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Reducing Hospitalizations and Costs: A Home Health Nutrition-Focused Quality Improvement Program

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Abstract

Background: Identification and treatment of malnutrition across the care continuum can help prevent illness onset or relapse and maximize the effectiveness of other medical treatments. This study aimed to evaluate the effect of a nutrition-focused quality improvement program (QIP) conducted in a home health agency (HHA) on hospitalization rates and healthcare costs incurred over 90 days. *Methods:* This was a multisite, pre-post QIP implemented at 2 branches of an Illinois-based HHA. The QIP included 1546 patients who were (1) at-risk or malnourished hospitalized patients discharged to the HHA, (2) referred by a physician during an outpatient visit, or (3) enrolled in the HHA through a skilled nursing facility. A historic (n = 7413 patients) and concurrent group (n = 5235) of patients were used for comparisons. Propensity score matching was used to account for imbalances in patient characteristics. *Results:* The QIP led to reduced relative risk of hospitalization post-enrollment to the QIP by 24.3%, 22.8%, and 18.3% at 30, 60, and 90 days, respectively, when compared with the historic group, and by 18.2%, 16.2%, and 12.1% when compared with the concurrent group. Total cost savings from reduced 90-day healthcare resource utilization was $2,318,894, or $1500 per patient treated. *Conclusions:* Rates of hospitalization and healthcare resources can be significantly reduced through the implementation of a nutrition-focused QIP delivering oral nutritional supplements in home health settings for adults at-risk/malnourished. These results highlight the importance of nutrition as a strategy for HHAs and other post-acute care institutions to improve patients' health outcomes and generate cost savings. (*JPEN J Parenter Enteral Nutr.* 2020;44:58–68)

Keywords

cost saving; home health; hospitalization; nutrition; oral nutritional supplements

Clinical Relevancy Statement

Malnourished patients are at increased risk of complications during hospitalization and are at further risk for adverse health events after discharge. Home health agencies are ideal partners to identify and treat patients with poor nutrition status and help healthcare organizations achieve better patient satisfaction, improved quality of care, and decreased costs. The clinical implications of our findings are that (1) malnutrition risk screening and at-home use of oral nutritional supplements as part of nutrition-focused care can reduce 30-day, 60-day, and 90-day hospitalization rates and healthcare resource utilization, thus yielding significant cost savings, and (2) nutrition care is important throughout the continuum of care.

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Introduction

As many as half of patients entering the hospital are malnourished,[1,2] particularly older adults.[3] Even among patients whose nutrition status is adequate upon admission, many experience nutrition deterioration during their hospital stay.[4] Malnourished patients are at increased risk of complications during hospitalization and are at further risk for adverse health events after discharge.[5] Thus, malnutrition remains a significant concern among adults receiving healthcare services in postacute care settings.[6-8] Yet, malnutrition often goes unrecognized during the hospital stay and continues to be overlooked after discharge.[9] For example, results of a U.S. study showed that about 25% of adults receiving home health services were at moderate-to-high nutrition risk.[10] Therefore, home health agencies (HHAs) are ideal partners to identify and treat patients with poor nutrition status and help healthcare organizations achieve better patient satisfaction, improved quality of care, and decreased costs.[11]

In fact, postacute care is one of the fastest-growing areas of healthcare spending in the United States,[12,13] accounting for the largest increase in Medicare spending.[14] A goal of all postacute providers, and HHAs in particular, is to prevent hospital readmissions within 30 days of discharge or in the first 30 days of home health enrollment.[15] Notably, costs of unplanned hospital readmissions are up to $12 billion each year among Medicare beneficiaries,[16] and patient readmissions are increasingly used as quality-of-care measures for provider reimbursements.[17]

Advocate Health Care (AHC) previously conducted a nutrition-focused quality improvement program (QIP) at 4 hospitals; this QIP significantly reduced hospital length of stay and 30-day readmissions in at-risk and malnourished patients.[18] Such benefits were associated with lower healthcare costs.[19] Our current AHC study evaluated the impact of a nutrition-focused QIP on 90-day hospitalization rates and healthcare resource utilization by at-risk or malnourished adults under HHA care. The QIP focused on bolstering patient-centered nutrition care using mandatory nutrition screening upon admission to home health, patient and caregiver education, motivational interviewing on nutrition, and provision of oral nutritional supplements (ONSs) when appropriate.

Methods

Study Design

AHC, a not-for-profit provider, is the largest integrated healthcare delivery system in Illinois. AHC serves individuals, families, and communities across metropolitan Chicago and central Illinois. AHC provides inpatient and outpatient services, home health services, hospice, counseling, physician services, and healthcare education programs and is recognized for clinical excellence in trauma, cardiovascular services, cancer care, and neurology. This study was a multisite, pre-post QIP implemented at 2 HHA branches of AHC. Patients were enrolled to the QIP between December 27, 2016, and December 7, 2017. The primary outcome was risk of hospitalization within 90 days of HHA enrollment. The study was approved by the AHC Institutional Review Board. This trial was registered under ClinicalTrials.gov identifier no. NCT03011944.

Patients and Controls

Patients were eligible for the QIP if they were admitted to the HHA from an AHC hospital, outpatient clinic, or affiliated skilled nursing facility (SNF); ≥18 years of age; at risk for malnutrition upon hospital discharge (score of ≥2 on the Malnutrition Screening Tool) and/or on admission to the HHA (score of ≥30 on the Nutritional Health Screen, [NHS], Appendix Figure A1); and able to consume food and beverages orally. Patients were excluded if they were pregnant, were intubated or receiving tube feeding or parenteral nutrition, had severe dementia or delirium, had a history of significant psychiatric disorder, were receiving hospice care, had any other disorder or condition that would interfere with ONS consumption, declined to participate, or did not have an existing relationship with an AHC hospital, outpatient clinic, or affiliated SNF.

Two control groups were established—historic and concurrent. The historic group included at-risk and malnourished patients enrolled at the same 2 branches of the HHA during the 12 months prior to the QIP start (December 27, 2015–December 26, 2016). As the NHS tool was not always used prior to the QIP, proxy measures also identified at-risk and malnourished patients: (1) malnutrition-related diagnoses (*International Classification of Diseases, Ninth Revision* [*ICD-9*] codes 263.0–263.9), (2) ONS orders during hospital admission, or (3) malnutrition-related documentation in physician notes on outpatient medical records. The concurrent control group included at-risk and malnourished patients enrolled at all branches of the HHA (n = 5) during the same 12 months of the implementation of the QIP (December 27, 2016–December 7, 2017). This group was identified using NHS tool results or proxy measures, as described above.

The QIP and control groups had 3 patient subgroups. Group 1 consisted of at-risk and malnourished hospital patients discharged to the HHA; group 2 consisted of at-risk and malnourished outpatients admitted to the HHA; and group 3 consisted of at-risk and malnourished patients discharged from SNF to HHA.

Program and Study Site

AHC's HHA is Joint Commission accredited and serves the Chicago and central Illinois areas. The HHA team

provides skilled nursing and other therapeutic services to help patients manage their health conditions independently. The program focuses on individualized treatment, including overall coordination of care with patients' healthcare providers. HHA has 5 branches, caring for 13,000 patients/year; the 2 largest branches participated in this QIP.

Measures

The primary endpoint was the rate of unplanned hospitalizations (including hospital readmission and admission) within 90 days of HHA enrollment. The secondary endpoint was healthcare resource utilization during the 90-day follow-up period. Healthcare resource utilization included hospitalizations, emergency department (ED) visits, and outpatient visits within the AHC network. Outpatient visits included ambulatory visits, imaging visits, and laboratory visits.

The following baseline sociodemographic variables were collected: patient characteristics (age, sex, race), referral status (patients admitted from hospitals, outpatient clinic, or SNF), health insurance type (private, public, self-pay, other, or unknown), ONS type during HHA stay, patient clinical characteristics (surgery vs medical status), and most common diagnostic profiles (myocardial infarction [MI], congestive heart failure [CHF], chronic obstructive pulmonary disease [COPD], diabetes, and malignancy).

Nutrition Intervention

Patients were screened for malnutrition risk with NHS, a tool used by Medicare-certified HHAs and built into the HHA's Allscripts electronic medical record (EMR) system. During the initial HHA visit, screening was completed by the admitting clinician (a nurse or physical therapist), who underwent training on NHS completion requirements. Clinicians were initially trained during an in-person, scenario-based group session. Additional training before and during the QIP implementation was provided on an individual basis by the clinical manager. The AHC lead registered dietitian was involved in developing the training materials and also conducting sessions as needed. The NHS tool uses 15 questions on nutrition status; a score is calculated based on patient responses (Appendix Figure A1). Patients were designated as good nutrition status (0–25 points), moderate nutrition risk (30–55 points), or high nutrition risk (60–100 points). Patients with moderate or high risk were flagged for intervention. A customized nutrition care plan, including ONS use during HHA care, was generated in the EMR. The admitting clinician ordered standard (Ensure, 2 bottles/d), diabetes-specific (Glucerna, 2 bottles/d), or renal-specific (Nepro, 1 bottle/d) according to the patient's dietary needs; ONS was provided to each enrolled patient for up to 30 days. A standard QIP ONS protocol was developed by the AHC lead dietitian, as dietitians were not available in HHAs to meet with patients to customize their dietary plan. The recommended ONS type and associated amounts were informed by standard nutrition protocols and guidelines. ONS was delivered directly to the patient's home within approximately 48–72 hours of enrollment in HHA. Clinicians used an allergy-based algorithm to inform product selection; patients made flavor choices.

The plan was reviewed at each patient visit, and nutrition status was documented in the patient's chart. Patients were educated on the importance of nutrition and the benefits of ONS using the teach-back method. In subsequent HHA visits, patients were reminded of the importance of nutrition, and caring clinicians used motivational interviewing strategies to encourage adherence to the ONS regimen. Coupons for discounts on ONS purchases were distributed to all participating QIP patients to replicate current practice.

Within 30–45 days after admission to the HHA, QIP patients were contacted by telephone and asked to participate in a survey. The survey included questions on patient experience, consumption of ONS, likelihood of ONS use post–HHA discharge, and clinician nutrition practices.

Data Sources and Management

For most QIP analyses, archival data were obtained from the AHC-wide Electronic Data Warehouse database. Additional data were abstracted from EMRs of hospitals and HHA, and patient survey data were compiled and summarized.

Fixed and variable QIP program costs were estimated using specific HHA staff time recorded for the QIP processes and the associated hourly wage rates from the 2017 Bureau of Labor Statistics.[20] The costs included those associated with patient screening and assessment ($67,043, n = 5688), patient and caregiver education, follow-up calls, survey administration, and other QIP procedures ($164,470, n = 1546). Costs for ONS and delivery ($171,281, n = 1546) were also included. The cost of hospitalization for malnourished adult patients of $17,985 was from the 2016 Healthcare Cost and Utilization Project (HCUP) report.[21] Average costs of ED and outpatient visits of $1252 and $511, respectively, were from the Medical Expenditure Panel Survey (2013).[22]

Statistical Analysis

Descriptive statistics were calculated. Between-group analyses were performed by comparing QIP patients with controls (either historic or concurrent) using the χ^2 test for categorical variables and the *t*-test for continuous variables. A Poisson regression model was used to estimate the risk of hospitalization during the 30-day, 60-day, or 90-day period while accounting for age, sex, race, insurance, referral source, MI, CHF, COPD, diabetes, and malignancy. Descriptive statistics were calculated for healthcare resource

utilization outcomes. A generalized linear regression model with Poisson distribution and log link was used to estimate risk reduction in resource utilization between the 2 cohorts. Analyses were performed with SPSS 22.0 and SAS 9.3; a 2-tailed *P*-value ≤ 0.05 was considered statistically significant.

Propensity Score Matching and Sensitivity Analysis

Propensity score matching (PSM) matched historic and concurrent controls to QIP patients. To estimate the propensity scores, a logistic regression model was used, adjusting for age, sex, race, insurance status, prevalent diagnoses (MI, CHF, COPD, diabetes, and malignancy), HHA admission branch (south vs north), and referral source (hospital, outpatient clinic, or SNF). The greedy algorithm was used for between-group matching.[23]

A sensitivity analysis compared hospitalization and healthcare resource utilization results across the different comparative analyses: QIP vs historic controls, QIP vs concurrent controls, PSM QIP vs historic controls, and PSM QIP vs concurrent controls.

Cost Analysis

Costs incurred from hospitalizations, ED and outpatient visits, and QIP implementation were analyzed in a descriptive manner for QIP and historic control groups. Sensitivity analysis compared cost findings of this analysis with those from the remaining 3 comparative analyses: QIP vs concurrent controls, PSM QIP vs historic controls, and PSM QIP vs concurrent controls.

Sample Size Calculation

Initial sample size calculation assumed a 20% relative-risk (RR) reduction for 90-day hospitalization between QIP patients and historic controls. With 95% confidence interval (CI), power of 80%, and a 2-sided α of 5%, we estimated a total enrollment of 1800 patients. A preplanned interim power analysis was performed upon enrollment of 30% of QIP patients. Hospitalization rates were 25% for historic controls vs 19.2% for QIP patients, and the required sample size was reestimated as 1450 QIP patients. To account for potential patient attrition, the decision was made to run the QIP longer, which led to enrollment of 1546 QIP patients.

Results

Patient Demographics

Of 5688 patients screened, 2206 (38.8%) patients were identified as at risk of malnutrition. Of these, 2135 patients (37.5%) were found to be at moderate nutrition risk, whereas 71 patients (1.3%) were at high risk; 1546 (70%) met the QIP eligibility criteria. Data were collected for 1546 QIP

Table 1. Demographic Characteristics of Participants in the QIP and Historic Control Groups.

Characteristic	QIP (n = 1546)	Historic Control (n = 7413)	*P*-value
Age, years[a]	76.8 (12.8)	73.7 (13.5)	<0.0001
Age group, %			<0.0001
<65	255 (16.5)	1828 (24.7)	
≥65	1291 (83.5)	5585 (75.3)	
Gender, %			0.90
Female	921 (59.6)	4404 (59.4)	
Male	625 (40.4)	3009 (40.6)	
Race, %			<0.0001
White	734 (47.5)	4264 (57.5)	
Black	587 (38.0)	2579 (34.8)	
Other	225 (14.6)	570 (7.7)	
Referral source, %			<0.0001
Hospital	1049 (67.9)	4653 (62.8)	
Outpatient clinic	203 (13.1)	722 (9.7)	
Skilled nursing facility	294 (19.0)	2038 (27.5)	
Insurance, %			<0.0001
Private	270 (17.5)	1318 (17.8)	
Public	1248 (80.7)	6028 (81.3)	
Self-pay	7 (0.5)	26 (0.4)	
Other	8 (0.5)	41 (0.6)	
Unknown	13 (0.8)	0 (0.0)	
ONS type during home health, %			NA
Standard (Ensure)	935 (60.5)		
Diabetes-specific (Glucerna)	539 (34.3)		
Renal-specific (Nepro)	81 (5.2)		
Surgical patients, %			<0.0001
Yes	489 (31.6)	2845 (38.4)	
No	1057 (68.4)	4568 (61.6)	
Myocardial infarction, %			0.79
Yes	47 (3.0)	235 (3.2)	
No	1499 (97.0)	7178 (96.8)	
Congestive heart failure, %			0.12
Yes	516 (33.4)	2324 (31.4)	
No	1030 (66.6)	5089 (68.7)	
COPD, %			0.15
Yes	382 (24.7)	1706 (23.0)	
No	1164 (75.3)	5707 (77.0)	
Diabetes, %			0.06
Yes	468 (30.3)	2510 (33.9)	
No	1078 (69.7)	4903 (66.1)	
Malignancy, %			
Yes	59 (3.82)	154 (2.94)	0.08
No	1487 (96.2)	5080 (97.1)	

Standard errors or percentages are shown in parentheses.
COPD, chronic obstructive pulmonary disease; NA, not applicable; ONS, oral nutritional supplement; QIP, quality improvement program.
[a]Average (standard deviation).

Table 2. Hospitalization Rates at 30, 60, and 90 Days Postenrollment to Home Health, Compared by Recruitment Types.

	QIP (n = 1546)		Historic Control (n = 7413)		Concurrent Control (n = 5235)	
Overall	N	%	N	%	N	%
30 day[a]	173	11.2	1096	14.8	716	13.7
60 day[a]	270	17.5	1676	22.6	1091	20.8
90 day[a]	344	22.3	2018	27.2	1325	25.3
Hospital						
30 day	122	11.6	626	13.5	438	12.2
60 day	192	18.3	974	20.9	690	19.2
90 day	246	23.5	1175	25.3	837	23.3
Skilled nursing facility						
30 day[a]	31	10.5	353	17.3	209	17.3
60 day[a]	50	17.0	508	24.9	282	23.3
90 day[a]	60	20.4	599	29.4	335	27.7
Outpatient clinics						
30 day[a]	20	9.8	117	16.2	69	15.7
60 day[a]	28	13.8	194	26.9	119	27.0
90 day[a]	38	18.7	244	33.8	153	34.7

QIP, quality improvement program.
[a] $P < 0.05$ when comparing QIP with historic control and QIP with concurrent control.

patients, 7413 historic control patients, and 5235 concurrent control patients. Since the results of the sensitivity analysis were consistent among all 4 comparative analyses (QIP vs historic controls, QIP vs concurrent controls, PSM QIP vs historic controls, and PSM QIP vs concurrent controls), we report the results of all 4 comparative analyses only for the primary outcome of interest, hospitalization. Results on demographic characteristics and healthcare resource utilization are reported only for QIP patients vs historic controls, as other results were similar.

Table 1 shows demographic information for QIP and historic control groups. Overall, QIP patients were older (mean age = 76.8 years), with 83.5% of patients ≥65 years of age compared with 75.3% in the historic control group. Most QIP participants were admitted from hospitals (n = 1049; 67.9%), whereas 19.0% (n = 294) and 13.1% (n = 203) came from SNFs and outpatient clinics, respectively. In the historic control group, 62.8% (n = 4653) were admitted from hospitals, whereas 27.5% (n = 2038) and 9.7% (n = 722) came from SNFs and outpatient clinics, respectively. Comparing the race of QIP and historic control patients, significantly more QIP participants were nonwhite (black or other). There were no significant differences between groups regarding sex and diagnoses (MI, CHF, COPD, diabetes, or malignancy) distribution; fewer of the QIP group were surgical patients, as compared with the control group.

Hospitalization Rates

Unadjusted hospitalization rates for 30 days, 60 days, and 90 days after enrollment to HHA (Table 2) were compared with historic controls and concurrent controls, as were PSM cohorts for both historic and concurrent groups (Table 3). Compared with the historic controls, the absolute reduction in 30-day hospitalization post-QIP was 3.6% (14.8%–11.2%), with a significant RR reduction of 24.3% ($P = 0.007$). For 60 and 90 days, absolute reductions in hospitalizations were 5.1% (22.6%–17.5%) and 4.9% (27.2%–22.3%), with significant RR reductions of 22.6% ($P < 0.001$) and 18.0% ($P = 0.001$), respectively. Compared with concurrent controls, the absolute reduction in 30-day hospitalizations was 2.5% (13.7%–11.2%), with a significant RR reduction of 18.2% ($P = 0.002$). For 60 and 90 days post-QIP, in comparison with the concurrent control group, there were absolute reductions in hospitalizations of 3.3% (20.8%–17.5%) and 3% (25.3%–22.3%), with significant RR reductions of 15.8% ($P = 0.009$) and 11.8% ($P = 0.03$), respectively. Statistically significant reductions in 30-day, 60-day, and 90-day hospitalizations post-QIP were observed for outpatients (all $P < 0.05$) and SNF patients (all $P < 0.05$). For hospital patients, hospitalization rates were lower, but reductions were not statistically significant (all $P > 0.05$).

PSM results generated by Poisson regression models were consistent with the unadjusted comparative results, showing significant improvements in hospitalization rates during the 90-day period for the overall patient population and significant improvements in outpatients and SNF patients (Table 3).

Healthcare Resource Utilization

During the 90-day follow-up period, significant reductions in healthcare resource utilization were observed for the

Table 3. RR Reduction Using Historic and Concurrent Control Groups as Comparators.

Comparison Group: Historic Controls									
	30 day			60 day			90 day		
QIP group	N	RR (95% CI)	*P*-value	N	RR (95% CI)	*P*-value	N	RR (95% CI)	*P*-value
Overall									
Unadjusted	1269	0.76 (0.65–0.88)	0.007	1946	0.77 (0.69–0.87)	<0.001	2362	0.82 (0.74–0.90)	0.001
PS matched	383	0.81 (0.65–0.88)	0.04	604	0.80 (0.68–0.94)	0.006	750	0.84 (0.73–0.97)	0.02
Hospital									
Unadjusted	748	0.86 (0.71–1.05)	0.14	1166	0.87 (0.75–1.02)	0.09	1421	0.93 (0.81–1.07)	0.29
PS matched	266	0.88 (0.70–1.13)	0.32	428	0.85 (0.70–1.03)	0.09	531	0.90 (0.76–1.07)	0.23
SNF									
Unadjusted	384	0.61 (0.42–0.88)	0.008	558	0.68 (0.51–0.91)	0.01	659	0.69 (0.53–0.91)	0.007
PS matched	77	0.63 (0.40–0.99)	0.05	115	0.73 (0.50–1.06)	0.09	138	0.73 (0.52–1.03)	0.07
Outpatient clinic									
Unadjusted	137	0.61 (0.38–0.98)	0.04	222	0.51 (0.35–0.76)	0.001	282	0.55 (0.39–0.78)	0.0007
PS matched	40	0.71 (0.38–1.33)	0.29	61	0.63 (0.38–1.04)	0.07	81	0.66 (0.43–1.03)	0.07
Comparison Group: Concurrent Controls									
	30 day			60 day			90 day		
QIP Group	N	RR (95% CI)	*P*-value	N	RR (95% CI)	*P*-value	N	RR (95% CI)	*P*-value
Overall									
Unadjusted	889	0.82 (0.69–0.97)	0.002	1361	0.84 (0.73–0.96)	0.009	1669	0.88 (0.78–0.99)	0.03
PS matched	386	0.81 (0.66–0.99)	0.04	587	0.85 (0.72–0.99)	0.04	733	0.88 (0.76–1.02)	0.08
Hospital									
Unadjusted	560	0.95 (0.78–1.16)	0.63	882	0.95 (0.81–1.12)	0.54	1083	1.01 (0.87–1.16)	0.95
PS matched	251	0.96 (0.75–1.22)	0.82	379	1.03 (0.84–1.26)	0.79	473	1.09 (0.91–1.30)	0.37
SNF									
Unadjusted	240	0.61 (0.42–0.89)	0.01	332	0.73 (0.54–0.98)	0.04	395	0.74 (0.56–0.97)	0.03
PS matched	85	0.53 (0.34–0.83)	0.005	126	0.61 (0.43–0.87)	0.007	153	0.60 (0.43–0.83)	0.002
Outpatient clinic									
Unadjusted	89	0.63 (0.38–1.04)	0.07	147	0.51 (0.34–0.77)	0.001	191	0.54 (0.38–0.77)	0.0007
PS matched	50	0.71 (0.40–1.24)	0.23	82	0.55 (0.35–0.87)	0.01	107	0.58 (0.39–0.87)	0.007

CI, confidence interval; N, number; PS, propensity score; QIP, quality improvement program; RR, relative risk; SNF, skilled nursing facility.

Table 4. Healthcare Resource Utilization During 90-Day Period Using Historic Controls as Comparison.

Healthcare Resource	Overall			
	RR	LCL	UCL	*P*-value
Inpatient visits	0.81	0.74	0.90	<0.0001
ED visits	1.46	1.27	1.69	<0.0001
Outpatient visits	0.83	0.81	0.85	<0.0001
Overall	0.92	0.90	0.94	<.0001
	Hospital			
	RR	LCL	UCL	*P*-value
Inpatient visits	0.89	0.79	0.99	0.0495
ED visits	1.57	1.32	1.86	<0.001
Outpatient visits	0.82	0.79	0.84	<0.0001
Overall	0.92	0.90	0.95	<.0001
	Outpatient Clinic			
	RR	LCL	UCL	*P*-value
Inpatient visits	0.57	0.43	0.76	0.0002
ED visits	1.07	0.70	1.62	0.73
Outpatient visits	0.73	0.67	0.79	<0.0001
Overall	0.87	0.81	0.92	<.0001
	Skilled Nursing Facility			
	RR	LCL	UCL	*P*-value
Inpatient visits	0.74	0.60	0.92	0.0075
ED visits	1.19	0.82	1.74	0.34
Outpatient visits	0.91	0.87	0.97	0.0023
Overall	0.96	0.91	0.99	0.0002

ED, emergency department; LCL, lower confidence limit; RR, relative risk; UCL, upper confidence limit.

overall QIP patient population (RR = 0.92, 95% CI 0.90–0.94, $P < 0.0001$) and the subgroups (P values < 0.001). Significant reductions for hospitalizations and outpatient visits were observed for the overall QIP patient population compared with historic controls; RRs were 0.81 (95% CI 0.74–0.90, $P < 0.001$) and 0.83 (95% CI 0.81–0.85, $P < 0.0001$), respectively. ED visits, however, were higher in the QIP group (RR = 1.46, 95% CI 1.27–1.69, $P < 0.0001$). Similar results were observed for the 3 subgroups: admitted from hospital, outpatient clinics, and SNF (Table 4). Sensitivity analysis showed that the results were consistent among all comparative analyses, with significant improvements for overall QIP patients.

Cost Savings

Total savings from reduced healthcare resource utilization (ie, avoided hospitalizations, outpatient visits) during the 90-day period was $2,318,894; net savings per treated patient was $1500 (Table 5). The results of the sensitivity analysis coincided with the original findings; cost savings ranged between $2,090,821 and $2,809,845, and net savings per treated patient ranged between $1366 and $1843.

Table 5. Cost Savings During 90-Day Period Using Historical Controls as Comparison.

QIP	USD Amount
Total HCRU costs[a]	$13,065,954
Total QIP resource costs[b]	$402,794
Per-patient QIP resource cost	$261
QIP total cost per patient	$8712
Historical Controls	**USD Amount**
Total HCRU costs	$75,701,028
Total QIP resource costs	$0
Per-patient QIP resource cost	$0
Comparison per-patient cost	$10,212
Cost Savings	**USD Amount**
For overall QIP patient population (n = 1546)	$2,318,894
Per patient	$1500

HCRU, healthcare resource utilization; ONS, oral nutritional supplement; QIP, quality improvement program; USD, U.S. dollar.
[a]Costs incurred from hospitalizations and emergency department and outpatient visits.
[b]Costs of QIP implementation include patient screening and assessment (n = 5688) as well as education, follow-ups, ONS bottles, and delivery (n = 1546).

Phone Survey Results

Of the 1546 QIP patients, 813 responded to the follow-up telephone survey (52.6%), and 764 (94.0%) patients reported consuming ONS while receiving home healthcare. During the first 30 days of the QIP period, participants reported consuming an average of 1.12 bottles/d of standard ONS (Ensure, n = 507), 1.09 bottles/d of diabetes-specific ONS (Glucerna, n = 266), and 1.13 bottles/d of renal-specific ONS (Nepro, n = 40) (Appendix Table A1). Participants reported that the importance of nutrition care was almost always discussed with the HHA clinician during the home healthcare episode. Nutrition education was always discussed with 57.2% of participants, usually discussed with 27.7%, and sometimes discussed with 8.2%; the remaining 6.9% of patients were not sure or did not remember such discussions. Regarding continued ONS use if prescribed, nearly 60% were very likely to consume ONS beyond their home healthcare episode, and only 5.0% were unlikely to do so. The main factors influencing an "unlikely" response were affordability, taste, and swallowing difficulties.

Discussion

Nutrition care is vital to achieving best outcomes for patients across the continuum of care, for which ONS is a

highly effective treatment of malnutrition.[24] This study in the home healthcare setting employed a nutrition-focused QIP to enhance comprehensive nutrition care for patients who were at risk or malnourished. With this QIP in place, RR of hospitalization was reduced by over 20% at 30 days, and the effect was largely sustained at 60 and 90 days. Reduction was observed consistently, regardless of whether historic or concurrent patient populations were used, and with or without adjustment of the comparator group by propensity matching of patients for sociodemographic variables and disease status. The reduced risk for hospitalization and outpatient visits among QIP HHA patients was associated with lower overall 90-day healthcare resource utilization, which generated significant costs savings of $2,318,894 for the entire QIP cohort or net savings of $1500 per patient treated. The current AHC results on nutrition-focused QIP in home healthcare are consistent with findings from the AHC in-hospital, ONS nutrition-focused QIP; the study led to total costs savings of $4,896,758 or $3858 per patient treated because of a shorter hospital length of stay and reductions in 30-day unplanned readmissions.[19]

Although this AHC QIP led to reduced hospitalizations and outpatient visits, ED visits increased. Clearly, there remains room for further improvement and cost savings. A recent systematic review found that a large proportion of all ED visits in the United States were for nonurgent conditions.[25] Studies have also shown that ED rates can be lowered by educating patients on getting treatment in outpatient clinics for nonurgent conditions.[25-27] Future research is needed to further explore the impact of a nutrition-based QIP on ED visits, as the reasons for ED visits in this population vary and may often be multifactorial.

This study included a large sample size, followed QIP methodology to implement changes systematically, and included a patient education component emphasizing nutrition awareness and compliance with ONS intake. In terms of limitations, our study used an observational real-world QIP methodology rather than a randomized design. Although ONS compliance data were available through self-reports for the majority of the QIP patients (52.6%), we did not fully capture such data for all participating patients. We also relied on administrative AHC data to confirm healthcare resource utilization rather than using a full claims data approach, so it did not account for healthcare visits outside of the AHC system. Because to date, ours is the first-ever study to evaluate the costs and benefits of using ONS as part of a nutrition QIP in HHA, it is important to question whether the findings are generalizable. Although our findings represent 1 system's experience, we showcase the AHC system as uniquely suited to conduct such a study, since it delivers integrated care for inpatients and outpatients with a wide range of illness acuity and serves a population that is diverse by age, race, and socioeconomic status.

Importantly, nutrition interventions have been repeatedly shown to reduce unplanned readmissions.[28] It has been estimated that anywhere from 5% to 79% of readmissions may be preventable;[29] reduction of avoidable readmissions by 10% could lead to a national savings of $1 billion or more.[30] The current findings support and extend prior reports on the benefit of ONS for patients at risk of malnutrition in terms of both clinical[31] and economic outcomes.[24,32] ONS use among such patients has been shown to reduce unplanned hospital readmissions,[31,33-35] and ONS use in the community improved clinically relevant outcomes and was cost-effective.[32]

U.S. healthcare programs increasingly support integrated acute and postacute care. In 2010, the Hospital Readmission Reduction Program, as part of the Affordable Care Act, authorized the Centers for Medicare and Medicaid Services (CMS) to hold hospitals accountable for postdischarge patient care.[36,37] Under the Hospital Value-Based Purchasing Program, CMS penalizes low-performing hospitals for care that occurs up to 30 days postdischarge[38] by reducing their Medicare reimbursements.[39] New proposals for the Home Health Value-Based Purchasing Model and Quality Reporting Program will likewise impact CMS reimbursement based on 30-day readmission and other quality measures,[40] thus highlighting the importance of implementing similar nutrition QIPs to inform 30-day readmission reductions for home health patients. Although 30-day outcomes are informative, our HHA study used 90-day hospital readmission as a primary outcome, since HHAs commonly care for people with chronic diseases—eg, COPD, CHF, and diabetes.[41] Also, as of 2018, CMS is expected to begin evaluating HHA care quality based on hospitalizations up to 90 days postenrollment.[42] Our real-world study results show that nutrition care can play an important role in promoting health and economic benefits for HHA patients at malnutrition risk and for healthcare systems offering postacute care.

Conclusions

Malnutrition is both a cause and consequence of poor health in adults; identification and treatment of malnutrition can help avert disease complications or relapses and can boost recovery. Given its ease of implementation and relatively low cost, nutrition is an appealing strategy for HHAs and other postacute care institutions. This study shows that at-home use of ONS, as part of nutrition-focused care, can reduce 30-day, 60-day, and 90-day hospitalization rates and healthcare resource utilization, thus yielding improved health outcomes and significant cost savings.

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Statement of Authorship

K. Riley, S. Sulo, J. Partridge, S. Kozmic, W. Landow, G. VanDerBosch, and K. Sriram contributed to conception/design of the research; K. Riley, F. Dabbous, S. Kozmic, W. Landow, and M. K. Falson contributed to acquisition, analysis, or interpretation of the data; K. Riley, S. Sulo, F. Dabbous, W. Landow, and S. Kozmic drafted the manuscript; J. Partridge, G. VanDerBosch, M. K. Falson, and K. Sriram critically revised the manuscript; and all authors agree to be fully accountable for ensuring the integrity and accuracy of the work. All authors read and approved the final manuscript.

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Appendix Material

§ (15) Without reason, has lost more than 10 lbs. in the last 3 months
§ (10) Has an illness or condition that made him/her change the type of and/or amount of food eaten
§ (10) Has an open decubitus, ulcer, burn, and/or wound
§ (10) Eats fewer that 2 meals a day
§ (10) Has a tooth/mouth problem which makes it hard to eat
§ (10) Has 3 or more drinks of beer, liquor, or wine almost every day
§ (10) Does not always have enough money to buy food needed
§ (5) Eats few fruits or vegetables or milk products
§ (5) Eats alone most of the time
§ (5) Takes 3 or more prescribed or OTC medications a day
§ (5) Is not always physically able to cook and/or feed self and has no caregiver to assist
§ (5) Frequently has problems with diarrhea or constipation

0–25 Good Nutrition Status
30–55 Moderate Nutrition Risk
60–100 High Nutrition Risk

Figure A1. Nutritional Health Screen with scoring points (in parentheses) for each attribute. OTC, over-the-counter.

Table A1. Results of a Phone Survey Conducted 30–45 Days Post–HHA Enrollment.

Survey Question	Response	N (%)
During your home health episode, did you consume ONS?	Yes	764 (94.0)
	No	49 (6.0)
During your home health episode, how many bottles of ONS did you consume per day?	1.12	507 (Ensure)
	1.09	266 (Glucerna)
	1.13	40 (Nepro)
During your home health episode, how often did a home health team member discuss the importance of nutrition care with you?	Always	465 (57.2)
	Usually	225 (27.7)
	Sometimes	67 (8.2)
	Not sure	56 (6.9)
If your doctor prescribed ONS beyond your home health episode, how likely would you be to consume ONS?	Very likely	482 (59.3)
	Somewhat likely	247 (30.4)
	Somewhat unlikely	43 (5.3)
	Very unlikely	41 (5.0)
If you would be unlikely to consume ONS, please select the primary reason:	Affordability/cost	36
	Taste	26
	Difficult swallowing	13
	Other	9

HHA, home health agency; N, number; ONS, oral nutritional supplement.