb and QIPe Program Differences.

Characteristic	QIPb	QIPe
MST is part of EMR	X	X
RN completes MST	X	X
ONS selection by automatic drop-down menu by RN		X
ONS ordered by MD, RN, or RD	X	X
RD consultation	X	X
Time to RD consultation: <24 hours		X
Time to ONS delivery in hours	24–48	1–24
Discharge planning instructions	X	X
Discharge materials, including coupons and literature		X
Standard postdischarge phone calls (24–72 hours)	X	X[a]
Nutrition-focused postdischarge phone calls (n = 4)		X[a]

EMR, electronic medical record; MD, medical doctor; MST, malnutrition screening tool; ONS, oral nutrition supplement; QIP, quality improvement program; QIPb, quality improvement program–basic; QIPe, quality improvement program–enhanced; RD, registered dietitian; RN, registered nurse.
[a]Nutrition-focused questions were incorporated in the standard postdischarge phone calls.

discharge, QIPb patients were provided discharge instructions as clinically indicated at the discretion of the dietitian.

Patients at QIPe hospitals with MST ≥2 got nurse-ordered ONS that started within 24 hours of malnutrition risk screening. The EMR-cued ONS formula type according to the patient's overall dietary orders (ie, standard, diabetes-specific, or renal-specific ONS) and a dietitian consultation was elicited. The dietitian rescreened the patients and introduced patients with confirmed MST ≥2 to the QIP, requested participation, and documented consent. Participating patients were educated on the importance of ONS compliance. At the time of discharge, QIPe patients were provided with instructions for postdischarge ONS use, nutrition literature, and discount coupons for ONS. A month's worth of high-value, $2.50–$3.00 multipack discount coupons (depending on the ONS product used) were distributed outside of the research setting to deliberately replicate current practice. Four telephone calls were made 48–72 hours postdischarge to confirm ONS use and at weeks 2, 3, and 4 postdischarge. The first phone call was done primarily by a transition call center nurse, and remaining calls were completed using an automated phone system. A personal follow-up call from the clinical team was optional.

Outcome Measures

QIP group readmissions. The primary outcome measure was unplanned 30-day readmission (all-cause) to any AHC system hospital. The final follow-up contact was on May 2, 2015.

Readmission rates for baseline and validation cohorts. Administrative records of a retrospective cohort admitted at AHC hospitals using a similar EMR during 2013 were used to estimate the baseline readmission rate for patients with malnutrition-related diagnoses (*International Classification of Diseases, Ninth Revision* codes 263.0–263.9) and ONS orders—the baseline cohort. This cohort was derived prior to QIP implementation and used to set study parameters. A total of 4611 patients were found to be eligible, and these patients had an aggregated readmission rate of 21.2%. Since the MST was not available pre-QIP implementation, the investigators established the pre-QIP readmission rate at 20%, which was confirmed comparable to a prior report.[19] We aimed to detect a 20% relative reduction in the readmission rate, which was consistent with the CMS goal.[10]

To validate this readmission estimate and identify possible confounding issues, data were extracted post hoc for a second QIP comparator cohort—patients who were admitted to the 4 hospitals a year prior to QIP (October 13, 2013–April 2, 2014) but otherwise met QIP inclusion criteria (validation cohort, n = 1319). This cohort was derived after QIP initiation and matched hospitals and timeframes. Their 30-day readmission rate was 22.1%, thereby affirming the conservative use of 20% as the baseline readmission rate estimate. For comparisons, pre-post QIP readmission differences were referenced to the baseline cohort and the validation cohort rates—20% and 22.1%, respectively.

LOS for baseline and validation cohorts. The secondary outcome was hospital LOS, calculated by subtracting admission day from discharge day. Average LOS for the baseline cohort was 6.3 ± 6 days; investigators conservatively set the pre-QIP LOS at 6 ± 6 days. The average LOS for the validation cohort was 7.2 ± 8 days. Pre-post QIP LOS differences are therefore calculated by referencing the LOS of 6 and 7.2 days, respectively, for baseline and validation cohorts.

Sample Size

Initial sample size was calculated to detect a 20% reduction, or absolute decrease of 4% from the baseline readmission rate of 20%, for 30-day readmissions. With 95% confidence interval and power of 80%, the sample size was calculated via PASS 11 (NCCS, LLC, Kaysville, UT) and determined to be 3000 (1500 patients in each group) for a 2-tailed χ^2 test. A preplanned interim power analysis was performed on the data from 6 months post-QIP initiation using both the baseline and validation cohort readmission rates. At interim analysis, 1269 patients were enrolled (769 QIPb and 500 QIPe patients). When using the 20% baseline readmission rate to compare the results of the 2 groups independently, power levels of 40% for QIPb and 50% for QIPe groups were estimated. However, a power of 80% was detected for both groups when using the 22.1% validation cohort readmission rate. Therefore, the study was stopped, and data were analyzed.

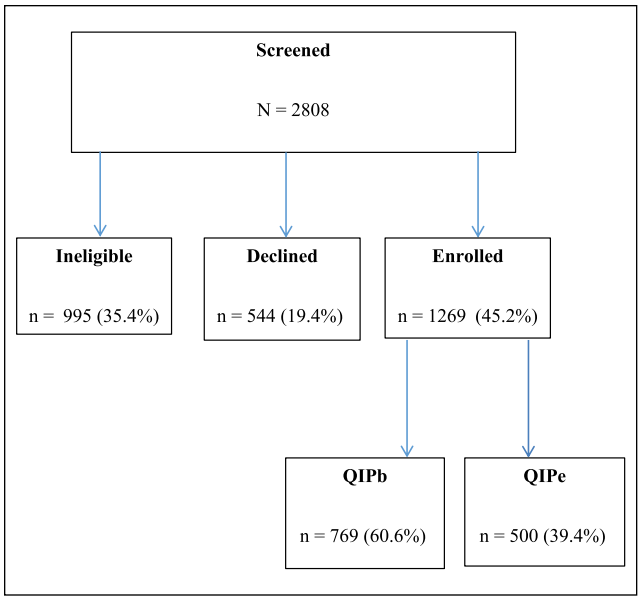

Figure 1. Study flowchart. QIPb, quality improvement program–basic; QIPe, quality improvement program–enhanced.

Statistical Analysis

Descriptive statistics are reported for all continuous and categorical variables. Pre-post group differences for readmission rates and LOS were performed using the χ^2 and Student *t* test, respectively. Similar tests were performed to compare other continuous and categorical variables, and *z* tests were performed for aggregate baseline readmission and LOS results. Spearman correlation was performed to assess the relationships between educational/reinforcing activities and MST errors, as well as MST errors and readmission rates over time for QIP patients. Analyses were performed using SPSS 22.0 (SPSS, an IBM Company, Chicago, IL) and a *z* test calculator. A 2-tailed *P* level of .05 was considered statistically significant.

Results

Demographics

Of the 2808 MST-screened patients, nearly half were at risk of malnutrition and included in the analysis (n = 1269, 45.2%; Figure 1). Demographic and clinical characteristics of pre-QIP patients derived from the validation cohort and QIP participants are presented in Table 2. Patients were mostly white (70.4%), older adults with a mean age of 66.6 ± 17.2 years and admitted for a primary medical diagnosis (77.3%).

Readmission Rates

Compared with the baseline cohort, the absolute reduction of 30-day readmission rate post-QIP in all QIP hospitals was 3.9% (20%–16.1%), which corresponds to a significant relative risk reduction (RRR) of 19.5% ($P = .001$). The readmission rate was 16.4% in the QIPb hospitals and 15.6% in the QIPe hospitals, showing absolute reductions of 3.6% (18% RRR, $P = .01$) and 4.4% (22% RRR, $P = .01$), respectively. Compared with the validation cohort readmission rate of 22.1%, RRRs were 27.1%, 25.8%, and 29.4% for all QIP, QIPb, and QIPe hospitals, respectively ($P < .01$; Table 3).

LOS

The post-QIP average LOS was 5.4 ± 4.7 days for all QIP hospitals, 5.4 ± 4.8 days for the QIPb hospitals, and 5.3 ± 4.5 days for the QIPe hospitals. Using the baseline cohort LOS of 6.0 ± 6 days, an overall 10.0% RRR was reported for all QIP hospitals and the QIPb hospitals and 11.7% RRR for the QIPe hospitals ($P < .05$). When using the validation cohort LOS of 7.2 ± 8 days, there was an absolute reduction of 1.8 ± 3.4 days (ie, a 25% RRR) ($P < .001$) for all QIP hospitals and for the QIPb hospitals (1.8 ± 3.3 days). A total LOS of 5.3 ± 4.5 days was reported in the QIPe hospitals, showing an absolute reduction of 1.9 ± 3.6 days (26% RRR, $P < .01$; Table 3).

QIP Program Findings

Information regarding postdischarge consumption of ONS was collected for a subset of QIPe patients (n = 206). In total, 141 (68%) patients confirmed consuming their recommended ONS, while the average amount of ONS that patients reported drinking was 1.03 bottles per day.

The relationship between educational activities and MST errors (accounting for false positives) throughout the course of QIP deployment is displayed in Figure 2. A negative correlation ($\rho = -.943$, $P = .005$; Figure 2) was observed, thus supporting the importance of education on reducing the rate of MST errors. Figure 3 outlines the relationship between MST errors and readmission rates throughout the same timeframe. Results suggested a positive but nonsignificant correlation of MST errors and readmission rates over time ($\rho = .026$, $P > .05$; Figure 3).

Discussion

The clinical implications of our findings were 2-fold: (1) we demonstrated that malnutrition risk screening and ONS use can improve outcomes in at-risk hospitalized patients (lowered readmission rates and shorter LOS), and (2) we highlighted how a real-world QIP study can provide a scalable model for evidence-based improvements in nutrition care.

Lowered Readmission Rates

The significant relative reductions in readmission rates we observed post-QIP are consistent with results of other studies assessing the impact of malnutrition screening and ONS

Table 2. Demographic and Clinical Characteristics of Pre-QIP and QIP Participants.

Characteristic	Validation Cohort (n = 1319)	QIP Cohort (n = 1269)	*P* Value
Male, No. (%)	622 (47.2)	552 (43.5)	.062
Age, mean ± SD, y	63.1 ± 17.4	66.6 ± 17.2	<.001
Race, No. (%)			<.001
Non-Hispanic white	865 (65.6)	893 (70.4)	
Non-Hispanic black	185 (14.0)	277 (21.8)	
Hispanic	120 (9.1)	84 (6.6)	
Other/unknown	149 (11.3)	15 (1.2)	
Diagnosis-related group service type, No. (%)			<.001
Medical	1217 (92.3)	981 (77.3)	
Surgical	102 (7.7)	288 (22.7)	
Diagnosis categories, No. (%)			<.001
Cardiovascular	170 (12.9)	142 (11.2)	
Oncological	118 (8.9)	247 (19.5)	
Gastrointestinal/pancreatic	352 (26.7)	174 (13.7)	
Kidney and urinary	100 (7.6)	95 (7.5)	
Infectious diseases	109 (8.3)	73 (5.7)	
Endocrine system	47 (3.6)	42 (3.3)	
Other[a]	367 (27.8)	468 (36.9)	
Discharged home, No. (%)	635 (48.1)	631 (49.7)	.421

QIP, quality improvement program.
[a]Respiratory system disorders and diseases, neuroscience, connective tissue, health status, myeloproliferative disorders and diseases, and behavioral health.

Table 3. Readmission Rates and Length of Stay Results by Group Pre-Post QIP.

	Readmission Rates		
RRR	QIP Cohorts, 16.1%	QIPb, 16.4%	QIPe, 15.6%
RRR from baseline cohort, 20%	19.5% (Δ = 3.9%)	18% (Δ = 3.6%)	22% (Δ = 4.4%)
P value	.001	.01	.01
RRR from validation cohort, 22.1%	27.1% (Δ = 6.0%)	25.8% (Δ = 5.7%)	29.4% (Δ = 6.5%)
P value	<.001	.001	.002
	Length of Stay		
	QIP Cohorts, 5.4 ± 4.7 d	QIPb, 5.4 ± 4.8 d	QIPe, 5.3 ± 4.5 d
RRR from baseline cohort, 6.0 ± 6 d	10.0% (Δ = .63 d)	10.0% (Δ = .63 d)	11.7% (Δ = .73 d)
P value	.001	.008	.011
RRR from validation cohort, 7.2 ± 8 d	25% (Δ = 1.8 d)	25% (Δ = 1.8 d)	26.4% (Δ = 1.9 d)
P value	<.001	<.001	<.001

d, day; Δ, delta (difference); NA, not applicable; QIP, quality improvement program; QIPb, quality improvement program–basic; QIPe, quality improvement program–enhanced; RRR, relative risk reduction; SD, standard deviation.

supplementation on 30-day unplanned readmissions.[9,20–22] In addition, Bally et al[11] confirmed that while nutrition interventions have little effect on many clinical outcomes (eg, functional outcomes, hospital-acquired infections), reduction of unplanned readmissions is consistently observed. Our findings therefore suggest that improved nutrition status can reduce illness recurrence in malnourished patients after hospital discharge.

Initiatives aimed at decreasing readmission rates do not typically emphasize the importance of early malnutrition risk screening for all hospitalized patients using an EMR-cued validated tool, followed by appropriate nutrition interventions coordinated by a trained dietitian.[23,24] This failure to recognize malnutrition as a contributing factor to adverse outcomes is also evidenced by the lack of acknowledgment of multidisciplinary team approaches in ensuring appropriate nutrition

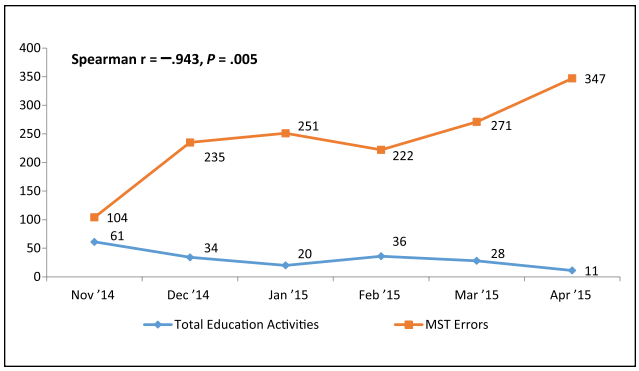

Figure 2. Educational activities and Malnutrition Screening Tool (MST) errors throughout quality improvement program deployment.

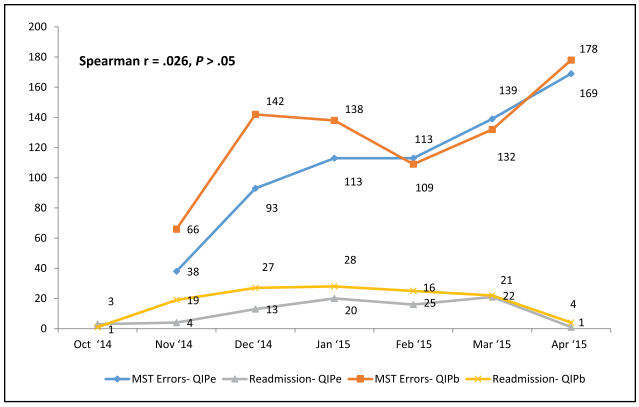

Figure 3. Malnutrition Screening Tool (MST) errors and readmissions observed over time. QIPb, quality improvement program–basic; QIPe, quality improvement program–enhanced.

intervention for malnourished patients.[25] Even regulatory bodies such as CMS do not clearly identify malnutrition as a major contributing cause for readmission.[10] Our findings support the need for similar nutrition interventions in acute settings.

Reduced LOS

The significant reductions in LOS observed in our patient population are supported by previous studies suggesting that ONS consumption by malnourished patients can also reduce LOS.[9,26–28] However, our findings are inconsistent with those reported by other researchers, including Gariballa et al[29] and Bally et al,[11] who concluded that nutrition supplementation and support (including counseling and oral and enteral feeding) have little and nonsignificant effects on LOS. It is important to note that in the previous studies, interventions were specific to feeding and nutrition counseling, while in our QIP, we introduced multiple innovative interventions that enabled us to observe improvements in LOS. While malnutrition is known to prolong LOS among inpatients,[28,30,31] our results suggest that with optimal nutrition-related interventions, LOS can be shortened significantly.

Study Limitations

This study has some limitations. First, this observational, real-world QIP inherits the limitations of nonrandomized, controlled study designs. The QIP does not allow assessment of causality and has risk of bias. Although we took several steps to produce comparable groups, population differences in demographic and clinical characteristics were observed. Also, given the lack of MST before QIP deployment, our historic comparison groups were defined differently than the QIP group with regard to nutrition status and discharge disposition. Second, it is possible that we did not fully capture readmission data as we could not account for readmissions outside our system hospitals. However, in hospitals with a fully implemented EMR, as in our QIP hospitals, the adjusted odds ratio of underestimation of 30-day readmission rate is only 0.97.[32]

Third, similar to other hospitals aiming to meet U.S. government requirements and avoid financial penalties, other efforts to decrease readmission rates and LOS may have been launched during the QIP period, potentially affecting the observed improvements. However, no efforts were focused on patients at risk for malnutrition. Also, the readmission rate and LOS of non-QIP patients admitted at the QIP hospitals during the life of the study remained generally constant (Supplementary Figure S2).

Fourth, we had limited data on ONS consumption and compliance after discharge. Although measuring consumption was beyond the scope of this current project, it is important to note that capturing reliable electronic data on ONS consumption is difficult or even impossible in a real-world QIP, especially because the ONS products are generally not issued from pharmacy services (which require strict processes of documentation). However, as noted by Philipson et al,[9] even an order placed for ONS was associated with positive outcomes. Thus, by improving the ONS ordering process, we believe that similar outcomes will be achieved. ONS compliance in hospitalized patients has been estimated at 67%,[33] and the data generated from the subset of QIPe patients suggest this is a reasonable estimate for our patient population, too. Despite uncertain ONS compliance, we did observe clinical benefits.

Although we do not report actual costs or cost-savings associated with the 2 QIP approaches, our results are likely to be reflected in cost savings as a result of reduced readmission rates and shorter lengths of stay. Finally, program sustainability was variable throughout the QIP period. These challenges were reflected in the number of MST errors (false positives) occurring throughout the QIP period and the significant differences in readmission rates during QIP deployment. We believe that MST errors and readmission rate increased during the second quarter of QIP and were mostly due to staff turnover, leadership changes, and other operational challenges. This

underscores the importance of having administrative support to help create a culture of accountability and to make malnutrition risk screening a system-wide key performance metric.

While the limitations and challenges of our study are worth considering, this was a real-world QIP study implemented in an integrated hospital system, which included both community and teaching hospitals. It is, to our knowledge, the first QIP of its kind to look at nutrition interventions as a mechanism to reduce readmissions and LOS. Our program was innovative in that it used a validated EMR-cued MST screening, enabled EMR-based ONS selection and ordering, included nutrition education and follow-up telephone calls during the 30-day postdischarge period for all QIPe patients (regardless of their discharge disposition), and, most important, addressed all 7 principles recommended to address adult hospital malnutrition.[7] We believe that the positive benefits associated with our nutrition-focused QIP resulted from the comprehensive, multistep strategy we followed, rather than from any single intervention introduced. Logically, adequate nutrition care depends on identifying patients at risk, addressing their nutrition shortfalls, and ensuring that both patients and their caregivers are educated about the importance of continuing to be attentive to nutrition needs.

Conclusions

The results of our study highlight the importance of nutrition as a way to hasten patient recovery, as evidenced by shorter lengths of stay in the hospital. Attention to nutrition also helped prevent hospital readmissions, thus indicating that nutrition can help hospitals reach the CMS goal of reducing readmissions by 20%.[10] Nearly half of our patients admitted to hospital were at risk for malnutrition, and use of nutrition-focused QIP interventions lowered readmission rates by about 20%. Our results show that nutrition care can improve patient health outcomes, and it can also improve health system quality indicators. Together, such results provide a rationale for expanding our nutrition-focused QIP to all our hospitals, as well as to other hospital systems.

Acknowledgments

We acknowledge the assistance of Maria Rozo, BA, and Nathan Leonardi, BA, for data retrieval. We acknowledge and appreciate the services of Nancy Cipparrone, MA; Michael Ries, MD; Barry Rosen, MD; and Sanja Nikolich, MD, for planning, implementation, and liaison with hospital administration and their ongoing participation in interim discussions. We thank Maureen Dziadosz, RN; Scott Goates, PhD; Ina Zamfirova, MS; Sarah Kozmic, BS; Wendy Landow, MPH; Geraldine Asis, BS; Angela Cisneros, BS; Sherri Velez; Dayle Juliano, MS; Tazeen Rizvi Zahra, MD; Kimberly Sorkin, RN; and Susan Okuno-Jones, DNP, for their support and feedback. We thank Cecilia Hofmann, PhD, for her critical review and editing of the manuscript. The services and leadership of the Transition Call Center and all dietitians, nurses and chief nurse executives, vice presidents of medical management, and other administrators at the participating hospitals are greatly appreciated.

Portions of this study were presented at the 2016 Clinical Nutrition Week in Austin, Texas, USA, and subsequently published as an abstract in *JPEN J Parenter Enteral Nutr*. 2016;40(1).

Statement of Authorship

K. Sriram, W. T. Summerfelt, S. Sulo, G. VanDerBosch, J. Partridge, R. A. Hegazi, and J. Feldstein contributed equally to the conception and design of the research; S. Sulo and W. T. Summerfelt contributed to the acquisition, analysis, and interpretation of data; J. Feldstein contributed to the analysis and interpretation of data; K. Sriram and S. Sulo drafted the manuscript with input from all authors as necessary; all authors read and critically revised the manuscript and gave final approval; and K. Sriram, S. Sulo, and W. T. Summerfelt agree to be accountable for all aspects of work ensuring integrity and accuracy.

Supplementary Materials

Figures S1 and S2 are available with the article online at http://journals.sagepub.com/home/pen.

References

1. Butterworth CE Jr. The skeleton in the hospital closet. *Nutr Today*. 1974;9(2):4-8.
2. Kirkland LL, Kashiwagi DT, Brantley S, Scheurer D, Varkey P. Nutrition in the hospitalized patient. *J Hosp Med*. 2013;8(1):52-58.
3. Singh H, Watt K, Veitch R, Cantor M, Duerksen DR. Malnutrition is prevalent in hospitalized medical patients: are housestaff identifying the malnourished patient? *Nutrition*. 2006;22(4):350-354.
4. McWhirter JP, Pennington CR. Incidence and recognition of malnutrition in hospital. *BMJ*. 1994;308(6934):945-948.
5. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr*. 2008;27(1):5-15.
6. Braunschweig C, Gomez S, Sheean PM. Impact of declines in nutritional status on outcomes in adult patients hospitalized for more than 7 days. *J Am Diet Assoc*. 2000;100(11):1316-1324.
7. Tappenden KA, Quatrara B, Parkhurst ML, Malone AM, Fanjiang G, Ziegler TR. Critical role of nutrition in improving quality of care: an interdisciplinary call to action to address adult hospital malnutrition. *J Acad Nutr Diet*. 2013;113(9):1219-1237.
8. Hegazi RA, Hustead DS, Evans DC. Preoperative standard oral nutrition supplements vs immunonutrition: results of a systematic review and meta-analysis. *J Am Coll Surg*. 2014;219(5):1078-1087.
9. Philipson TJ, Snider JT, Lakdawalla DN, Stryckman B, Goldman DP. Impact of oral nutritional supplementation on hospital outcomes. *Am J Manag Care*. 2013;19(2):121-128.
10. Readmission Reduction Program, Patient Protection and Affordable Care Act, §3025 (2010). https://www.cms.gov/medicare/medicare-fee-for-service-payment/acuteinpatientpps/readmissions-reduction-program.html. Accessed April 2, 2016.
11. Bally MR, Blaser Yildirim PZ, Bounoure L, et al. Nutritional support and outcomes in malnourished medical inpatients: a systematic review and meta-analysis. *JAMA Intern Med*. 2016;176(1):43-53.
12. Deutz NE, Matheson EM, Matarese LE, et al. Readmission and mortality in malnourished, older, hospitalized adults treated with a specialized oral nutritional supplement: a randomized clinical trial. *Clin Nutr*. 2016;35(1):18-26.
13. Jensen MB, Hessov I. Dietary supplementation at home improves the regain of lean body mass after surgery. *Nutrition*. 1997;13(5):422-430.
14. Jenq GY, Doyle MM, Belton BM, Herrin J, Horwitz LI. Quasi-experimental evaluation of the effectiveness of a large-scale readmission reduction program. *JAMA Intern Med*. 2016;176(5):681-690.

15. Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. *Nutrition*. 1999;15(6):458-464.
16. Ferguson M, Banks M, Bauer J, Isenring E, Vivanti A, Capra S. Nutrition screening practices in Australian healthcare facilities: a decade later. *Nutr Diet*. 2010;67(4):213-218.
17. Young AM, Kidston S, Banks MD, Mudge AM, Isenring EA. Malnutrition screening tools: comparison against two validated nutrition assessment methods in older medical inpatients. *Nutrition*. 2013;29(1): 101-106.
18. Jeejeebhoy KN, Keller H, Gramlich L, et al. Nutritional assessment: comparison of clinical assessment and objective variables for the prediction of length of hospital stay and readmission. *Am J Clin Nutr*. 2015;101(5):956-965.
19. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med*. 2009;360(14):1418-1428.
20. Meehan A, Loose C, Bell J, Partridge J, Nelson J, Goates S. Health system quality improvement: impact of prompt nutrition care on patient outcomes and health care costs. *J Nurs Care Qual*. 2016;31(3):217-223.
21. Snider JT, Jena AB, Linthicum MT, et al. Effect of hospital use of oral nutritional supplementation on length of stay, hospital cost, and 30-day readmissions among Medicare patients with COPD. *Chest*. 2015;147(6):1477-1484.
22. Stratton RJ, Hebuterne X, Elia M. A systematic review and meta-analysis of the impact of oral nutritional supplements on hospital readmissions. *Ageing Res Rev*. 2013;12(4):884-897.
23. Donnelly JP, Hohmann SF, Wang HE. Unplanned readmissions after hospitalization for severe sepsis at academic medical center-affiliated hospitals. *Crit Care Med*. 2015;43(9):1916-1927.
24. Turrentine FE, Denlinger CE, Simpson VB, et al. Morbidity, mortality, cost, and survival estimates of gastrointestinal anastomotic leaks. *J Am Coll Surg*. 2015;220(2):195-206.
25. Pannick S, Davis R, Ashrafian H, et al. Effects of interdisciplinary team care interventions on general medical wards: a systematic review. *JAMA Intern Med*. 2015;175(8):1288-1298.
26. Martins CP, Correia JR, do Amaral TF. Undernutrition risk screening and length of stay of hospitalized elderly. *J Nutr Elder*. 2005;25(2):5-21.
27. Somanchi M, Tao X, Mullin GE. The facilitated early enteral and dietary management effectiveness trial in hospitalized patients with malnutrition. *JPEN J Parenter Enteral Nutr*. 2011;35(2):209-216.
28. Stratton RJ, King CL, Stroud MA, Jackson AA, Elia M. 'Malnutrition Universal Screening Tool' predicts mortality and length of hospital stay in acutely ill elderly. *Br J Nutr*. 2006;95(2):325-330.
29. Gariballa S, Forster S, Walters S, Powers H. A randomized, double-blind, placebo-controlled trial of nutritional supplementation during acute illness. *Am J Med*. 2006;119(8):693-699.
30. Allard JP, Keller H, Jeejeebhoy KN, et al. Malnutrition at hospital admission—contributors and effect on length of stay: a prospective cohort study from the Canadian Malnutrition Task Force. *JPEN J Parenter Enteral Nutr*. 2016;40(4):487-497.
31. Lim SL, Ong KC, Chan YH, Loke WC, Ferguson M, Daniels L. Malnutrition and its impact on cost of hospitalization, length of stay, readmission and 3-year mortality. *Clin Nutr*. 2012;31(3):345-350.
32. Gonzalez AA, Shih T, Dimick JB, Ghaferi AA. Using same-hospital readmission rates to estimate all-hospital readmission rates. *J Am Coll Surg*. 2014;219(4):656-663.
33. Hubbard GP, Elia M, Holdoway A, Stratton RJ. A systematic review of compliance to oral nutritional supplements. *Clin Nutr*. 2012;31(3): 293-312.