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Addressing Malnutrition Across the Continuum of Care: Which Patients Are Likely to Receive Oral Nutritional Supplements

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Abstract

Oral nutritional supplements (ONS) have been shown to improve patient outcomes in the hospital setting, but limited results from long-term care or community settings exist. Using electronic health records (EHRs) from 2009 to 2014 for both adult inpatients and outpatients, we compare the demographic and clinical characteristics of patients who received ONS (n = 1,251) with a non-ONS control group (n =25,513). Multivariable logistic regression modeling was used to describe and compare differences in baseline characteristics between the groups including age, sex, race, tobacco use, and comorbidities. We found that patients receiving ONS were older and sicker than control patients. Hospitalized ONS patients were more likely to be admitted from the emergency department and have a hospitalization within the last month prior to the index date. Our results suggest that there is a need for nutrition screening and incorporating nutrition status into the EHR as an important way to coordinate hospital and community medical care. ONS can be an important therapy for vulnerable populations in both the hospital and the community settings.

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Introduction

Malnutrition is a serious and undertreated problem in both the hospital and community settings. Malnourished patients face greater risk of poor functional, clinical, and economic outcomes. For example, poor nutritional status is associated with a heightened risk of comorbid complications (1-2), longer hospital length of stay (LOS) (3-4), higher health care costs (5-6), more frequent readmissions (7-9), and an increased risk of mortality (10).

Malnutrition is prevalent in 30-50% of patients at the time of hospital admission (11-13), depending on the location and the specific patient population considered. In the outpatient community population, the prevalence of malnutrition is 7.2%-30% (14-16). Yet, despite the magnitude of malnutrition and evidence demonstrating the resulting adverse clinical and economic effects, malnutrition continues to be under-recognized and undertreated (17).

A growing body of evidence has shown oral nutritional supplements (ONS), which consist of both macronutrients and micronutrients, to be a cost-effective way to prevent and treat malnutrition and to improve patient outcomes (18-19). However, ONS is a therapy that is often overlooked in community health (20), which is at the intersection of inpatient and outpatient services.

This study aims to better understand the delivery of ONS as an important therapy in both inpatient and outpatient settings, with patients in the outpatient setting experiencing a hospitalization within the last year. Specifically, we compared the characteristics of patients receiving ONS to those of patients who were not. This research contributes to the literature by demonstrating the patterns of ONS usage in a large integrated health system throughout the continuum of care over a 6 year time period.

Methods

This analysis was conducted using an electronic health records (EHR) database from Geisinger Health System, which primarily serves residents throughout 45 counties in central and northeast Pennsylvania. The EHR database contains clinical data from outpatient and inpatient encounters across approximately 100 facilities for more than 4 million distinct patients since 1996. The study sample was restricted to adults 18 years or older with healthcare system encounters (e.g., outpatient visit, hospitalization or emergency department visit) from January 2008 through May 2015. Because all data was received from a health system data broker in deidentified form, the Geisinger Institutional Review Board waived the requirement for review.

Patients were initially identified with a prescription order for any product in the nutritional supplements category between 2009 and 2014 (2008 and 2015 were excluded to account for a run in and wash out period), based on the system's medication order classification system. We excluded prescriptions that were ordered to be administered "continuously" or in units of "mL/hour" which implied a tube feeding method of delivery as opposed to oral consumption. The date of the first order was defined as the patient's index date.

The majority of ONS patients had multiple comorbidities and either received their first ONS prescription order in an inpatient setting or had been recently admitted to an inpatient facility. To minimize heterogeneity and ensure an adequate medical history for patients in our sample, our final study cohort focused on ONS patients with a recent history of inpatient utilization. Therefore, inclusion criteria were: (1) patients were age 18 years or older on the index date; (2) patients had at least one hospitalization within 12 months prior to the index date; (3) patients had at least 6 months history of encounters prior to the index date; (4) patients had at least 12 months history of encounters after the index date; (5) patients had scored

2 or higher on the Charlson Comorbidity Index, and; (6) patients had more than two ONS prescription orders. These criteria yielded an initial population of 1,251 ONS patients.

We also identified 168,110 potential control patients (non-ONS users) for comparison purposes. Since there was no ONS order defining an index date, an encounter date for each control was randomly selected to be the index date. To ensure similar follow-up between ONS and controls, control patients were also required to meet the same criteria as the treatment group, with the exception of ONS orders.

Baseline characteristics of all ONS and control patients were calculated as of their index date. Additionally, we found that there were no patients in the ONS group with a primary index encounter diagnosis of stable angina, unstable angina, or type 1 diabetes, and so any patients in the control group with these primary diagnoses were excluded, leaving a final control population of 25,513 patients.

Baseline demographics, comorbidities, and hospitalization characteristics were reported descriptively using means with standard deviations or medians with interquartile ranges (as applicable) for continuous variables, and raw counts with percentages for categorical measures. Associations expressed as adjusted odds ratios (OR) with 95% confidence intervals (CI) were computed using multivariable logistic regression. Specifically, we estimated each patient's probability of being an ONS user as a function of sex, age, race (Caucasian or other), smoking status, prior diagnoses, Charlson Comorbidity Index (CCI), primary diagnosis at the index encounter, index encounter type (inpatient or other, and whether the patient was admitted via emergency department), length of time since most recent hospitalization, and payor type. The CCI does not contain any eating disorder or gastrointestinal causes of malnutrition except for peptic ulcer. We find no patients in the ONS cohort with dysphagia, anorexia, or unspecified eating disorders. In the control cohort, there were 1,824 patients with a diagnosis of dysphagia (7%), 294 patients with a diagnosis of anorexia (1%), and no patients with the diagnosis for unspecified eating disorders. There are two implications for our results (1) since there were no patients in either cohort with unspecified eating disorders, adding that to the analysis would have no impact (2) the portion of control patients with dysphagia and anorexia is small, thus omitting those variables in our regression analysis would not materially affect our results

The diagnosis of malnutrition are the following ICD-9 codes: 260 (Kwaslorkor), 261 (Nutriional Marasmus), 262 (other severe, protein-calorie malnutrition, 263 (Other unspecified protein-energy malnutrition), 263.0 (moderate malnutrition), 263.1 (mild malnutrition), 263.2 (arrested development following protein-calorie malnutrition), 263.8 (other protein-calorie malnutrition), 263.9 (unspecified protein-calorie malnutrition), 285.9 (anemia nos), 783.22 (underweight) and 783.21 (abnormal loss of weight).

Reported *p* values were two-sided, with *p* values less than 0.05 considered statistically significant. Analyses were performed using SAS 9.4 (SAS Institute Inc. Cary, NC, USA).

Results

Table 1 compares the basic demographics of ONS and control patients. The average age in the ONS group was 72 (± 15) years, compared to 63 (± 15) years for the controls, and ONS patients were significantly more likely to be 80 years or older (38%) compared to control patients (12%). Both groups were similar with respect to sex (46-47% male) and race (98% Caucasian), the latter reflecting the Geisinger population which is predominantly in rural Pennsylvania. Very similar percentages of ONS and control patients were either current smokers (14% in both groups) or

Table 1. Basic demographics of ONS and control patients at the Geisinger Health System, 2009-2014

	ONS Patients N (%)	Control Patients N (%)	Adjusted Odds Ratio [95% CI]	P-value
No. of patients	1,251	25,513		
Males	580 (46%)	12,094 (47%)	0.94 [0.80, 1.10]	0.42
Age at index date				
18-39	50 (4%)	1842 (7%)	ref.	ref.
40-49	75 (6%)	2738 (11%)	0.87 [0.55, 1.38]	0.55
50-59	136 (11%)	4930 (19%)	0.89 [0.58, 1.35]	0.57
60-69	225 (18%)	6392 (25%)	1.17 [0.77, 1.78]	0.47
70-79	288 (23%)	6535 (26%)	2.24 [1.46, 3.45]	0.0002
80-89	371 (30%)	2859 (11%)	5.23 [3.37, 8.14]	<0.0001
90+	106 (8%)	217 (1%)	19.76 [11.47,	<0.0001
Mean (SD)	72 (15)	63 (15)		
Median [IQR]	75 [62, 84]	65 [53, 74]		
White/Caucasian	1222 (98%)	25,099 (98%)	0.65 [0.37, 1.12]	0.12
Smoking				
Never	523 (42%)	10863 (42%)	ref.	ref.
Current Smoker	172 (14%)	3457 (14%)	1.03 [0.87. 1.23]	0.72
Quit	530 (42%)	10601 (42%)	1.04 [0.92, 1.18]	0.55
Unknown/Not	26 (2%)	592 (2%)	0.91 [0.61, 1.36]	0.65

ref. indicates reference value for variables with >2 categories. SD standard deviation. IQR inter-quartile range.

had quit smoking (42% in both groups).

Table 2 illustrates how ONS and control patients' nutritional status change over time. The baseline mean measures the average BMI on index date. The year 1-4 means in column 3-6 captures the change in BMI compared to baseline in each year after the index date.

At the baseline index date, the average ONS patient had lower BMI than control group. However, the ONS cohort's BMIs have steadily increased over the time after receiving ONS while the Control group's BMIs slightly decreased over time. Thus, patients receiving ONS showed steadily increasing weight gain over the treatment period, on average, whereas the control cohort showed steadily decreasing BMI's over the time.

Table 2. Change in BMI of ONS and control patients at the Geisinger Health System, 2009-2014

	Baseline Mean (SD)	Year 1 Mean (SD)	Year 2 Mean (SD)	Year 3 Mean (SD)	Year 4 Mean (SD)
Control	30.5 (7.3) [n=25,181]	-0.04 (2.0) [n=24,639]	-0.06 (2.4) [n=23,346]	-0.10 (2.5) [n=21,750]	-0.14 (2.6) [n=20,048]
ONS	25.4 (7.1) [n=1,159]	0.05 (3.1) [n=678]	0.4 (3.8) [n=406]	0.7 (3.9) [n=224]	1.3 (3.9) [n=112]

SD standard deviation.

Table 3 describes common comorbidities in each group. Of the diseases included in the CCI, the most common in the ONS population were hypertension (82%), hyperlipidemia (69%), chronic obstructive pulmonary disease (55%), coronary heart disease (46%), peripheral vascular disease (46%), renal disease (45%) and type 2 diabetes (45%). Prevalence of all of these diseases except hyperlipidemia were lower in the control population, suggesting a healthier control population, which was surprising given our inclusion criteria that required recent history of hospitalization and CCI scores of 2 or greater. The average CCI was significantly higher in ONS patients than the control (6.9 vs. 4.7, $p < 0.0001$), which again suggests that sicker patients were more likely to be prescribed ONS.

Table 4 shows further characteristics of the index date encounters in both groups. The majority of both ONS and control index encounters were outpatient visits (69% and 79%), but ONS patients were more likely to have been admitted to the hospital from the emergency department compared to the control group (21% vs. 10%, $p<0.0001$). The most frequent primary diagnoses included in the CCI and associated with index date encounters for ONS patients were malignancy (12%), renal disease (7%), congestive heart failure (4%), type 2 diabetes (4%), COPD (3%), hypertension (3%), and peripheral vascular disease (3%). The most frequent primary diagnoses for index date encounters of control patients were similarly distributed, with a few significant exceptions (e.g., more coronary heart disease, less renal disease, and more type 2 diabetes).

Table 4 also shows that a much larger portion of ONS patients had a public insurer (Medicare or Medicaid) as their primary payer (41%) compared to control patients who were much more likely to have a commercial insurer (82% commercial, with only 5% Medicare or Medicaid, $p<0.0001$). Furthermore, although all patients studied had been hospitalized within 12 months, ONS patients were significantly more likely to have been hospitalized in the 2 weeks prior to the index event compared to the control patients (43% vs. 19%, $p<0.0001$).

Even after controlling for age, gender, race, current comorbidities and primary diagnosis on the index date, patients with higher CCI were more likely to be prescribed ONS (OR=1.23; CI=1.12-1.34; p <0.0001). Additionally, even after controlling for age, ONS patients were more likely to have Medicare as opposed to commercial insurance than the control group (OR=22.4; CI=19.4-25.9; p=0.0009).

In the inpatient setting, the five most common physician specialties that ordered ONS were internal medicine (36%), critical care medicine (16%), general surgery (14%), cardiovascular medicine (4%) and thoractic/cardiac surgery (4%). In comparison, in outpatient encounters, the five most common provider specialties were family practice (19%), internal medicine (13%), physician assistant (12%), nurse practitioner (9%) and general surgery (5%).

Discussion

This study represents a detailed description of ONS use in both inpatient and outpatient settings in a large integrated health system in the United States. The most common populations and diagnoses for which ONS was used over a 6-year period are described. Overall, our data showed that ONS patients were older, sicker (CCI of 6.9 vs. 4.7, $p < 0.0001$) and much more likely to be admitted from emergency departments (21% vs. 10%, $p<0.0001$) than non-ONS control patients.

Beyond diagnoses included in the CCI, the most frequent of *all* diagnoses in ONS patients was malnutrition including abnormal loss of weight and anemia (33%), which is consistent with the guidelines of American Society of Parenteral and Enteral Nutrition (ASPEN)/The Academy of Nutrition and Dietetics (21) and the European Society of Parenteral and Enteral Nutrition guidelines (ESPEN, 22). The fact that the

Table 3. Charlson Index comorbidities of ONS and control patients at the Geisinger Health System, 2009-2014

	ONS Patients N (%)	Control Patients N (%)	Adjusted Odds Ratio [95% CI]	P-value
No. of patients Comorbidities at index date	1,251	25,513		--
AIDS	6 (<1%)	54 (<1%)	0.85 [0.17, 4.21]	0.84
AMI, any prior	199 (16%)	2321 (9%)	1.60 [1.10, 2.33]	0.01
AMI, recent (last 12 months)	116 (9%)	1514 (6%)	1.08 [0.70, 1.66]	0.72
Chronic obstructive pulmonary disease	687 (55%)	11074 (43%)	1.30 [1.07, 1.57]	0.008
Congestive heart failure	528 (42%)	5503 (22%)	1.01 [0.80, 1.27]	0.93
Coronary artery bypass graft procedure	25 (2%)	444 (2%)	1.74 [0.88, 3.41]	0.11
Coronary heart disease	581 (46%)	9258 (36%)	0.92 [0.76, 1.13]	0.43
Coronary revascularization procedure	65 (5%)	1670 (7%)	0.77 [0.49, 1.19]	0.24
Dementia	118 (9%)	580 (2%)	2.04 [1.49, 2.79]	<0.0001
Hemiplegia	103 (8%)	717 (3%)	1.61 [1.10, 2.34]	0.01
Hyperlipidemia	857 (69%)	18800 (74%)	0.86 [0.71, 1.04]	0.11
Hypertension	1020 (82%)	19636 (77%)	1.02 [0.81, 1.29]	0.86
Ischemic stroke	207 (17%)	1823 (7%)	1.40 [1.09, 1.81]	0.009
Leukemia	22 (2%)	321 (1%)	0.70 [0.37, 1.32]	0.27
Lymphoma	126 (10%)	2561 (10%)	0.83 [0.61, 1.14]	0.25
Malignancy, any	496 (40%)	7906 (31%)	1.02 [0.79, 1.32]	0.87
Metastasis, any	162 (13%)	1364 (5%)	0.83 [0.45, 1.53]	0.55
Mild liver disease	266 (21%)	3120 (12%)	1.85 [1.47, 2.33]	<0.0001
Moderate to severe liver disease	58 (5%)	325 (1%)	1.34 [0.78, 2.30]	0.3
Peptic ulcer disease	125 (10%)	1016 (4%)	1.36 [0.99, 1.85]	0.05
Peripheral vascular disease	576 (46%)	7227 (28%)	1.20 [0.95, 1.51]	0.12
Renal disease	569 (45%)	6438 (25%)	1.15 [0.64, 2.08]	0.64
Rheumatic disease	118 (9%)	1807 (7%)	0.93 [0.69, 1.25]	0.64
Stable angina	148 (12%)	2140 (9%)	1.55 [1.19, 2.03]	0.001
Type 1 diabetes	119 (10%)	1622 (7%)	1.38 [1.04, 1.83]	0.03
Type 2 diabetes	559 (45%)	10434 (41%)	2.65 [1.25, 5.64]	0.01
Unstable angina, any prior	107 (9%)	1815 (7%)	0.85 [0.57, 1.26]	0.41
Unstable angina, recent (last 12 months)	38 (3%)	973 (4%)	0.71 [0.40, 1.26]	0.24
Charlson Comorbidity Index (CCI)				
Mean (SD)	6.9 (3.8)	4.7 (2.9)	1.23 [1.12, 1.34]*	<0.0001
Median [IQR]	6 [4, 9]	4 [2, 6]		

SD standard deviation. *IQR* inter-quartile range. *Odds ratio corresponding to 1-unit increase in CCI.

Table 4. Encounter characteristics of ONS and control patients at the Geisinger Health System, 2009-2014

	ONS Patients N (%)	Control Patients N (%)	Adjusted Odds Ratio [95% CI]	P-value
No. of patients	1,251	25,513	--	--
Encounter type				
Outpatient / ED Only	860 (69%)	20246 (80%)	ref.	ref.
Inpatient only	132 (11%)	2722 (11%)	1.75 [1.55, 1.98]*	<0.0001
Inpatient + ED	259 (21%)	2545 (10%)	2.35 [1.74, 3.18]**	<0.0001
Charlson Comorbidity Index: Primary diagnosis at index encounter				
AIDS	2 (<1%)	9 (<1%)	2.99 [0.11, 80.28]	0.51
AMI	11 (<1%)	187 (<1%)	0.52 [0.14, 1.99]	0.34
Chronic obstructive pulmonary disease	36 (3%)	978 (4%)	0.94 [0.61, 1.45]	0.76
Congestive heart failure	53 (4%)	824 (3%)	0.62 [0.42, 0.91]	0.01
Coronary heart disease	19 (2%)	1004 (4%)	0.43 [0.24, 0.75]	0.003
Dementia	4 (<1%)	25 (<1%)	0.22 [0.05, 1.05]	0.06
Hemiplegia	3 (<1%)	22 (<1%)	2.04 [0.41, 10.12]	0.38
Hyperlipidemia	4 (<1%)	377 (1%)	0.59 [0.20, 1.77]	0.35
Hypertension	38 (3%)	1224 (5%)	0.65 [0.43, 1.00]	0.049
Ischemic stroke	8 (<1%)	195 (<1%)	0.58 [0.20, 1.72]	0.33
Leukemia	1 (<1%)	69 (<1%)	0.15 [0.01, 1.64]	0.12
Lymphoma	2 (<1%)	49 (<1%)	1.02 [0.20, 5.23]	0.98
Malignancy, any	147 (12%)	2425 (10%)	1.45 [1.10, 1.92]	0.009
Metastasis, any	14 (1%)	193 (1%)	0.50 [0.23, 1.08]	0.08
Mild liver disease	20 (2%)	165 (1%)	1.52 [0.75, 3.09]	0.25
Moderate to severe liver disease	3 (<1%)	40 (<1%)	0.22 [0.04, 1.15]	0.07
Peptic ulcer disease	5 (<1%)	55 (<1%)	1.14 [0.29, 4.54]	0.85
Peripheral vascular disease	38 (3%)	444 (2%)	2.25 [1.27, 3.99]	0.006
Renal disease	92 (7%)	563 (2%)	2.31 [1.64, 3.24]	<0.0001
Rheumatic disease	9 (<1%)	187 (1%)	2.29 [0.95, 5.54]	0.07
Type 2 diabetes	54 (4%)	2282 (9%)	1.61 [0.25, 10.49]	0.62
Primary insurer type				
Commercial	462 (37%)	20,921 (82%)	ref.	ref.
Medicare	449 (36%)	907 (4%)	22.4 [19.4, 25.9]	<0.0001
Medicaid	58 (5%)	216 (1%)	12.2 [9.0, 16.5]	<0.0001
All Other	282 (23%)	3469 (14%)	3.7 [3.2, 4.3]	<0.0001
Time since last hospitalization				
<2 weeks	538 (43%)	4848 (19%)	2.35 [1.90, 2.89]	<0.0001
2 weeks to <1 month	208 (17%)	3220 (13%)	1.54 [1.21, 1.97]	0.0005
1 to <3 months	259 (21%)	5943 (23%)	ref.	ref.
3 to <6 months	136 (11%)	4869 (19%)	0.67 [0.51, 0.88]	0.003
6 to 12 months	110 (9%)	6633 (26%)	0.49 [0.37, 0.64]	<0.0001

ref. indicates reference value for variables with >2 categories. *Odds Ratio corresponding to inpatient vs. all other encounters. **Odds Ratio corresponding to inpatient admitted via ED vs. all others.

remaining two-thirds of ONS patients did not have diagnosis codes for malnutrition suggests that the identification of malnutrition by ICD-9 codes may not be reliable. Besides malnutrition, the other three most common diagnoses were end stage renal disease, diabetes, and chronic kidney disease, which may cause complications that result in the need for specialized ONS.

This study has several limitations. The data represent hospitals located in a mostly rural region of Pennsylvania where patients are predominantly white; therefore, results of the study may not be generalizable to more diverse or urban population. Since ONS does not require a prescription, many of the orders were documented during medical reconciliation which could result in misclassification of non-ONS patients who actually were consuming the product without a documented order. However, this is a common limitation associated with any studies employing retrospective designs. Finally, data on the compliance, dosage, and duration of use of ONS were not available. Future studies employing prospective study designs with more diverse patient populations are needed.

Conclusion

This paper provides a description of ONS prescribing practices in both the inpatient and outpatient settings of an integrated health system. These data indicate that patients receiving ONS are older, have more comorbidities and are more likely to have been recently hospitalized. Given the negative health and financial impact of malnutrition, and the vulnerability of this population, these results highlight the importance of carefully screening patients for malnutrition. Although most hospitals implement some type of nutrition screening, practice varies widely between hospitals and patients are not always treated in a timely manner. In 2015, ASPEN called for a National Goal to address disease-related malnutrition in hospitalized patients. This call noted that "the standards and systems of care need to drive the process such that a patient identified to be "at nutrition risk" or who is in fact malnourished receives an intervention as rapidly as possible. In addition, nutrition must be addressed early in discharge planning so that it is identified in the transition from hospital to home or alternate care settings" (23).

Although tools for screening malnutrition in outpatients exist (24), there is limited guidance on how and when these tools should be used. This paper may be useful in identifying populations that are most likely to benefit from nutrition screening and intervention in the outpatient setting. As health care systems move increasingly towards population health management, improving the consistency of malnutrition screening and incorporating screening results into EHRs could help coordinate care across the continuum for this vulnerable population.

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