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ERRATUM

The Effect of an Inpatient Smoking Cessation Treatment Program on Hospital Readmissions and Length of Stay

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BACKGROUND: Most clinical research involving tobacco dependence treatment is related to outpatient interventions and focuses on health outcomes. Inpatient smoking cessation treatment has been found to be cost-effective in the Canadian healthcare system, but the finding's applicability to US health systems is unclear.

OBJECTIVE: The objective of this study is to estimate the impact of an inpatient tobacco cessation treatment program on 30-day readmission rates and length of stay (LOS).

METHODS: Participants were 28,994 patients admitted to the hospital between July 2012 and July 2014. Smokers were identified through the electronic medical records system and were offered cessation treatment. Program effects were estimated by using a difference-in-differences approach, comparing all smokers to all nonsmokers before versus after introduction of the program. Readmission rates were modeled by using probit regression; LOS was modeled by using truncated negative binomial regression. Models controlled for age, sex, race, payer, hospital department, severity of illness, and intensive care unit days.

RESULTS: The hospital-initiated smoking cessation intervention had no significant effect on 30-day readmission rates or LOS. Other control variables had the expected signs and were statistically significant.

CONCLUSIONS: The evaluation of an inpatient tobacco dependence treatment did not find significant short-term changes in healthcare utilization in the first 30 days after initial hospitalization. *Journal of Hospital Medicine* 2017;12: 880-885. Published online first August 23, 2017. © 2017 Society of Hospital Medicine.

Successful smoking cessation interventions result in substantial gains in health and life expectancy by reducing smoking-related illnesses and preventing premature deaths.[1,2] The Department of Health and Human Services recommends clinicians use hospitalization as "an opportunity to promote smoking cessation" and "to prescribe medications to alleviate withdrawal symptoms"[3] because individual readiness to quit may be high during hospitalizations. A meta-analysis of 50 studies (21 from the United States) examining the efficacy of hospital-initiated smoking cessation interventions concluded that smoking cessation support programs that began in the hospital and continued for at least 1 month postdischarge significantly increase the likelihood of patients being smoke-free in the long term.[4] The most efficacious strategies included counseling and pharmacotherapy rather than counseling alone.[3] Most inpatient smoking cessation studies have focused on quit-rates or medical outcomes, while fewer studies have looked at healthcare utilization.

However, previous research has shown that smoking cessation for inpatients has relatively immediate economic and health benefits. Patients who quit smoking during hospitalizations for cardiovascular disease are less likely to be readmitted or to die during follow-up.[5,6] Patients with acute myocardial infarction (AMI), unstable angina, heart failure, and chronic obstructive pulmonary disease who received an inpatient smoking cessation intervention had reductions in inpatient readmission rates.[7] A 1% reduction in overall smoking rates would lead to an annual reduction of 3,022 hospitalizations for stroke and 1,684 hospitalizations for AMI.[8] One comprehensive program, the Ottawa Model for Smoking Cessation (OMSC), found that a hospital-initiated intervention increased long-term cessation rates by 15% in cardiac patients and by 11% in general hospital populations.[9,10] The applicability of this result to US healthcare systems is unknown. This paper adds to the existing literature by evaluating the impact of an inpatient smoking cessation program on healthcare utilization among patients hospitalized for any reason, rather than solely focused on those with cardiopulmonary diagnoses.

The current study focuses on an inpatient smoking cessation program at a teaching hospital in the Rocky Mountain region. The hospital implemented a smoking cessation treatment program on July 1, 2013, based on the OMSC. The goal was to identify and support inpatient adult smokers who wanted to make a quit attempt and help them remain smoke-free after discharge. The objective of the current study was to determine the effect of the program on 30-day readmission rates and length of stay (LOS) of the index hospitalization. Although the general cost effectiveness of

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properly structured smoking cessation programs are well established,[11-13] the healthcare utilization effects of inpatient smoking cessation programs are not well understood.

METHODS

Data

The study population consists of patients over age 18 who were admitted to the hospital between July 1, 2012, and July 1, 2014. Baseline smoking status was assessed at hospital admission and recorded in Epic (Epic Systems Corporation, Verona, Wisconsin), the electronic medical records system, as a current smoker (every day and some days), former smoker, never smoker, and never assessed. To check the accuracy of recorded smoking status, a random sample of 819 inpatients was selected and contacted via telephone for verification; 93% of Epic-identified smokers confirmed that they were smokers at hospital admission.[14]

Intervention

The intervention, which launched July 13, 2014, modified the Epic system to automatically alert providers viewing a tobacco user's medical record that the patient should receive standardized orders for a bedside consultation with a Tobacco Treatment Specialist (TTS) and a prescription for nicotine replacement therapy (NRT) while in the hospital.[15] Previously, referrals for tobacco treatment were done on an ad-hoc basis by the physician, and NRT was not routinely available. This system-level intervention standardized and automated the referral process. For patients with a bedside consultation order, TTS used a patient-centered approach (motivational interviewing) to explore patients' motivation to quit smoking and offered NRT to improve comfort and safety while in the hospital. Patients who chose to make a quit attempt received a free 2-week supply of NRT at discharge and 6 months of free follow-up counseling by interactive voice response (IVR) telephone technology that included (a) prerecorded advice keyed to individual patient needs, (b) a warm-transfer option to speak with a live TTS (later dropped), and (c) a collection of patient smoking and cessation treatment measures.[15]

Statistical Analysis

We used an intent-to-treat (ITT) framework for the analysis, which considers everyone eligible for the treatment to be in the treatment group. The approach ignores treatment nonacceptance, nonadherence, protocol deviations, withdrawal from treatment, and cessation outcomes, thus providing conservative estimates of outcomes.[16-18]

Readmission rates and LOS were estimated by using a "difference-in-differences" model, comparing outcomes between smokers before versus after the introduction of the cessation treatment program with nonsmokers before versus after program introduction. The difference-in-differences method looks at the difference pre-and-post in the exposed group (smokers) and unexposed group (nonsmokers). Subtracting the difference between the 2 groups gives an estimate of the policy effect controlling for background trends.[19] The smoking cessation treatment effect on readmission is measured by the coefficient on the interaction term between the smoking variable and an indicator that the program is operational. The coefficient is the "difference-in-differences."

Other control variables include demographic factors (gender, age, race), hospitalization payer (Medicare, Medicaid, commercial), and the service line of the admission. We also included a severity of illness variable from the APR-DRG Grouper (3M, Maplewood, Minnesota)[20] and the number of days spent in the intensive care unit. For the readmission model, we included LOS as a control variable, because individuals with longer LOS had a better opportunity to access the intervention.

For readmissions, the model was estimated by using a probit model, predicting the effect of each of the intervention variables and the control variables on the marginal probability of a readmission. Because patients can appear in both the pre- and postyears, clustered standard errors were used, which correct for the lack of independence from multiple observations from the same individual.[21] For LOS, a truncated negative binomial model was used. The negative binomial model is a specification for count models with a mass of observations plus a long right tail. The truncation is because zero and negative values for LOS are not possible. The dependent variable represents the number of days the individual was hospitalized. For both models, the reported coefficients represent the marginal effect of the independent variable on the dependent variable. This was calculated using the "margins" command in Stata version 13 (StataCorp LLC, College Station, Texas).

RESULTS

Descriptive statistics for the sample are provided in Table 1. Total sample size was 28,994. Of these, 24,619 (84.9%) were nonsmokers and 4375 (15.1%) were smokers. The overall readmission rate was 9.8%. The readmission rate for nonsmokers (10.0%) was higher than for smokers (9.3%), although the difference was not statistically significant. Similarly, the overall mean LOS was identical for nonsmokers and smokers (4.8 days). Average LOS increased slightly from pre- to postprogram among nonsmokers (4.6-4.9 days) and smokers (4.5-5.0 days). There were a number of statistically significant differences between smokers and nonsmokers. Smokers were more likely to be black and to be in the moderate, major, and extreme health severity categories and to have their hospitalization paid for by Medicaid.

During the first 9 months of the project, 88% of the eligible inpatient smokers (n = 802) consented to the consult. Consults were completed for 93% of those who consented (n = 746). Twenty-seven percent of inpatients who received a consult reported smoking at least 1 pack of cigarettes per day; approximately half of these reported being in either the "precontemplation" or "contemplation" stages of readiness to quit tobacco. Free 2-week NRTs were ordered for 39% of inpatients who received a consult, while 22% of inpatients

TABLE 1. Descriptive Statistics for Sample

Characteristics	Nonsmoker	Smoker	Total Sample
Rehospitalization overall (%)	10.0%	9.3%	9.8%
Rehospitalization preintervention (%)	9.9%	8.9%	9.8%
Rehospitalization postintervention (%)	10.0%	9.7%	10.0%
Mean overall length of stay (SE)	4.8 (0.05)	4.8 (0.13)	4.8 (0.05)
Mean preintervention length of stay (SE)	4.6 (0.07)	4.5 (0.15)	4.6 (0.09)
Mean postintervention length of stay (SE)	4.9 (0.08)	5.0 (0.20)	4.9 (0.10)
Mean age (SE)[a]	50.2 (0.12)	47.7 (0.23)	49.9 (0.11)
Mean ICU days (SE)[b]	0.71 (0.02)	0.85 (0.05)	0.73 (0.02)
Female (%)[a]	32.6	25.1	31.5
Race (%)			
White[b]	64.3	62.5	64.0
Black[a]	11.8	19.7	12.9
Other[a]	22.7	16.9	21.8
Severity of illness (%)			
Minor[a]	33.4	25.2	32.2
Moderate[a]	39.3	42.5	39.8
Major[a]	22.4	26.7	23.0
Extreme[b]	4.8	5.6	4.9
Primary payer			
Private[a]	32.1	16.6	29.8
Medicaid[a]	24.8	35.8	26.5
Medicare[a]	31.7	27.7	31.1
Other[a]	11.4	19.9	12.6
Service line			
General medicine[a]	24.8	38.9	26.9
General surgery[b]	9.0	8.0	8.9
Cardiology/cardiac surgery[a]	7.6	9.3	7.9
Obstetrics[a]	21.9	7.0	19.7
Other	36.7	36.8	36.7
Sample size (n) (%)	24,619 (84.9)	4,375 (15.1)	28,994

[a]$P < .01$.

[b]$P < .05$.

NOTE: Student t tests and $\chi 2$ tests were performed to determine the differences in the proportion of variables among nonsmokers and smokers. Abbreviations: ICU, intensive care unit; SE, standard error.

who received a consult completed 3 or more IVR counseling calls (out of 5 total calls). Thirty percent of inpatients who received a consult enrolled in the follow-up program and reported remaining tobacco free 6 months after hospital discharge.[22]

In the probit analysis, the smoking cessation intervention (Smoker*post intervention) showed no significant effect on the probability of readmission (Table 2). The coefficient is positive ($\beta = 0.008$) and statistically insignificant ($P = 0.36$). This indicates that we failed to reject the null hypothesis that there was not a systematic difference in the probability of readmission because of the smoking cessation intervention. Other significant variables generally had the expected relationship with readmission rates. Smokers were 1.6% less likely to be readmitted than nonsmokers ($P = 0.01$), controlling for other factors.

Similar results were found in the truncated negative binomial analysis of LOS (Table 3).

The program effect on smoker LOS was statistically insignificant ($\beta = 0.008$; $P = 0.36$). Smokers overall had a shorter LOS than nonsmokers ($\beta = -0.090$; $P = 0.01$), controlling for other factors. Overall LOS was longer postintervention ($\beta = 0.047$; $P < 0.01$). The control variables generally had the same relationship for the LOS model as for the readmission model.

DISCUSSION

This study investigated the effect of an inpatient smoking cessation program, based on a successful Canadian model, on inpatient readmission rates and LOS. The program showed no effect on 30-day readmission rates or LOS. We see several

TABLE 2. Results of Difference-in-Differences Probit Analysis on Readmissions

Variable	Marginal Probability	*P* Value	95% Confidence Interval	
Smoker	–0.016	.01	–0.029	–0.004
Postintervention	–0.003	.42	–0.009	0.004
Smoker*Post (dif-in-dif)	0.008	.36	–0.009	0.025
Female	–0.009	.03	–0.017	–0.001
Age	–0.0004	.00	–0.001	0.000
Black	–0.012	.04	–0.022	–0.001
Other race	–0.009	.06	–0.019	0.000
Medicaid	0.006	.41	–0.008	0.020
Medicare	0.038	.00	0.023	0.052
Other payer	–0.023	.00	–0.036	–0.010
General medicine	–0.018	.00	–0.026	–0.009
General surgery	–0.017	.01	–0.028	–0.005
Cardiology	–0.030	.00	–0.042	–0.019
Obstetrics	–0.066	.00	–0.075	–0.057
Severity of illness: moderate	0.045	.00	0.035	0.056
Severity of illness: major	0.072	.00	0.058	0.086
Severity of illness: extreme	0.085	.00	0.058	0.112
Length of stay	0.002	.00	0.001	0.002
ICU days	–0.001	.04	–0.002	0.000

NOTE: N = 28,994; Wald $\chi 2$ (19) = 572.96; prob > $\chi 2$ = 0.0000. Abbreviations: dif-in-dif, difference-in-differences; ICU, intensive care unit.

potential explanations for the absence of a detectable impact.

First, the ITT approach reflected real-world implementation of smoking cessation services. The ITT approach adopts the hospital's perspective because the hospital will assess overall effectiveness without regard to programmatic limitations. The intervention group for this analysis included individuals who were offered but declined treatment, individuals who accepted treatment but failed to quit smoking, and individuals who both accepted treatment and quit smoking. If the analysis had focused only on the latter group, an effect would have been more likely to be found. Further analysis of the subset of patients who accepted the intervention and quit smoking is warranted. Nevertheless, hospitals cannot expect all inpatient smokers, or even a majority, to embrace an offer of cessation treatment. This also emphasizes the challenges hospitals will face in offering tobacco cessation programs to smokers in a timely way. Reasons for patients not receiving orders varied but included issues with weekend admissions.

Second, the timeframe of the analysis is limited to the inpatient stay (for LOS) and 30 days (for readmission). A longer-term analysis might have found an effect. However, we examined this from the hospital perspective. For the hospital, LOS is a key cost driver; thus, reductions in LOS would create a strong financial incentive for hospitals to implement smoking cessation programs. Similarly, reducing readmissions is now a priority for hospitals because of new Medicare rules that penalize hospitals for readmissions. Thus, the 2 outcomes we examined are outcomes that are financially important to hospitals.

There are several limitations to our analysis. First, the difference-in-differences model assumes that in the absence of treatment, the average change in the dependent variables would have been the same for both the treatment and control groups, also known as the parallel trends assumption. Specification tests showed this assumption was met for the preperiod. Second, our study relies on electronic health record data to identify smokers. However, 93% of individuals who were identified as smokers confirmed their smoking status upon interview. Finally, we looked at all categories of inpatient admissions. Improvement in LOS and short-term readmission rates may be limited to patients admitted for specific conditions, such as cardiovascular and respiratory conditions.

There are a number of plausible reasons for our null finding. First, the "dose" of intervention may have been too weak; that is, the number of smokers who were offered the treatment, accepted the treatment, and adhered to the treatment may have been too low, leading to too few smokers quitting smok-

TABLE 3. Results of Difference-in-Differences Truncated Negative Binomial Model of Length of Stay

Variable	Marginal Effect	*P* Value	95% Confidence Interval	
Smoker	−0.090	.01	−0.160	−0.021
Post intervention	0.047	.00	0.016	0.078
Smoker*post (dif-in-dif)	0.008	.84	−0.073	0.089
Female	−0.087	.00	−0.132	−0.043
Age	−0.001	.38	−0.003	0.001
Black	−0.120	.00	−0.178	−0.062
Other race	−0.028	.32	−0.084	0.027
Medicaid	0.184	.00	0.107	0.260
Medicare	0.105	.01	0.030	0.179
Other payer	−0.124	.00	−0.191	−0.058
General medicine	−0.511	.00	−0.566	−0.456
General surgery	0.103	.00	0.036	0.171
Cardiology	−0.321	.00	−0.390	−0.252
Obstetrics	−0.421	.00	−0.497	−0.344
Severity of illness: moderate	0.424	.00	0.374	0.474
Severity of illness: major	1.113	.00	1.054	1.172
Severity of illness: extreme	1.581	.00	1.475	1.687
Smoker	0.239	.00	0.180	0.298
ICU days	0.085	.00	0.076	0.094
Constant	0.790	.00	0.681	0.899

NOTE: N = 28,994; truncation point: 0; Wald $\chi 2$ (19) = 4547.46. Abbreviations: dif-in-dif, difference-in-differences; ICU, intensive care unit.

ing and, thus, no effect of the intervention on our outcomes. This follows directly from the ITT design of the study.[23] This suggests that hospitals who wish to adopt smoking cessation programs need to focus on ensuring a timely offering of treatment and encouragement of uptake by smokers.

A second reason for the null finding may have been the short duration for the NRT, which was only offered for 2 weeks. Research suggests that use of NRT for less than 4 weeks is associated with a reduced likelihood of smoking cessation.[24] However, a review of the literature concludes that the duration of NRT is less important than the dosage and the combination of NRT with other forms of smoking cessation therapy.[25] It is important to note that this study used NRT; other treatments such as Chantix could have different effectiveness.[26,27] Further research on different treatment approaches, including longer duration of NRT, would be appropriate.

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Treatment Trends and Outcomes in Healthcare-Associated Pneumonia

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BACKGROUND: The American Thoracic Society and Infectious Diseases Society of America guidelines for management of healthcare-associated pneumonia (HCAP), first published in 2005, have been controversial regarding the selection of empiric broad-spectrum antibiotics, whether the criteria for HCAP predicts the likelihood of infection with multidrug resistant organisms, and whether HCAP patients have improved outcomes when treated with empiric broad-spectrum antibiotics.

METHODS: A retrospective cohort study at 488 US hospitals from July 2007 to November 2011. Patients who met criteria for HCAP were included. Guideline-concordant antibiotics were assessed based on guideline recommendations. We assessed changes in hospital rates of concordant antibiotic use over time and their correlation with outcomes.

RESULTS: Among 149,963 patients with HCAP, 19.6% received fully guideline-concordant antibiotics, 21.7% received partially concordant antibiotics, and 58.9% received discordant antibiotics. Guideline concordance increased over time. Rates of fully or partially concordant antibiotics varied across hospitals (median 36.4%; interquartile range 25.8%-49.1%). Among patients who received discordant antibiotics, 81.5% were treated according to community-acquired pneumonia (CAP) guidelines. On average, the rate of guideline concordance increased by 2.2% per 6-month interval, while hospital level rates of mortality, excess length of stay, and progression to respiratory failure did not change.

CONCLUSIONS: In this large, nationally representative cohort, only 1 in 5 patients with risk factors for HCAP received treatment that was fully in accordance with guidelines, and many received CAP therapy instead. At the hospital level, increases in the use of concordant antibiotics were not associated with declines in mortality, excess length of stay, or progression to respiratory failure. *Journal of Hospital Medicine* 2017;12: 886-891. © 2017 Society of Hospital Medicine

Bacterial pneumonia remains an important cause of morbidity and mortality in the United States, and is the 8th leading cause of death with 55,227 deaths among adults annually.[1] In 2005, the American Thoracic Society (ATS) and the Infectious Diseases Society of America (IDSA) collaborated to update guidelines for hospital-acquired pneumonia (HAP), ventilator-associated pneumonia, and healthcare-associated pneumonia (HCAP).[2] This broad document outlines an evidence-based approach to diagnostic testing and antibiotic management based on the epidemiology and risk factors for these conditions. The guideline specifies the following criteria for HCAP: hospitalization in the past 90 days, residence in a skilled nursing facility (SNF), home infusion therapy, hemodialysis, home wound care, family members with multidrug resistant organisms (MDRO), and immunosuppressive diseases or medications, with the presumption that these patients are more likely to be harboring MDRO and should thus be treated empirically with broad-spectrum antibiotic therapy. Prior studies have shown that patients with HCAP have a more severe illness, are more likely to have MDRO, are more likely to be inadequately treated, and are at a higher risk for mortality than patients with community-acquired pneumonia (CAP).[3,4]

These guidelines are controversial, especially in regard to the recommendations to empirically treat broadly with 2 antibiotics targeting *Pseudomonas* species, whether patients with HCAP merit broader spectrum coverage than patients with CAP, and whether the criteria for defining HCAP are adequate to predict which patients are harboring MDRO. It has subsequently been proposed that HCAP is more related to CAP than to HAP, and a recent update to the guideline removed recommendations for treatment of HCAP and will be placing HCAP into the guidelines for CAP instead.[5] We sought to investigate the degree of uptake of the ATS and IDSA guideline recommendations by physicians over time, and whether this led to a change in outcomes among patients who met the criteria for HCAP.

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METHODS

Setting and Patients

We identified patients discharged between July 1, 2007, and November 30, 2011, from 488 US hospitals that participated in the Premier database (Premier Inc., Charlotte, North Carolina), an inpatient database developed for measuring quality and healthcare utilization. The database is frequently used for healthcare research and has been described previously.[6] Member hospitals are in all regions of the US and are generally reflective of US hospitals. This database contains multiple data elements, including sociodemographic information, *International Classification of Diseases, 9th Revision-Clinical Modification* (ICD-9-CM) diagnosis and procedure codes, hospital and physician information, source of admission, and discharge status. It also includes a date-stamped log of all billed items and services, including diagnostic tests, medications, and other treatments. Because the data do not contain identifiable information, the institutional review board at our medical center determined that this study did not constitute human subjects research.

We included all patients aged ≥18 years with a principal diagnosis of pneumonia or with a secondary diagnosis of pneumonia paired with a principal diagnosis of respiratory failure, acute respiratory distress syndrome, respiratory arrest, sepsis, or influenza. Patients were excluded if they were transferred to or from another acute care institution, had a length of stay of 1 day or less, had cystic fibrosis, did not have a chest radiograph, or did not receive antibiotics within 48 hours of admission.

For each patient, we extracted age, gender, principal diagnosis, comorbidities, and the specialty of the attending physician. Comorbidities were identified from ICD-9-CM secondary diagnosis codes and Diagnosis Related Groups by using Healthcare Cost and Utilization Project Comorbidity Software, version 3.1, based on the work of Elixhauser (Agency for Healthcare Research and Quality, Rockville, Maryland).[7] In order to ensure that patients had HCAP, we required the presence of ≥1 HCAP criteria, including hospitalization in the past 90 days, hemodialysis, admission from an SNF, or immune suppression (which was derived from either a secondary diagnosis for neutropenia, hematological malignancy, organ transplant, acquired immunodeficiency virus, or receiving immunosuppressant drugs or corticosteroids [equivalent to ≥20 mg/day of prednisone]).

Definitions of Guideline-Concordant and Discordant Antibiotic Therapy

The ATS and IDSA guidelines recommended the following antibiotic combinations for HCAP: an antipseudomonal cephalosporin or carbapenem or a beta-lactam/lactamase inhibitor, plus an antipseudomonal quinolone or aminoglycoside, plus an antibiotic with activity versus methicillin resistant *Staphylococcus aureus* (MRSA), such as vancomycin or linezolid. Based on these guidelines, we defined the receipt of fully guideline-concordant antibiotics as 2 recommended antibiotics for *Pseudomonas* species plus 1 for MRSA administered by the second day of admission. Partially guideline-concordant antibiotics were defined as 1 recommended antibiotic for *Pseudomonas* species plus 1 for MRSA by the second day of hospitalization. Guideline-discordant antibiotics were defined as all other combinations.

Statistical Analysis

Descriptive statistics on patient characteristics are presented as frequency, proportions for categorical factors, and median with interquartile range (IQR) for continuous variables for the full cohort and by treatment group, defined as fully or partially guideline-concordant antibiotic therapy or discordant therapy. Hospital rates of fully guideline-concordant treatment are presented overall and by hospital characteristics. The association of hospital characteristics with rates of fully guideline-concordant therapy were assessed by using 1-way analysis of variance tests.

To assess trends across hospitals for the association between the use of guideline-concordant therapy and mortality, progression to respiratory failure as measured by the late initiation of invasive mechanical ventilation (day 3 or later), and the length of stay among survivors, we divided the 4.5-year study period into 9 intervals of 6 months each; 292 hospitals that submitted data for all 9 time points were examined in this analysis. Based on the distribution of length of stay in the first time period, we created an indicator variable for extended length of stay with length of stay at or above the 75th percentile, defined as extended. For each hospital at each 6-month interval, we then computed risk-standardized guideline-concordant treatment (RS-treatment) rates and risk-standardized in-hospital outcome rates similar to methods used by the Centers for Medicare and Medicaid Services for public reporting.[8] For each hospital at each time interval, we estimated a predicted rate of guideline-concordant treatment as the sum of predicted probabilities of guideline-concordant treatment from patient factors and the random intercept for the hospital in which they were admitted. We then calculated the expected rate of guideline-concordant treatment as the sum of expected probabilities of treatment received from patient factors only. RS-treatment was then calculated as the ratio of predicted to expected rates multiplied by the overall unadjusted mean treatment rate from all patients.[9] We repeated the same modeling strategy to calculate risk-standardized outcome (RS-outcome) rates for each hospital across all time points. All models were adjusted for patient demographics and comorbidities. Similar models using administrative data have moderate discrimination for mortality.[10]

We then fit mixed-effects linear models with random hospital intercept and slope across time for the RS-treatment and outcome rates, respectively. From these models, we estimated the mean slope for RS-treatment and for RS-outcome over time. In addition, we estimated a slope or trend over time for each hospital for treatment and for outcome and evaluated the correlation between the treatment and outcome trends.

TABLE. Antibiotics Received Among Patients Given Fully Guideline-Concordant, Partially Guideline-Concordant, or Guideline-Discordant Antibiotics for HCAP

Early Antibiotics (Days 0/1/2)	Overall	HCAP Fully Guideline-Concordant	HCAP Partially Guideline-Concordant	HCAP Guideline-Discordant	*P* Valuea
	n (%)	n (%)	n (%)	n (%)	
	149,963 (100)	29,359 (19.6)	32,604 (21.7)	88,000 (58.9)	
Vancomycin	63,480 (42.3)	27,466 (93.6)	30,484 (93.5)	5530 (6.3)	<.0001
Linezolid	6429 (4.3)	2877 (9.8)	3090 (9.5)	462 (0.5)	<.0001
Antipseudomonal carbapenem	11,344 (7.6)	4505 (15.3)	3802 (11.7)	3037 (3.5)	<.0001
Nonpseudomonal carbapenem	1328 (0.9)	173 (0.6)	807 (2.5)	807 (0.9)	<.0001
Third generation cephalosporin (without activity vs Pseudomonas sp.)	56,079 (37.4)	4704 (16.0)	8153 (25.0)	43,222 (49.1)	<.0001
Antipseudomonal cephalosporin	20,615 (13.8)	7274 (24.8)	6319 (19.4)	7022 (8.0)	<.0001
Antipseudomonal beta-lactam/lactamase inhibitor	53,284 (35.5)	18,507 (63.0)	16,474 (50.5)	18,303 (20.8)	<.0001
Aztreonam	5546 (3.7)	2609 (8.9)	1435 (4.4)	1502 (1.7)	<.0001
Nonpseudomonal beta-lactam/lactamase inhibitor	1501 (1.0)	173 (0.6)	311 (1.0)	1017 (1.2)	<.0001
Beta-lactam	315 (0.2)	59 (0.2)	96 (0.3)	160 (0.2)	.001
Respiratory quinolone	76,262 (50.9)	19,743 (67.2)	10,232 (31.4)	46,287 (52.6)	<.0001
Antipseudomonal quinolone	69,668 (46.5)	25,952 (88.4)	6748 (20.7)	36,968 (42.0)	<.0001
Macrolide	49,846 (33.2)	4390 (15.0)	8236 (25.3)	37,220 (42.3)	<.0001
Doxycycline	2805 (1.9)	375 (1.3)	528 (1.6)	1902 (2.2)	<.0001
Aminoglycoside	8076 (5.4)	4887 (16.6)	1065 (3.3)	2124 (2.4)	<.0001

[a]*P*-value from Chi-square test

NOTE: Abbreviation: HCAP, heathcare-associated pneumonia.

All analyses were performed using the Statistical Analysis System version 9.4 (SAS Institute Inc., Cary, NC) and STATA release 13 (StataCorp, LLC, College Station, Texas).

RESULTS

Of 1,601,064 patients with a diagnosis of pneumonia in our dataset, 436,483 patients met our inclusion criteria, and of those, 149,963 (34.4%) met at least 1 HCAP criterion and were included as our study cohort (supplementary Figure). Among the study cohort, the median age was 73 years (IQR, 61-83), 51.4% of patients were female, 69.6% of patients were white, and a majority of patients (76.2 %) were covered by Medicare. HCAP categories included hospitalization in the past 90 days (63.1%), hemodialysis (12.8%), admission from a SNF (23.6%), and immunosuppression (28.9%). One-quarter of the patients were treated in the intensive care unit (ICU) by day 2 of their hospitalization. The most common comorbidities were hypertension (65.1%), chronic obstructive pulmonary disease (47.3%), anemia (40.9%), diabetes (36.6%), and congestive heart failure (35.7%). Pneumonia was the principal diagnosis in 61.9% of patients, and sepsis was the principal diagnosis in 29.3% of patients. The unadjusted median length of stay was 6 days, the median cost was $10,049, and the in-hospital mortality was 11.1%. Patients who received fully or partially guideline-concordant antibiotics were younger on average and had a higher combined comorbidity score, and they were more likely to have been admitted to the ICU and to have received vasopressor medications and mechanical ventilation. They also had higher unadjusted mortality, longer lengths of stay, and higher costs (see supplemental Table 1 for more details).

The Table shows the antibiotics received by patients. Overall, 19.6% of patients received fully guideline-concordant treatment, 21.7% received partially guideline-concordant treatment, and the remaining 58.9% received guideline-discordant antibiotics. Among the guideline-discordant patients, 81.5% were treated according to CAP guidelines instead. Next, we examined the degree to which guide-

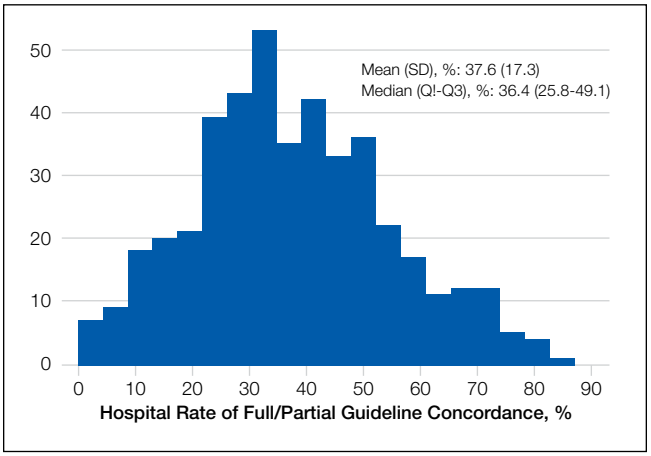

FIG 1. Distribution of rates of compliance with administering guideline-concordant antibiotics among hospitals. The X axis shows the rate that hospitals are compliant with prescribing at least partially guideline concordant antibiotics (ie, the percent of HCAP patients at a hospital who receive at least partially concordant antibiotics), and the Y axis shows the number of hospitals with each rate of compliance.

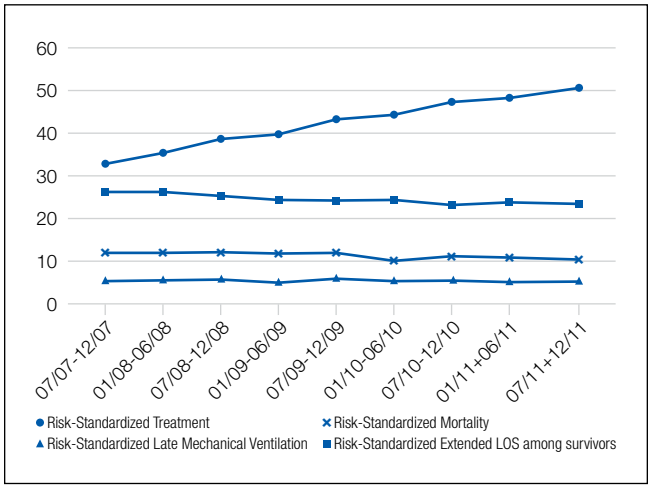

FIG 2. Trends in Risk-Standardized Guideline-concordant treatment and Risk-Standardized outcomes.

line-concordant antibiotics were prescribed at the hospital level. Figure 1 shows the distribution of hospital rates of administering at least partially guideline-concordant therapy. Rates range from 0% to 87.1%, with a median of 36.4%. Hospital-level characteristics associated with administering higher rates of at least partially guideline-concordant antibiotics included larger size, urban location, and being a teaching institution (supplementary Table 2). Overall, physician adherence to guideline-recommended empiric antibiotic therapy slowly increased over the 4-year study period with no indication of a plateau (Figure 2, top line).

Next, we examined the outcomes associated with the administration of guideline-concordant antibiotics at the hospital level. Among the 488 hospitals, there were 292 hospitals for which we had data over the entire study period, which included 121,600 patients. Among these patients, 49,445 (40.7%) received guideline-concordant antibiotics and 72,155 (59.3%) received guideline-discordant antibiotics. On average, the rate of guideline concordance increased by 2.2% per 6-month interval, while mortality fell by 0.24% per interval. After adjustment for patient demographics and comorbidities at the hospital level, there was no significant correlation between increases in concordant antibiotic prescribing rates and hospital mortality (Pearson correlation = −0.064; $P = 0.28$), progression to respiratory failure (ie, late initiation of intermittent mandatory ventilation; Pearson correlation = 0.084; $P = 0.15$), or extended length of stay among survivors (Pearson correlation = 0.10; $P = 0.08$; Figure 2).

DISCUSSION

In this large, retrospective cohort study, we found that there was a substantial gap between the empiric antibiotics recommended by the ATS and IDSA guidelines and the empiric antibiotics that patients actually received. Over the study period, we saw an increased adherence to guidelines, in spite of growing evidence that HCAP risk factors do not adequately predict which patients are at risk for infection with an MDRO.[11] We used this change in antibiotic prescribing behavior over time to determine if there was a clinical impact on patient outcomes and found that at the hospital level, there were no improvements in mortality, excess length of stay, or progression to respiratory failure despite a doubling in guideline-concordant antibiotic use.

At least 2 other large studies have assessed the association between guideline-concordant therapy and outcomes in HCAP.[12,13] Both found that guideline-concordant therapy was associated with increased mortality, despite propensity matching. Both were conducted at the individual patient level by using administrative data, and results were likely affected by unmeasured clinical confounders, with sicker patients being more likely to receive guideline-concordant therapy. Our focus on the outcomes at the hospital level avoids this selection bias because the overall severity of illness of patients at any given hospital would not be expected to change over the study period, while physician uptake of antibiotic prescribing guidelines would be expected to increase over time. Determining the correlation between increases in guideline adherence and changes in patient outcome may offer a better assessment of the impact of guideline adherence. In this regard, our results are similar to those achieved by 1 quality improvement collaborative that was aimed at increasing guideline concordant therapy in ICUs. Despite an increase in guideline concordance from 33% to 47% of patients, they found no change in overall mortality.[14]

There were several limitations to our study. We did not have access to microbiologic data, so we were unable to determine which patients had MDRO infection or determine antibiotic-pathogen matching. However, the treating physicians in our study population presumably did not have access to this data at the time of treatment either because the time period we examined was within the first 48 hours of hospi-

talization, the interval during which cultures are incubating and the patients are being treated empirically. In addition, there may have been HCAP patients that we failed to identify, such as patients who were admitted in the past 90 days to a hospital that does not submit data to Premier. However, it is unlikely that prescribing for such patients should differ systematically from what we observed. While the database draws from 488 hospitals nationwide, it is possible that practices may be different at facilities that are not contained within the Premier database, such as Veterans Administration Hospitals. Similarly, we did not have readings for chest x-rays; hence, there could be some patients in the dataset who did not have pneumonia. However, we tried to overcome this by including only those patients with a principal diagnosis of pneumonia or sepsis with a secondary pneumonia diagnosis, a chest x-ray, and antibiotics administered within the first 48 hours of admission.

There are likely several reasons why so few HCAP patients in our study received guideline-concordant antibiotics. A lack of knowledge about the ATS and IDSA guidelines may have impacted the physicians in our study population. El-Solh et al.[15] surveyed physicians about the ATS-IDSA guidelines 4 years after publication and found that only 45% were familiar with the document. We found that the rate of prescribing at least partially guideline-concordant antibiotics rose steadily over time, supporting the idea that the newness of the guidelines was 1 barrier. Additionally, prior studies have shown that many physicians may not agree with or choose to follow guidelines, with only 20% of physicians indicating that guidelines have a major impact on their clinical decision making,[16] and the majority do not choose HCAP guideline-concordant antibiotics when tested.[17] Alternatively, clinicians may not follow the guidelines because of a belief that the HCAP criteria do not adequately indicate patients who are at risk for MDRO. Previous studies have demonstrated the relative inability of HCAP risk factors to predict patients who harbor MDRO[18] and suggest that better tools such as clinical scoring systems, which include not only the traditional HCAP risk factors but also prior exposure to antibiotics, prior culture data, and a cumulative assessment of both intrinsic and extrinsic factors, could more accurately predict MDRO and lead to a more judicious use of broad-spectrum antimicrobial agents.[19-25] Indeed, these collective findings have led the authors of the recently updated guidelines to remove HCAP as a clinical entity from the hospital-acquired or ventilator-associated pneumonia guidelines and place them instead in the upcoming updated guidelines on the management of CAP.[5] Of these 3 explanations, the lack of familiarity fits best with our observation that guideline-concordant therapy increased steadily over time with no evidence of reaching a plateau. Ironically, as consensus was building that HCAP is a poor marker for MDROs, routine empiric treatment with vancomycin and piperacillin-tazobactam ("vanco and zosyn") have become routine in many hospitals. Additional studies are needed to know if this trend has stabilized or reversed.

CONCLUSIONS

In conclusion, clinicians in our large, nationally representative sample treated the majority of HCAP patients as though they had CAP. Although there was an increase in the administration of guideline-concordant therapy over time, this increase was not associated with improved outcomes. This study supports the growing consensus that HCAP criteria do not accurately predict which patients benefit from broad-spectrum antibiotics for pneumonia, and most patients fare well with antibiotics targeting common community-acquired organisms.

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What's the Purpose of Rounds? A Qualitative Study Examining the Perceptions of Faculty and Students

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BACKGROUND: Rounds are a critical activity on any inpatient service, but there is little literature describing the purpose of rounds from the perspective of faculty and trainees in teaching hospitals.

OBJECTIVE: To evaluate and compare the perceptions of pediatric and internal medicine attendings and medical students regarding the purpose of inpatient attending rounds.

METHODS: The authors conducted 10 semistructured focus groups with attendings and medical students in the spring of 2014 at 4 teaching hospitals. The protocol was approved by the institutional review boards at all institutions. The authors employed a grounded theory approach to data collection and analysis, and data were analyzed by using the constant-comparative method. Two transcripts were read and coded independently by 2 authors to generate themes.

RESULTS: Forty-eight attendings and 31 medical students participated in the focus groups. We categorized 218 comments into 4 themes comprised of 16 codes representing what attendings and medical students believed to be the purpose of rounds. These themes included communication, medical education, patient care, and assessment.

CONCLUSIONS: Our results highlight that rounds serve 4 purposes, including communication, medical education, patient care, and assessment. Importantly, both attendings and students agree on what they perceive to be the many purposes of rounds. Despite this, a disconnect appears to exist between what people believe are the purposes of rounds and what is happening during rounds. *Journal of Hospital Medicine* 2017;12:892-897. Published online first September 20, 2017. © 2017 Society of Hospital Medicine

For more than a century, medical rounds have been a cornerstone of patient care and medical education in teaching hospitals. They remain critical activities for exposing generations of trainees to clinical decision making, coordination of care, and patient communication.[1]

Despite this established importance within medical education and patient care, there is a relative paucity of research addressing the purpose of medical rounds in the 21st century. Medicine has evolved significantly since Osler's day, and it is unclear whether the purpose of rounds has evolved along with it. Rounds, to Osler, were an important opportunity for future physicians to learn at the bedside from an attending physician. Increased duty hour restrictions, mandatory adoption of electronic medical records, and increasingly complex care have changed how rounds are performed, making it more difficult to achieve Osler's ideals.[2,3] While several studies have aimed to quantify the changes to rounds and have demonstrated a significant decline in bedside teaching,[4-6] few studies have explored the purpose of rounds from the perspective of pertinent stakeholders, students, residents, and faculty. The authors have published the results of focus groups of resident stakeholders recently.[7] We made the decision to combine the student/faculty data and describe it separately from the resident data to allow the most accurate and relevant discussion as it pertained to each group.

The aim of this study was to explore the perceptions of faculty and students of general inpatient rounds on internal medicine and pediatric rotations, and to identify any notable differences between these key stakeholders.

METHODS

Between April 2014 and June 2014, we conducted 10 semistructured focus groups at 4 teaching hospitals: The University of Chicago Medical Center, Children's National Health System, Georgetown University Medical Center, and the University of California, San Francisco Medical Center. A sample of eligible 3rd-year medical students and residents on pediatrics and internal medicine hospitalist services as well as hospitalist attendings in pediatrics and internal medicine were invited by e-mail to participate voluntarily without compensation. Identical semistructured focus groups were also conducted with pediatric and internal medicine interns (postgraduate year [PGY1]) and senior residents (PGY2 and PGY3), and those data have been published previously.[7]

Data Collection

Most focus groups had 6 to 8 participants, with 2 groups of

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3 and 4. The groups were interviewed separately by training and specialty: 3rd-year medical students who had completed internal medicine and/or pediatrics rotations, hospitalist attendings in pediatrics, and hospitalist attendings in internal medicine. Attendings with training in medicine-pediatrics were included in the department in which they worked most frequently. The focus group script was informed by a literature review and expert input, and we used open-ended questions to explore perspectives on current and ideal purposes of rounds. Interviews were digitally recorded, transcribed, and names of speakers or references to specific patients were removed to preserve confidentiality and anonymity. The focus groups lasted between 30 and 60 minutes. The author (OH) conducted focus groups at 1 site, and trained facilitators conducted focus groups at the remaining 3 sites. The protocol was determined to be exempt by the institutional review boards at all participating sites. Prior to the focus groups, the definition of family-centered rounds was read aloud; after which, participants were asked to fill out a demographic survey.

Data Analysis

The authors employed a grounded theory approach to data collection and analysis,[8] and data were analyzed by using the constant-comparative method.[9] There was no a priori hypothesis. Four transcripts were independently reviewed by 2 authors (OH and RR) by using sentences and phrases as the units of data, which were coded with an identifier. The authors discussed initial codes and resolved discrepancies through deliberation and consensus to create codebooks. Themes, made up of multiple codes, were identified inductively and iteratively and were refined to reflect the evolving dataset. One author (OH) independently coded the remaining transcripts by using a revised codebook as a guide. A faculty author (JF) assessed the interrater reliability of the final codebook by reviewing 2 previously coded, randomly selected transcripts with no new codes emerging in the process, with a kappa coefficient of >0.8 indicating significant agreement.

TABLE 1. Focus Group Participant Demographics

Population	Attendings	Medical Students
Number of participants	48	31
Gender		
Male (%)	0.42	0.29
Female (%)	0.58	0.71
Mean age (SD)	40.52 (8.05)	26.5 (1.61)
Mean years in practice (SD)	10.50 (8.50)	—
Specialty		
Pediatric attendings (%)	0.48	—
Medicine attendings (%)	0.38	—
Other attendings (%)	0.15	—
Academic rank		
Instructor (%)	0.13	—
Assistant professor (%)	0.52	—
Associate professor (%)	0.25	—
Professor (%)	0.08	—
Clinical experience pre-2011 duty hours?		
Yes (%)	0.95	—
No (%)	0.05	—
Clinical experience pre-2003 duty hours?		
Yes (%)	0.66	—
No (%)	0.34	—
Do you conduct FCR?[a]		
Yes (%)	0.58	—
No (%)	0.42	—
[Did you experience] FCR on pediatrics?		
Yes (%)	—	0.87
No (%)	—	0.13
[Did you experience] FCR on medicine?		
Yes (%)	—	
No (%)	—	0.16
		0.84

[a]The following definition of family-centered rounds was read to participants: "family-centered rounds are multidisciplinary rounds that occur inside patients' rooms, in the presence of patients and family members, and integrate patient and parent perspectives and preferences into clinical decision making."

NOTE: Abbreviations: FCR, family-centered rounds; SD, standard deviation.

RESULTS

Forty-eight attendings participated in the attending focus groups, and 31 medical students participated in the student focus groups (Table 1).

What Do You Perceive the Purpose of Rounds to Be?

With respect to this prompt, we identified 4 themes, which represent 16 codes describing what attendings and medical students believed to be the purpose of rounds (Table 2). These themes are communication, medical education, patient care, and assessment.

Communication

Communication includes all comments addressing the role of rounds as it relates to communication between team members, patients, family members, and all those involved in patient care. There were 4 main codes, including coordination of patient care team, patient/family communication, establishing rapport with patients and/or family, and establishment of roles.

Coordination of patient care team identified rounds as a time "to make sure everyone is on the same page" and "to come together whenever possible," so that everyone "had the same information of what was going on." It also included comments related to interdisciplinary communication, with 1 participant describing rounds as "a time when your consulting team, or people with outside expertise, can weigh in on some medical issues."

Patient/family communication characterized rounds as a time to update the patient and/or family about the care plan and address potential concerns. One medical student commented that rounds were a "way to keep the family involved

TABLE 2. Domains and Themes of "What Do You Perceive to Be the Purpose of Rounds?" 218 Comments, 2014

		Number (%) of Comments Per Theme			
Domain	Theme	Medical Students	Pediatric Attendings	Medicine Attendings	Total
Communication		25 (30)	31 (44)	18 (27)	74 (34)
	The coordination of patient care team	12 (48)	19 (61)	12 (67)	43 (58)
	Time for patient/family communication	8 (32)	9 (29)	4 (22)	21 (28)
	Establishing rapport with patients	3 (12)	3 (10)	0 (0)	6 (8)
	The establishment of roles	2 (8)	0 (0)	2 (11)	4 (54)
Medical education		25 (30)	21 (30)	20 (30)	66 (30)
	The delivery of medical education	15 (60)	14 (67)	12 (60)	41(62)
	Exposing students and residents to clinical decision-making	4 (16)	2 (10)	3 (15)	9 (14)
	Time for attendings to role model	1 (4)	4 (19)	2 (10)	7 (11)
	A time for student presentations	2 (8)	1 (5)	1 (5)	4 (6)
	The establishment of student/resident autonomy	2 (8)	0 (0)	2 (10)	4 (6)
	To provide for a safe learning environment	1 (4)	0 (0)	0 (0)	1 (2)
Assessment		14 (17)	9 (13)	15(23)	38 (17)
	Attending observation, assessment, and feedback	13 (92)	9 (100)	14 (93)	36 (95)
	The establishment of expectations and goals	1 (7)	0 (0)	1 (7)	2 (5)
Patient care		12 (15)	9 (13)	13 (20)	34 (16)
	The formation of the patient care plan	6 (50)	6 (67)	6 (46)	18 (53)
	The delivery of patient care	6 (50)	3 (33)	7 (54)	16 (47)
	The purpose varies with attending	6 (7)	0 (0)	0 (0)	6 (3)
Total comments		82 (35)	70 (32)	66 (30)	218 (100)

in the whole story." Establishing rapport with patients and/or family identified rounds as a time to build "trust…between the patients and the parents and the team." Establishment of roles was exclusively identified by medical students, who noted that rounds were a time to "let the attending know what your level is and what you think you should be doing."

Medical Education

The theme of medical education is made up of 6 codes that encompass comments related to teaching and learning during rounds. These 6 codes include delivery of clinical education, exposure to clinical decision making, role modeling, student presentations, establishment of trainee autonomy, and providing a safe learning environment.

Delivery of clinical education included comments identifying rounds as a time for didactic teaching, teachable moments, "clinical pearls," and bedside teaching of physical exam skills. Exposure to clinical decision making included comments by both medical students and attendings who described the purpose of rounds as a time for learning and teaching, specifically about how best to approach problems and decision making in a systematic manner, with 1 medical student explaining it as a time to "expose [trainees] to the way that people think about problems and how they decided to go about addressing them."

Role modeling includes comments addressing rounds as a time for attendings to demonstrate appropriate behaviors and skills to trainees. One attending explained that "everybody learns from watching other people present and interact…so everybody has a chance to pick up things that they think, 'Oh, this works well.'" Student presentations include comments, predominantly from students, that described rounds as an opportunity to practice presentations and receive feedback, with 1 student explaining it was a time "to learn how to present but also to be questioned and challenged."

Establishing trainee autonomy is a code that identifies rounds as a time to encourage resident and student autonomy in order to achieve rounds that function with minimal input from the attending, with 1 attending describing how they "put resident leadership first as far as priorities… [and] fostering that because I usually let them decide what we're going to do."

Providing a safe learning environment identifies the purpose of rounds as being a space in which trainees can feel comfortable learning from their mistakes. One student described rounds as, "…a setting where it's okay to be wrong and feel comfortable enough to know that it's about a learning process."

Assessment

Assessment is a theme composed of comments identifying the purpose of rounds as being related to observation, assessment, and feedback, and it includes 2 codes: attending observation, assessment, and feedback and establishment of expectations. Attending observation, assessment, and feedback includes comments from attendings and students alike who described rounds as a place for observation, evaluation, and provision of feedback regarding the skills and abilities of trainees. One attending explained that rounds gave him an "opportunity to observe trainees interacting with each other, with the patient, the patient's family, and ancillary staff," with another commenting it was time used "to assess how med students are gathering information, presenting information, and eventually their assessment and plan." Establishment of expectations captures comments that describe rounds as a time for the establishment of expectations and goals of the team.

Patient Care

Patient care is a theme comprised of comments identifying the purpose of rounds as being directly related to the formation and delivery of the patient care plan, and it includes 2 codes: formation of the patient care plan and delivery of patient care. Formation of the patient care plan includes comments, which identified rounds as a time for discussing and forming the plan for the day, with an attending stating, "The purpose [of rounds] was to make a plan, a treatment plan, and to include the parents in making the treatment plan." Delivery of patient care included comments identifying rounds as a means of ensuring timely, safe, and appropriate delivery of patient care occurred. One attending explained, "It can't be undersold that the priority of rounds is patient care and the more eyes that look over information the less likely there are to be mistakes."

What Do You Believe the Ideal Purpose of Rounds Should Be?

This study originally sought to compare responses to 2 different questions: "What do you perceive the purpose of rounds to be?" and "What do you believe the ideal purpose of rounds should be?" What became clear during the focus groups was that these were often interpreted to be the same question, and as such, responses to the latter question were truncated or were reiterations of what was previously said: "I think we've already discussed that, I think it's no different than what we already kind of said, patient care, education, and communication," explained 1 attending. Fifty-four responses to the question regarding the ideal purpose of rounds were coded and did not differ significantly from the previously noted results in terms of the domains represented and the frequency of representation.

Variation Among Respondents

Overall, there is a high level of concordance between the comments from medical students and attendings regarding the purpose of rounds, particularly in the medical education theme. However, medicine and pediatric attendings differ in their comments relating to the theme of communication, with 2 codes primarily accounting for this difference: pediatric attendings place more emphasis on time for patient/family communication and establishing rapport with patients than their internal medicine colleagues. Of note, all of the pediatric attendings involved in the study answered that they conducted family-centered rounds (FCR), compared with 22% of internal medicine attendings.[10]

Another notable discrepancy came up during focus groups involving comments from medical students who reiterated that the purpose of rounds was not fixed, but rather dependent on the attending that was running rounds. This theme was only identified in focus groups involving medical students. One student explained, "I think that it depends on the attending and if they actually want to teach," and another commented that "it's incredibly dependent on what the attending… is willing to invest." No attendings identified student or attending variability as an important factor influencing the purpose of rounds.

DISCUSSION

This qualitative study is one of the first to explore the purpose of rounds from the perspective of both medical students and attendings. Reassuringly, our results indicate that medical student and attending perceptions are largely concordant. The 4 themes of communication, medical education, assessment, and patient care are in line with the findings of previous observational studies of internal medicine and pediatrics rounds.[1,11] The themes are similar to the findings of resident focus groups done at these same sites.[7]

Our results support that both medical students and attendings identify the importance of medical education during rounds. This is in contrast with findings in previous observational time-motion research by Stickrath that describes the focus on patient care related activities and the relative scarcity of education during rounds.[1] This stresses a divide between how medical students and attendings define the purpose of rounds and what other research suggests actually occurs on rounds. This distinction is an important one. It is possible that the way we, and others, define "medical education" and "patient care" may be at least partially responsible for these findings. This is supported by the ambiguous distinction between formal and informal educational activities on rounds and the challenges in characterizing the hidden curriculum and its role in medical student and resident education.[11] Attendings role modeling effective patient communication strategies, for example, highlights that patient care, medical education, and communication are frequently

indistinguishable.[12] This hybridization of activities and dedication to diverse types of learning is an essential quality of rounds and is suggestive of why they have survived as a preeminent tool within the arsenal of medical education for the past century.

Yet, this finding does not excuse or adequately explain a well-documented disappearance of more formal educational activities during rounds. Recent observational studies have shown that the percentage of rounds dedicated to educational activities fell from 25% to 10% after the implementation of duty hour restrictions,[1,13,14] and a recent ethnographic study of pediatric attending rounds confirmed teaching during rounds, though seen as a pedagogical ideal, occurred infrequently and inconsistently in large part because of time pressures.[15] In our attending focus groups, duty hours and time pressures were frequently cited as actively working against the purpose of rounds, specifically opportunities for teaching, with 1 attending explaining, "I just don't think we achieve our [teaching] goals like we used to." Another attending mentioned that, because of time pressures, "I often find myself apologizing. 'I'm so sorry. I can't resist. Can I just tell you this one thing? I'm so sorry to do teaching.'" This tension between time pressures and education on rounds is well documented in the literature.[4,16,17]

Our results highlight that attendings and medical students still believe that medical education is a primary and important purpose of rounds even in the face of increasing time pressures. As such, efforts should be made to better align the many purposes of rounds with the realities of the modern day rounding environment. Increasing the presence of medical education on rounds need not be at the expense of time given that techniques like the 1-minute preceptor have been rated as both efficient and effective methods of teaching and delivering feedback.[18] This is echoed in research that has found that faculty development with a focus on teaching significantly increased the rate of clinical education and interdisciplinary communication during rounds.[1] Opportunities for faculty development are increasingly accessible,[19] including programs like the Advancing Pediatric Excellence Teaching Program, sponsored by the American Academy of Pediatrics Section on Hospital Medicine and the Academic Pediatric Association, and the Teaching Educators Across the Continuum of Healthcare program, sponsored by the Society for General Internal Medicine.[20,21]

A testament to the adaptability of rounds can be seen in our findings that expose the increased emphasis with which pediatric attendings identify communication as a purpose of rounds, particularly within the themes of patient/family communication and establishing rapport with patients. This is likely due to the practice of FCR by 100% of the pediatric attendings in our focus groups, and is supported elsewhere in the literature.[22] A key to family-centered rounds is communication, with active participation in the care discussion by patients and families as described and endorsed by a 2012 American Academy of Pediatrics (AAP) policy.[10,23]

This emphasis could explain the increased frequency of comments made by pediatric attendings within the themes of patient/family communication and establishing rapport with patients. Furthermore, the AAP policy statement stresses the need to share information in a way that patients and families "effectively participate in care and decision making," which could explain why pediatric attendings placed greater emphasis on the formation of the patient care plan in the theme of patient care.

As noted, the authors published a related study focusing on resident perceptions regarding the purpose of rounds. We initially undertook a separate analysis of the 3 groups: faculty, residents, and medical students. From that analysis, it became apparent that residents (PGY1-PGY3) viewed rounds differently than faculty and medical students. Where faculty and medical students were more focused on communication and medical education, the residents were more focused on the practical aspects of rounds (eg, "getting work done"). It was also noted that the residents' focus aligned with the graduate medical education milestones, and framing the results within the milestones made the interpretation far more robust. In addition, the residents discussed their difficulties with patient and family involvement, especially in the context of family centered rounds, which is a topic that was rarely discussed by attendings or medical students.

Our study has a number of limitations. Only 4 university-based hospitals were included in the focus groups. This has the potential to limit the generalizability to the community hospital setting. Within the focus groups, the number of participants varied, and this may have had an impact on the flow and content of conversation. Facilitators were chosen to minimize potential bias and prior relationships with participants; however, this was not always possible, and as such, may have influenced responses. There may be a discrepancy between how people perceive rounds and how rounds actually function. Rounds were not standardized between institutions, departments, or attendings.

CONCLUSION

Rounds are an appropriate metaphor for medical education at large: they are time consuming, complex, and vary in quality, but are nevertheless essential to the goals of patients and learners alike because of their adaptability and hybridization of purpose. Our results highlight that rounds serve 4 critical purposes, including communication, medical education, patient care, and assessment. Importantly, both attendings and students agree on what they perceive to be the many purposes of rounds. Despite this agreement, a disconnect appears to exist between what people believe are the purposes of rounds and what is perceived to be happening during rounds. The causes of this gap are not well defined, and further efforts should be made to better understand the obstacles facing effective rounding. To improve rounds and adapt them to the needs of 21st century learners, it is critical that we better define the scope of medical education, both formal and informal, that occurs during rounds. In doing so, it will be possible to identify areas of development and train-

ing for faculty, residents, and medical students, which will ensure that rounds remain useful and critical tools for the development and education of future physicians.

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Association Between Anemia and Fatigue in Hospitalized Patients: Does the Measure of Anemia Matter?

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BACKGROUND: Restrictive blood transfusion practices in hospitalized patients with anemia have reduced the use of transfusion. Consequently, hospitalized patients are more likely to have lower hemoglobin (Hb) concentrations. Lower Hb is associated with increased fatigue in ambulatory patients. However, it is not known whether anemia is associated with fatigue in hospitalized patients. It is also unclear how to best measure anemia in hospitalized patients because Hb levels generally vary over a hospital stay.

OBJECTIVE: To assess multiple Hb-based measures of anemia in hospitalized patients and test whether these are associated with fatigue.

DESIGN: Prospective observational study.

SETTING: Urban, academic medical center.

PATIENTS: Hospitalized general medicine patients, age ≥50 years, with any Hb < 9 g/dL.

INTERVENTION: Patients' anemia-related fatigue was measured during hospitalization.

MEASUREMENTS: Measures of anemia were created for each patient based on the Hb values from their hospitalization (mean, median, minimum, maximum, admission, and discharge). Fatigue was measured using the Functional Assessment of Chronic Illness Therapy (FACIT)-Fatigue subscale.

RESULTS: Seven hundred eighty-four patients participated. Minimum Hb was strongly associated with fatigue. Patients with a minimum Hb of < 8 g/dL had higher fatigue levels (mean FACIT [standard deviation] Hb < 7 g/dL: 25 [13], 7 g/dL ≤ Hb <8 g/dL: 25 [14] Hb ≥8 g/dL: 29 [14], $P \leq 0.001$) and were more likely to report high levels of fatigue (FACIT-Fatigue < 27) (56% vs 41%; $P = 0.002$). Mean Hb had a less robust association with fatigue than minimum Hb, and no other measure of Hb was associated with patients' fatigue levels.

CONCLUSION: Minimum Hb is associated with fatigue while hospitalized and may help identify patients for interventions to address anemia-related fatigue. *Journal of Hospital Medicine* 2017;12: 898-904. Published online first September 6, 2017. © 2017 Society of Hospital Medicine

Fatigue is the most common clinical symptom of anemia and is a significant concern to patients.[1,2] In ambulatory patients, lower hemoglobin (Hb) concentration is associated with increased fatigue.[2,3] Accordingly, therapies that treat anemia by increasing Hb concentration, such as erythropoiesis stimulating agents,[4-7] often use fatigue as an outcome measure.

In hospitalized patients, transfusion of red blood cell increases Hb concentration and is the primary treatment for anemia. However, the extent to which transfusion and changes in Hb concentration affect hospitalized patients' fatigue levels is not well established. Guidelines support transfusing patients with symptoms of anemia, such as fatigue, on the assumption that the increased oxygen delivery will improve the symptoms of anemia. While transfusion studies in hospitalized patients have consistently reported that transfusion at lower or "restrictive" Hb concentrations is safe compared with transfusion at higher Hb concentrations,[8-10] these studies have mainly used cardiac events and mortality as outcomes rather than patient symptoms, such as fatigue. Nevertheless, they have resulted in hospitals increasingly adopting restrictive transfusion policies that discourage transfusion at higher Hb levels.[11,12] Consequently, the rate of transfusion in hospitalized patients has decreased,[13] raising questions of whether some patients with lower Hb concentrations may experience increased fatigue as a result of restrictive transfusion policies. Fatigue among hospitalized patients is important not only because it is an adverse symptom but because it may result in decreased activity levels, deconditioning, and losses in functional status.[14,15]

While the effect of alternative transfusion policies on fatigue in hospitalized patients could be answered by a randomized clinical trial using fatigue and functional status as outcomes, an important first step is to assess whether the Hb concentration of hospitalized patients is associated with their fatigue level during hospitalization. Because hospitalized patients often have acute illnesses that can cause fatigue in and of themselves, it is possible that anemia is not associated with fatigue in hospitalized patients despite anemia's association with fatigue in ambulatory patients. Additionally, Hb concentration varies during hospitalization,[16] raising the question of what measures of Hb during hospitalization might be most associated with anemia-related fatigue.

The objective of this study is to explore multiple Hb measures in hospitalized medical patients with anemia and

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test whether any of these Hb measures are associated with patients' fatigue level.

METHODS

Study Design

We performed a prospective, observational study of hospitalized patients with anemia on the general medicine services at The University of Chicago Medical Center (UCMC). The institutional review board approved the study procedures, and all study subjects provided informed consent.

Study Eligibility

Between April 2014 and June 2015, all general medicine inpatients were approached for written consent for The University of Chicago Hospitalist Project,[17] a research infrastructure at UCMC. Among patients consenting to participate in the Hospitalist Project, patients were eligible if they had Hb <9 g/dL at any point during their hospitalization and were age ≥50 years. Hb concentration of <9 g/dL was chosen to include the range of Hb values covered by most restrictive transfusion policies.[8-10,18] Age ≥50 years was an inclusion criteria because anemia is more strongly associated with poor outcomes, including functional impairment, among older patients compared with younger patients.[14,19-21] If patients were not eligible for inclusion at the time of consent for the Hospitalist Project, their Hb values were reviewed twice daily until hospital discharge to assess if their Hb was <9 g/dL. Proxies were sought to answer questions for patients who failed the Short Portable Mental Status Questionnaire.[22]

Patient Demographic Data Collection

Research assistants abstracted patient age and sex from the electronic health record (EHR), and asked patients to self-identify their race. The individual comorbidities included as part of the Charlson Comorbidity Index were identified using *International Classification of Diseases*, 9th Revision codes from hospital administrative data for each encounter and specifically included the following: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatic disease, peptic ulcer disease, liver disease, diabetes, hemiplegia and/or paraplegia, renal disease, cancer, and human immunodeficiency virus/acquired immunodeficiency syndrome.[23] We also used Healthcare Cost and Utilization Project (www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp) diagnosis categories to identify whether patients had sickle cell (SC) anemia, gastrointestinal bleeding (GIB), or a depressive disorder (DD) because these conditions are associated with anemia (SC and GIB) and fatigue (DD).[24]

Measuring Anemia

Hb measures were available only when hospital providers ordered them as part of routine practice. The first Hb concentration <9 g/dL during a patient's hospitalization, which made them eligible for study participation, was obtained through manual review of the EHR. All additional Hb values during the patient's hospitalization were obtained from the hospital's administrative data mart. All Hb values collected for each patient during the hospitalization were used to calculate summary measures of Hb during the hospitalization, including the mean Hb, median Hb, minimum Hb, maximum Hb, admission (first recorded) Hb, and discharge (last recorded) Hb. Hb measures were analyzed both as a continuous variable and as a categorical variable created by dividing the continuous Hb measures into integer ranges of 3 groups of approximately the same size.

Measuring Fatigue

Our primary outcome was patients' level of fatigue reported during hospitalization, measured using the Functional Assessment of Chronic Illness Therapy (FACIT)-Anemia questionnaire. Fatigue was measured using a 13-question fatigue subscale,[1,2,25] which measures fatigue within the past 7 days. Scores on the fatigue subscale range from 0 to 52, with lower scores reflecting greater levels of fatigue. As soon as patients met the eligibility criteria for study participation during their hospitalization (age ≥50 years and Hb <9 g/dL), they were approached to answer the FACIT questions. Values for missing data in the fatigue subscale for individual subjects were filled in using a prorated score from their answered questions as long as >50% of the items in the fatigue subscale were answered, in accordance with recommendations for addressing missing data in the FACIT.[26] Fatigue was analyzed as a continuous variable and as a dichotomous variable created by dividing the sample into high (FACIT <27) and low (FACIT ≥27) levels of fatigue based on the median FACIT score of the population. Previous literature has shown a FACIT fatigue subscale score between 23 and 26 to be associated with an Eastern Cooperative Oncology Group (ECOG)[27] C Performance Status rating of 2 to 3[3] compared to scores ≥27.

Statistical Analysis

Statistical analysis was performed using Stata statistical software (StataCorp, College Station, Texas). Descriptive statistics were used to characterize patient demographics. Analysis of variance was used to test for differences in the mean fatigue levels across Hb measures. χ^2 tests were performed to test for associations between high fatigue levels and the Hb measures. Multivariable analysis, including both linear and logistic regression models, were used to test the association of Hb concentration and fatigue. P values <0.05 using a 2-tailed test were deemed statistically significant.

RESULTS

Patient Characteristics

During the study period, 8559 patients were admitted to the general medicine service. Of those, 5073 (59%) consented for participation in the Hospitalist Project, and 3670 (72%) completed the Hospitalist Project inpatient interview. Of these patients, 1292 (35%) had Hb <9 g/dL, and 784 (61%) were 50 years or older and completed the FACIT questionnaire.

Table 1 reports the demographic characteristics and comorbidities for the sample, the mean (standard deviation

[SD]) for the 6 Hb measures, and mean (SD) and median FACIT scores.

Bivariate Association of Fatigue and Hb

Categorizing patients into low, middle, or high Hb for each of the 6 Hb measures, minimum Hb was strongly associated with fatigue, with a weaker association for mean Hb and no statistically significant association for the other measures.

Minimum Hb

Patients with a minimum Hb <7 g/dL and patients with Hb 7-8 g/dL had higher fatigue levels (FACIT = 25 for each) than patients with a minimum Hb ≥8 g/dL (FACIT = 29; $P < 0.001$; Table 2). When excluding patients with SC and/or GIB because their average minimum Hb differed from the average minimum Hb of the full population ($P < 0.001$), patients with a minimum Hb <7 g/dL or 7-8 g/dL had even higher fatigue levels (FACIT = 23 and FACIT = 24, respectively), with no change in the fatigue level of patients with a minimum Hb ≥8 g/dL (FACIT = 29; $P < 0.001$; Table 2). Lower minimum Hb continued to be associated with higher fatigue levels when analyzed in 0.5 g/dL increments (Figure).

Lower values of minimum Hb were also associated with patients reporting high fatigue levels (FACIT <27). Fatigue levels were high for 50% of patients with a minimum Hb <7 g/dL and 56% of patients with a minimum Hb 7–8 g/dL compared with only 41% of patients with a minimum Hb ≥8 g/dL ($P < 0.002$). Excluding patients with SC and/or GIB, fatigue levels were high for 54% of patients with a minimum Hb <7 g/dL and 57% of patients with a minimum Hb 7-8 g/dL compared with 41% of patients with a minimum Hb ≥8 g/dL ($P < 0.001$; Table 2).

Mean Hb and Other Measures

Fatigue levels were high for 47% of patients with a mean Hb <8g /dL and 53% of patients with a mean Hb 8-9 g/dL compared with 43% of patients with a mean Hb ≥9 g/dL ($P = 0.05$). However, the association between high fatigue and mean Hb was not statistically significant when patients with SC and/or GIB were excluded (Table 2). None of the other 4 Hb measures was significantly associated with fatigue.

Linear Regression of Fatigue on Hb

In linear regression models, minimum Hb consistently predicted patient fatigue, mean Hb had a less robust association with fatigue, and the other Hb measures were not associated with patient fatigue. Increases in minimum Hb (analyzed as a continuous variable) were associated with reduced fatigue (higher FACIT score; $\beta = 1.4$; $P = 0.005$). In models in which minimum Hb was a categorical variable, patients with a minimum Hb of <7 g/dL or 7-8 g/dL had greater fatigue (lower FACIT score) than patients whose minimum Hb was ≥8 g/dL (Hb <7 g/dL: $\beta = -4.2$; $P \leq 0.001$; Hb 7-8 g/dL: $\beta = -4.1$; $P < 0.001$). These results control for patients' age, sex, individual comorbidities, and whether their minimum Hb occurred before or after the measurement of fatigue during hospitalization (Model 1), and the results are unchanged when also controlling for the number of Hb laboratory draws patients had during their hospitalization (Model 2; Table 3). In a stratified analysis excluding patients with either SC and/or GIB, changes in minimum Hb were associated with larger changes in patient fatigue levels (Supplemental Table 1). We also stratified our analysis to include only patients whose minimum Hb occurred before the measurement of their fatigue level during hospitalization to avoid a spurious association of fatigue with minimum Hb occurring after fatigue was measured. In both Models 1 and 2,

TABLE 1. Patient Characteristics

Total N = 784	N (%)
Female	447 (57)
Age–Mean ± SD (years)	66 ± 11
Race	
American Indian or Alaskan Native	3 (<1)
Asian	12 (2)
Black or African American	507 (65)
White	212 (27)
Multiple reported races	8 (1)
Don't know or refused	42 (5)
Ethnicity	
Hispanic or Latino	46 (6)
Not Hispanic or Latino	711 (91)
Don't know or refused	27 (3)
Admission comorbidities	
Myocardial infarction	59 (8)
Congestive heart failure	251 (32)
Peripheral vascular disease	71 (9)
Cerebrovascular disease	25 (3)
Dementia	0 (0)
Chronic pulmonary disease	211 (27)
Rheumatic disease	40 (5)
Peptic ulcer disease	47 (6)
Liver disease	126 (16)
Diabetes	344 (43)
Hemiplegia and/or paraplegia	10 (1)
Renal disease	165 (21)
Cancer	134 (17)
AIDS/HIV	10 (1)
Sickle cell anemia	21 (3)
Gastrointestinal bleeding	98 (13)
Depressive disorder	103 (13)
Hemoglobin measures ± SD (g/dL)	
Mean	8.5 ± 0.8
Median	8.4 ± 0.8
Minimum	7.3 ± 1.1
Maximum	9.8 ± 1.5
Admission	8.9 ± 1.8
Discharge	8.5 ± 0.9
Transfusion during hospitalization	289 (35)
FACIT-Fatigue subscale score (range 0-52)	
Mean ± SD	26 ± 14
Median (IQR1-IQR3)	27 (15-37)

NOTE: Abbreviations: AIDS/HIV, acquired immunodeficiency syndrome/human immunodeficiency virus; FACIT, Functional Assessment of Chronic Illness Therapy; IQR, interquartile range; SD, standard deviation.

TABLE 2. Bivariate Analysis of Fatigue and Hemoglobin Measures

		Full Population (N = 784)					Excluding SC and/or GIB Patients (N = 666)				
Hemoglobin Measure	Range	Subjects (n = 784)	Mean Fatigue Score[a] (s.e)	*P*[b]	Percent High Fatigue, FACIT <27	*P*[c]	Subjects (n = 594)	Mean Fatigue Score[a] (s.e)	*P*[b]	Percent High Fatigue, FACIT <27	*P*[c]
Mean	Hb < 8 g/dL	214	26 (1.0)	.07	47	.05	147	25 (1.2)	.06	51	.09
	8 g/dL ≤ Hb < 9 g/dL	370	25 (0.7)		53		283	25 (0.8)		53	
	Hb ≥ 9 g/dL	200	28 (1.0)		43		164	28 (1.1)		43	
Median	Hb < 8 g/dL	222	26 (1.0)	.47	48	.65	157	24 (1.1)	.3	52	.81
	8 g/dL ≤ Hb < 9 g/dL	380	26 (0.7)		50		291	26 (0.8)		50	
	Hb ≥ 9 g/dL	182	27 (1.0)		46		146	27 (1.1)		48	
Minimum	Hb < 7 g/dL	284	25 (0.8)	<.001	50	.002	180	23 (0.9)	<.001	54	<.001
	7 g/dL ≤ Hb < 8 g/dL	234	25 (0.9)		56		181	24 (1.0)		57	
	Hb ≥ 8 g/dL	266	29 (0.9)		41		233	29 (0.9)		41	
Maximum	Hb < 9 g/dL	212	27 (1.0)	.27	44	.17	159	26 (1.1)	.32	47	.36
	9 g/dL ≤ Hb < 10 g/dL	278	26 (0.8)		49		203	26 (0.9)		49	
	Hb ≥ 10 g/dL	294	25 (0.8)		52		232	25 (0.9)		53	
Admission	Hb < 8 g/dL	196	26 (1.0)	.27	47	.37	112	24(1.2)	.23	51	.72
	8 g/dL ≤ Hb < 10 g/dL	384	27 (0.7)		53		309	26 (0.8)		49	
	Hb ≥ 10 g/dL	204	25 (1.0)		49		173	25 (1.0)		52	
Discharge	Hb < 8 g/dL	244	26 (0.9)	.83	49	.86	160	25 (1.1)	.59	52	.66
	8 g/dL ≤Hb < 9 g/dL	267	26 (0.8)		50		292	26 (0.8)		50	
	Hb ≥ 9 g/dL	273	27 (0.9)		47		142	26 (1.1)		50	

[a]Higher fatigue scores equate with lower fatigue.

[b]*P* values for analysis of variance.

[c]*P* values for $\chi 2$.

NOTE: Abbreviations: FACIT, Functional Assessment of Chronic Illness Therapy; GIB, gastrointestinal bleeding; Hb, hemoglobin; SC, sickle cell anemia.

minimum Hb remained a predictor of patients' fatigue levels with similar effect sizes, although in Model 2, the results did not quite reach a statistically significant level, in part due to larger confidence intervals from the smaller sample size of this stratified analysis (Supplemental Table 2a). We further stratified this analysis to include only patients whose transfusion, if they received one, occurred after their minimum Hb and the measurement of their fatigue level to account for the possibility that a transfusion could affect the fatigue level patients report. In this analysis, most of the estimates of the effect of minimum Hb on fatigue were larger than those seen when only analyzing patients whose minimum Hb occurred before the measurement of their fatigue level, although again, the smaller sample size of this additional stratified analysis does produce larger confidence intervals for these estimates (Supplemental Table 2b).

Analyzed as a categorical variable, a mean Hb <8 g/dL or 8-9 g/dL was also associated with higher levels of fatigue compared with patients whose mean Hb is ≥9 g/dL in both Models 1 and 2, although the results were only statistically significant for patients with a mean Hb 8-9 g/dL (β=−2.5; $P < 0.04$; Table 3). There were no statistically significant associations between mean Hb and fatigue when excluding SC and/or GIB patients (Supplemental Table 3).

No Hb measure other than minimum or mean had significant association with patient fatigue levels in linear regression models.

Logistic Regression of High Fatigue Level on Hb

Using logistic regression, minimum Hb analyzed as a categorical variable predicted increased odds of a high fatigue

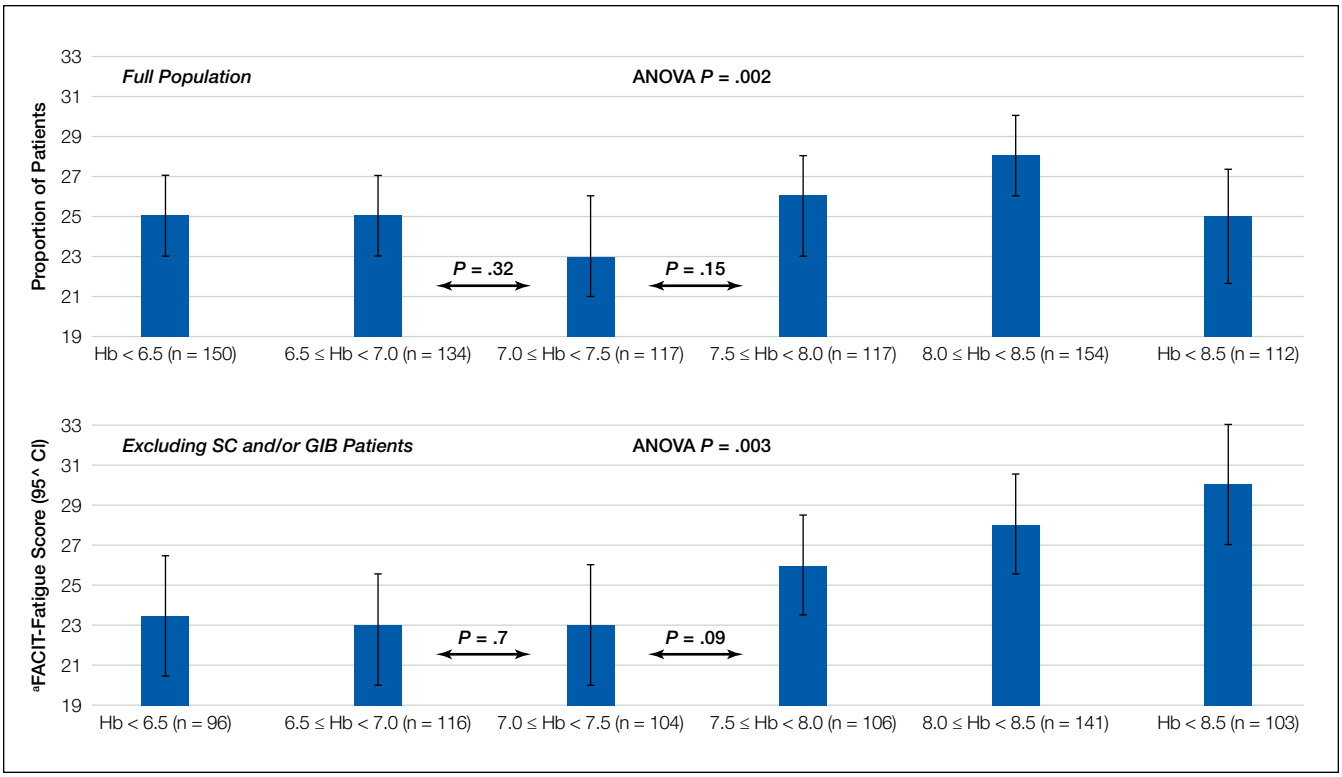

FIG. Mean fatigue score by minimum hemoglobin concentration.

NOTE: Abbreviations: ANOVA, analysis of variance; CI, confidence interval; GIB, gastrointestinal bleeding; Hb, hemoglobin; SC, sickle cell anemia.

[a]Higher FACIT fatigue subscale scores equate with lower fatigue

level. Patients with a minimum Hb <7 g/dL were 50% (odds ratio [OR] = 1.5; $P = 0.03$) more likely to have high fatigue and patients with a minimum Hb 7-8 g/dL were 90% (OR = 1.9; $P < 0.001$) more likely to have high fatigue compared with patients with a minimum Hb ≥8 g/dL in Model 1. These results were similar in Model 2, although the effect was only statistically significant in the 7-8 g/dL Hb group (Table 3). When excluding SC and/or GIB patients, the odds of having high fatigue as minimum Hb decreased were the same or higher for both models compared to the full population of patients. However, again, in Model 2, the effect was only statistically significant in the 7-8 g/dL Hb group (Supplemental Table 1).

Patients with a mean Hb <8 g/dL were 20% to 30% more likely to have high fatigue and patients with mean Hb 8-9 g/dL were 50% more likely to have high fatigue compared with patients with a mean Hb ≥9 g/dL, but the effects were only statistically significant for patients with a mean Hb 8-9 g/dL in both Models 1 and 2 (Table 3). These results were similar when excluding patients with SC and/or GIB, but they were only significant for patients with a mean Hb 8-9 g/dL in Model 1 and patients with a mean Hb <8 g/dL in the Model 2 (Supplemental Table 3).

DISCUSSION

These results demonstrate that minimum Hb during hospitalization is associated with fatigue in hospitalized patients age ≥50 years, and the association is stronger among patients without SC and/or GIB as comorbidities. The analysis of Hb as a continuous and categorical variable and the use of both linear and logistic regression models support the robustness of these associations and illuminate their clinical significance. For example, in linear regression with minimum Hb a continuous variable, the coefficient of 1.4 suggests that an increase of 2 g/dL in Hb, as might be expected from transfusion of 2 units of red blood cells, would be associated with about a 3-point improvement in fatigue. Additionally, as a categorical variable, a minimum Hb ≥8 g/dL compared with a minimum Hb <7 g/dL or 7-8 g/dL is associated with a 3- to 4-point improvement in fatigue. Previous literature suggests that a difference of 3 in the FACIT score is the minimum clinically important difference in fatigue,[3] and changes in minimum Hb in either model predict changes in fatigue that are in the range of potential clinical significance.

The clinical significance of the findings is also reflected in the results of the logistic regressions, which may be mapped to potential effects on functional status. Specifically, the odds of having a high fatigue level (FACIT <27) increase 90% for persons with a minimum Hb 7–8 g/dL compared with persons with a minimum Hb ≥8 g/dL. For persons with a minimum Hb <7 g/dL, point estimates suggest a smaller (50%) increase in the odds of high fatigue, but the 95% confidence interval overlaps heavily with the estimate of patients whose minimum Hb is 7-8 g/dL. While it might be

TABLE 3. Minimum and Mean Hb Effect on Patient Fatigue (N = 784)

Minimum Hb			Inpatient Fatigue Level			High Fatigue (FACIT<27)		
	Model	Hb Concentration	β	95% CI	P	OR	95% CI	P
	1	Minimum Hb (continuous)	1.4	(0.4, 2.3)	.005	0.9	(0.8, 1.0)	.09
		7 g/dL ≤ Hb < 8 g/dLa	−4.1	(−6.6, −1.7)	<.001	1.9	(1.3, 2.8)	<.001
		Hb < 7 g/dLa	−4.2	(−6.6, −1.6)	<.001	1.5	(1.1, 2.2)	.03
	2	Minimum Hb (continuous)	1.0	(−0.1, 2.0)	.05	0.9	(0.8, 1.1)	.41
		7 g/dL ≤ Hb < 8 g/dLa	−3.9	(−6.3, −1.4)	.02	1.9	(1.3, 2.7)	.001
		Hb < 7 g/dLa	−3.2	(−5.7, −0.6)	.02	1.3	(0.9, 1.9)	.21
Mean Hb			Inpatient Fatigue Level			High Fatigue (FACIT<27)		
	Model	Hb Concentration	β	95% CI	P	OR	95% CI	P
	1	Mean Hb (continuous)	0.22	(−1.0, 1.5)	.71	1.0	(0.9, 1.2)	.67
		8 g/dL ≤ Hb < 9 g/dLb	−2.5	(−4.9, −0.1)	.04	1.5	(1.0, 2.1)	.03
		Hb < 8 g/dLb	−2.4	(−5.1, 0.4)	.09	1.2	(0.8, 1.9)	.3
	2	Mean Hb (continuous)	0.4	(−0.9, 1.6)	.6	1.0	(0.9, 1.2)	.3
		8 g/dL ≤ Hb < 9 g/dLb	−2.5	(−4.9, −0.2)	.04	1.5	(1.1, 2.2)	.03
		Hb < 8 g/dLb	−2.4	(−5.1, 0.3)	.08	1.3	(0.8, 1.9)	.27

[a]Hb ≥ 8g/dL referent group.

[b]Hb ≥ 9g/dL referent group.

NOTE: Linear/Logistic Regression Model 1: Adjusted for age, sex, time of minimum Hb relative to measurement of fatigue, comorbidities. Linear/Logistic Regression Model 2: Adjusted for age, sex, time of minimum Hb relative to measurement of fatigue, number of of complete blood countss drawn during hospitalization, comorbidities. Comorbidities: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatic disease, peptic ulcer disease, liver disease, diabetes, hemiplegia/paraplegia, renal disease, cancer, sickle cell anemia, gastrointestinal bleeding, depressive disorder. Abbreviations: CI, confidence interval; FACIT, Functional Assessment of Chronic Illness Therapy; Hb, hemoglobin; OR, odds ratio.

expected that patients with a minimum Hb <7 g/dL have greater levels of fatigue compared with patients with a minimum Hb 7-8 g/dL, we did not observe such a pattern. One reason may be that the confidence intervals of our estimated effects are wide enough that we cannot exclude such a pattern. Another possible explanation is that in both groups, the fatigue levels are sufficiently severe, such that the difference in their fatigue levels may not be clinically meaningful. For example, a FACIT score of 23 to 26 has been shown to be associated with an ECOG performance status of 2 to 3, requiring bed rest for at least part of the day.[3] Therefore, patients with a minimum Hb 7-8 g/dL (mean FACIT score = 24; Table 2) or a minimum Hb of <7 g/dL (mean FACIT score = 23; Table 2) are already functionally limited to the point of being partially bed bound, such that further decreases in their Hb may not produce additional fatigue in part because they reduce their activity sufficiently to prevent an increase in fatigue. In such cases, the potential benefits of increased Hb may be better assessed by measuring fatigue in response to a specific and provoked activity level, a concept known as fatigability.[20]

That minimum Hb is more strongly associated with fatigue than any other measure of Hb during hospitalization may not be surprising. Mean, median, maximum, and discharge Hb may all be affected by transfusion during hospitalization that could affect fatigue. Admission Hb may not reflect true oxygen-carrying capacity because of hemoconcentration.

The association between Hb and fatigue in hospitalized patients is important because increased fatigue could contribute to slower clinical recovery in hospitalized patients. Additionally, increased fatigue during hospitalization and at hospital discharge could exacerbate the known deleterious consequences of fatigue on patients and their health outcomes[14,15] after hospital discharge. Although one previous study, the Functional Outcomes in Cardiovascular Patients Undergoing Surgical Hip Fracture Repair (FOCUS)[8] trial, did not report differences in patients' fatigue levels at 30 and 60 days postdischarge when transfused at restrictive (8 g/dL) compared with liberal (10 g/dL) Hb thresholds, confidence in the validity of this finding is reduced by the fact that more than half of the patients were lost to follow-up at the 30- and 60-day time points. Further, patients in the restrictive transfusion arm of FOCUS were transfused to maintain Hb levels at or above 8 g/dL. This transfusion threshold of 8 g/dL may have mitigated the high levels of fatigue that are seen in our study when patients' Hb drops below 8 g/dL, and maintaining a Hb level of 7 g/dL is now the standard of care in stable hospitalized patients. Lastly, FOCUS was limited to postoperative hip fracture patients, and the generalizability of FOCUS to hospitalized medicine patients with anemia is limited.

Therefore, our results support guideline suggestions that practitioners incorporate the presence of patient symptoms such as fatigue into transfusion decisions, particularly if patients' Hb is <8 g/dL.[18] Though reasonable, the suggestion to incorporate symptoms such as fatigue into transfusion decisions has not been strongly supported by evidence so far, and it may often be neglected in practice. Definitive evidence to support such recommendations would benefit from study through an optimal trial[18] that incorporates symptoms into decision making. Our findings add support for a study of transfusion strategies that incorporates patients' fatigue level in addition to Hb concentration.

This study has several limitations. Although our sample size is large and includes patients with a range of comorbidities that we believe are representative of hospitalized general medicine patients, as a single-center, observational study, our results may not be generalizable to other centers. Additionally, although these data support a reliable association between hospitalized patients' minimum Hb and fatigue level, the observational design of this study cannot prove that this relationship is causal. Also, patients' Hb values were measured at the discretion of their clinician, and therefore, the measures of Hb were not uniformly measured for participating patients. In addition, fatigue was only measured at one time point during a patient's hospitalization, and it is possible that patients' fatigue levels change during hospitalization in relation to variables we did not consider. Finally, our study was not designed to assess the association of Hb with longer-term functional outcomes, which may be of greater concern than fatigue.

CONCLUSION

In hospitalized patients ≥50 years old, minimum Hb is reliably associated with patients' fatigue level. Patients whose minimum Hb is <8 g/dL experience higher fatigue levels compared to patients whose minimum Hb is ≥8 g/dL. Additional studies are warranted to understand if patients may benefit from improved fatigue levels by correcting their anemia through transfusion.

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Sustainability in the AAP Bronchiolitis Quality Improvement Project

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BACKGROUND AND OBJECTIVES: Adherence to American Academy of Pediatrics (AAP) bronchiolitis clinical practice guideline recommendations improved significantly through the AAP's multiinstitutional collaborative, the Bronchiolitis Quality Improvement Project (BQIP). We assessed sustainability of improvements at participating institutions for 1 year following completion of the collaborative.

METHODS: Twenty-one multidisciplinary hospital-based teams provided monthly data for key inpatient bronchiolitis measures during baseline and intervention bronchiolitis seasons. Nine sites provided data in the season following completion of the collaborative. Encounters included children younger than 24 months who were hospitalized for bronchiolitis without comorbid chronic illness, prematurity, or intensive care. Changes between baseline-, intervention-, and sustainability-season data were assessed using generalized linear mixed-effects models with site-specific random effects. Differences between hospital characteristics, baseline performance, and initial improvement between sites that did and did not participate in the sustainability season were compared.

RESULTS: A total of 2275 discharges were reviewed, comprising 995 baseline, 877 intervention, and 403 sustainability-season encounters. Improvements in all key bronchiolitis quality measures achieved during the intervention season were maintained during the sustainability season, and orders for intermittent pulse oximetry increased from 40.6% (95% confidence interval [CI], 22.8-61.1) to 79.2% (95% CI, 58.0-91.3). Sites that did and did not participate in the sustainability season had similar characteristics.

DISCUSSION: BQIP participating sites maintained improvements in key bronchiolitis quality measures for 1 year following the project's completion. This approach, which provided an evidence-based best-practice toolkit while building the quality-improvement capacity of local interdisciplinary teams, may support performance gains that persist beyond the active phase of the collaborative. *Journal of Hospital Medicine* 2017;12:905-910. Published online first September 6, 2017. © 2017 Society of Hospital Medicine

Acute viral bronchiolitis is the most common cause of hospitalization for children less than 1 year of age.[1] Overuse of ineffective therapies has persisted despite the existence of the evidence-based American Academy of Pediatrics (AAP) clinical practice guideline (CPG), which recommends primarily supportive care.[2-8] Adherence to the AAP CPG recommendations for management of bronchiolitis improved significantly through the AAP's Bronchiolitis Quality Improvement Project (BQIP), a 12-month, multiinstitutional collaborative of community and free-standing children's hospitals.[9] This subsequent study investigates if these improvements were sustained after completion of the formal 12-month project.

Published multiinstitutional bronchiolitis quality improvement (QI) work is limited to 1 study[5] that describes the results of a single intervention season at academic medical centers. Multiyear bronchiolitis QI projects are limited to single-center studies, and results have been mixed.[5,6,8,10-13] One study[11] observed continued improvement in bronchodilator use in subsequent seasons, whereas a second study[10] observed a return to baseline bronchodilator use in the following season. Mittal[6] observed inconsistent improvements in key bronchiolitis measures during postintervention seasons.

Our specific aim was to assess the sustainability of improvements in bronchiolitis management at participating institutions 1 year following completion of the AAP BQIP collaborative.[9] Because no studies demonstrate the most effective way to support long-term improvement through a QI collaborative, we hypothesized that the initial collaborative activities, which were designed to build the capacity of local interdisciplinary teams while providing standardized evidence-based care pathways, would lead to performance in the subsequent season at levels similar to or better than those observed during the active phase of the collaborative, without additional project interventions.

METHODS

Study Design and Setting

This was a follow-up study of the AAP Quality Improvement Innovation Networks project entitled "A Quality Collaborative for Improving Hospital Compliance with the

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AAP Bronchiolitis Guideline" (BQIP).[9] The AAP Institutional Review Board approved this project.

Twenty-one multidisciplinary, hospital-based teams participated in the BQIP collaborative and provided monthly data during the January through March bronchiolitis season. Teams submitted 2013 baseline data and 2014 intervention data. Nine sites provided 2015 sustainability data following the completion of the collaborative.

Participants

Hospital encounters with a primary diagnosis of acute viral bronchiolitis were eligible for inclusion among patients from 1 month to 2 years of age. Encounters were excluded for prematurity (<35 weeks gestational age), congenital heart disease, bronchopulmonary dysplasia, genetic, congenital or neuromuscular abnormalities, and pediatric intensive-care admission.

Data Collection

Hospital characteristics were collected, including hospital type (academic, community), bed size, location (urban, rural), hospital distributions of race/ethnicity and public payer, cases of bronchiolitis per year, presence of an electronic medical record and a pediatric respiratory therapist, and self-rated QI knowledge of the multidisciplinary team (very knowledgeable, knowledgeable, and somewhat knowledgeable). A trained member at each site collected data through structured chart review in baseline, intervention, and sustainability bronchiolitis seasons for January, February, and March. Site members reviewed the first 20 charts per month that met the inclusion criteria or all charts if there were fewer than 20 eligible encounters. Sites input data about key quality measures into the AAP's Quality Improvement Data Aggregator, a web-based data repository.

Intervention

The BQIP project was designed as a virtual collaborative consisting of monthly education webinars about QI methods and bronchiolitis management, opportunities for collaboration via teleconference and e-mail listserv, and individual site-coaching by e-mail or telephone.[9] A change package was shared with sites that included examples of evidence-based pathways, ordersets, a respiratory scoring tool, communication tools for parents and referring physicians, and slide sets for individual site education efforts. Following completion of the collaborative, written resources remained available to participants, although virtual collaboration ceased and no additional project interventions to promote sustainability were introduced.

Bronchiolitis Process and Outcome Measures

Process measures following admission included the following: severity assessment using a respiratory score, respiratory score use to assess response to bronchodilators, bronchodilator use, bronchodilator doses, steroid doses per patient encounter, chest radiographs per encounter, and presence of an order to transition to intermittent pulse oximetry monitoring. Outcome measures included length of stay and readmissions within 72 hours.

Analysis

Changes among baseline-, intervention-, and sustainability-season data were assessed using generalized linear mixed-effects models with random effect for study sites. Negative binomial models were used for count variables to allow for overdispersion. Length of stay was log-transformed to achieve a normal distribution. We also analyzed each site individually to assess whether sustained improvements were the result of broad sustainability across all sites or whether they represented an aggregation of some sites that continued to improve while other sites actually worsened.

To address any bias introduced by the voluntary and incomplete participation of sites in the sustainability season, we planned a priori to conduct 3 additional analyses. First, we compared the characteristics of sites that did participate in the sustainability season with those that did not participate by using Chi-squared tests for differences in proportions and t tests for differences in means. Second, we determined whether the baseline-season process and outcome measures were different between sites that did and did not participate using descriptive statistics. Third, we assessed whether improvements between the baseline and intervention seasons were different between sites that did and did not participate using a linear mixed-effects model for normally distributed outcomes and generalized linear mixed-effects model with site-specific random effects for nonnormally distributed outcomes. All study outcomes were summarized in terms of model-adjusted means along with the corresponding 95% confidence intervals. All P values are 2-sided, and $P < 0.05$ was used to define statistical significance. Data analyses were conducted using SAS software (SAS Institute Inc., Cary, North Carolina) version 9.4.

RESULTS

A total of 2275 patient encounters were reviewed, comprising 995 encounters from the baseline season, 877 from the intervention season, and 403 from the sustainability season. Improvements were observed across key bronchiolitis quality measures from the baseline to intervention season,[9] although not every site improved in every metric. All improvements achieved by the combined groups during the intervention season were sustained during the sustainability season (Table 1). No measures demonstrated statistically significant reductions between the intervention and sustainability seasons, and the use of intermittent pulse oximetry continued to increase. Length of stay and 72-hour readmissions were not statistically different between seasons (P = 0.54 and P = 0.98, respectively).

Mean use of a respiratory score, which was 6.6% (95% confidence interval [CI], 1.8-21.5) in the baseline season, increased to 73.9% (95% CI, 56.9-85.9) during the intervention season and 70.7% (95 % CI, 53.8-83.5) in the sustainability season. The number of bronchodilator doses per

TABLE 1. Differences in Performance of Bronchiolitis QI Measures Following Admission Between Baseline, Intervention and Sustainability Seasons

	Severity Assessed using Respiratory Score % (95% CI)	Respiratory Score Use to Assess Response to Bronchodilator % (95% CI)	Bronchodilator Use % (95% CI)	Bronchodilator Doses / Encounter Mean (95% CI)	Steroid Doses / Encounter Mean (95% CI)	CXR / Encounter Mean (95% CI)	Presence of an Order to Transition to Intermittent Pulse Oximetry % (95% CI)	Length of Stay[a]	Readmitted Within 72 Hours % (95% CI)
Baseline	6.6 (1.8-21.5)	8.6 (2.4-26.2)	45.5 (37.9-53.3)	3.1 (2.1-4.4)	0.33 (0.23-0.48)	0.18 (0.11-0.29)	40.6 (22.8-61.1)	0.53 (0.35-0.71)	2.4 (1.3-4.1)
Intervention	73.9 (56.9-85.9)	68.3 (48.1-83.3)	23 (17.0-30.0)	1.0 (0.7-1.4)	0.04 (0.02-0.11)	0.08 (0.06-0.11)	68.6 (47.4-84.1)	0.37 (0.19-0.55)	1.8 (1.0-3.2)
P Value Baseline to Intervention	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	.51
Sustainability	70.7 (53.8-83.5)	57.6 (37.9-75.1)	26.1 (19.6-33.8)	0.8 (0.5-1.3)	0.10 (0.04-0.24)	0.07 (0.04-0.15)	79.2 (58.0-91.3)	0.40 (0.22-0.58)	1.7 (1.0-3.6)
Change from Intervention to Sustainability	–3.3 (–9.1-2.7)	–10.8 (–23.3-1.8)	3.1 (–3.1-9.3)	–0.2 (–0.7-0.3)	0.05 (–0.04-0.14)	0.00 (–.05 – 0.05)	10.7 (–5.0-16.4)	0.03 (–0.07-0.13)	0.0 (–2.0-2.1)
P Value Intervention to Sustainability	.26	.09	.3	.5	.21	.84	<.01	.54	.98

[a]Log transformed length of stay in days.

NOTE: Abbreviations: CI, confidence interval; CXR, chest radiograph.

encounter decreased from 3.1 (95% CI, 2.1-4.4) in the baseline season to 1.0 (95% CI, 0.7-1.4) in the intervention season and 0.8 (95% CI, 0.5-1.3) in the sustainability season. Orders for intermittent pulse oximetry increased significantly from a baseline of 40.6% (95% CI, 22.8-61.1) to 68.6% (95% CI, 47.4-84.1) in the intervention season and 79.2% (95% CI, 58.0-91.3) in the sustainability season. In general, this same pattern was present, ie, individual sites did not demonstrate significant improvement or worsening across the measures (Appendix 1a). The Figure illustrates individual site and overall project performance over the study period using bronchodilator use as a representative example.

Characteristics of sites that did and did not participate in the sustainability season were not significantly different (Table 2). The majority of sites were medium-sized centers that cared for an average of 100 to 300 inpatient cases of bronchiolitis per year and were located in an urban environment.

Differences in baseline bronchiolitis quality measures between sites that did and did not participate in the sustainability season are displayed in Table 3. Sustainability sites had significantly lower baseline use of a respiratory score, both to assess severity of illness at any point after hospitalization as well as to assess responsiveness following bronchodilator treatments ($P < 0.001$). At baseline they also had fewer orders for intermittent pulse oximetry use ($P = 0.01$) and fewer doses of bronchodilators per encounter ($P = 0.04$). Sites were not significantly different in their baseline use of bronchodilators, oral steroid doses, or chest radiographs. Sites that participated in the sustainability season demonstrated larger magnitude improvement between baseline and intervention seasons for respiratory score use ($P < 0.001$ for any use and $P = 0.02$ to assess bronchodilator responsiveness; Appendix 1b).

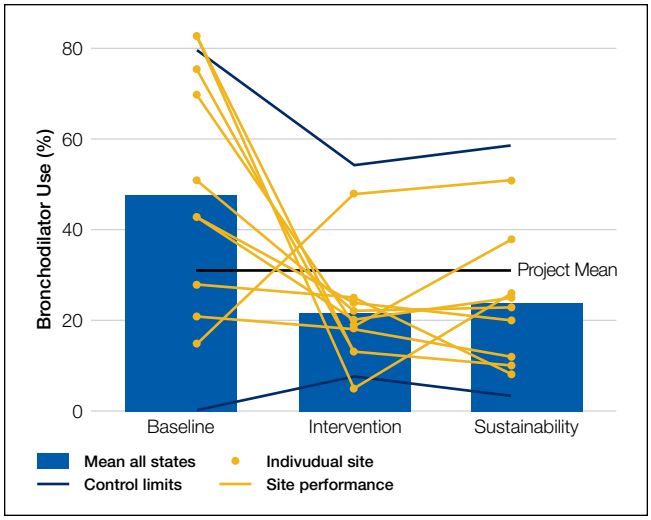

FIG. Individual site performance of bronchodilator use after hospital admission over baseline, intervention and sustainability time periods.

NOTE: Control limits are 2 standard deviations from the project mean.

DISCUSSION

To our knowledge, this is the first report of sustained improvements in care achieved through a multiinstitutional

TABLE 2. Characteristics of Sites that Did and Did Not Participate in the BQIP Sustainability Data Collection Season

Characteristics of Sites		Sustaining Site (n = 9) %	Nonsustaining Site (n = 12) %	*P* Value
Hospital Type	Academic	67	58	.99
	Community	33	42	
Bed Size	≥50	11	17	.60
	10-50	0	17	
	<10	89	67	
Hospital Location	Urban	67	58	.99
	Suburban	33	42	
Racial/Ethnic Distribution of Hospital Populationa	White, non-Hispanic	58.6	35.4	.06
	Hispanic	19.1	25.8	.19
	Black, non-Hispanic	15.4	28.2	.07
*Public-Insurance Distribution of Hospital Population[a]	Public Insurance	60.9	57.6	.67
Presence of EHR	Yes	100	83	.84
Annual Cases of Bronchiolitis	≥300	22	8	.84
	100-300	44	42	
	<100	33	50	
Presence of Pediatric RT	Yes	66	92	.27
QI Knowledge, self-rated	Very Knowledgeable	11	17	.84
	Knowledgeable	56	33	
	Somewhat	33	50	

[a]These proportions reflect the hospital's self-reported distribution of race/ethnicity and public-payer status and not necessarily the distributions of encounters included in the Bronchiolitis Quality Improvement Project (BQIP) collaborative.
NOTE: Abbreviations: BQIP, Bronchiolitis Quality Improvement Project; EHR, electronic health record; RT, respiratory therapist; QI, quality improvement.

QI collaborative of community and academic hospitals focused on bronchiolitis care. We found that overall sites participating in a national bronchiolitis QI project sustained improvements in key bronchiolitis quality measures for 1 year following the project's completion. For the aggregate group no measures worsened, and one measure, orders for intermittent pulse oximetry monitoring, continued to increase during the sustainability season. Furthermore, the sustained improvements were primarily the result of consistent sustained performance of each individual site, as opposed to averages wherein some sites worsened while others improved (Appendix 1a). These findings suggest that designing a collaborative approach, which provides an evidence-based best-practice toolkit while building the QI capacity of local interdisciplinary teams, can support performance gains that persist beyond the project's active phase.

There are a number of possible reasons why improvements were sustained following the collaborative. The BQIP requirement for institutional leadership buy-in may have motivated accountability to local leaders in subsequent bronchiolitis seasons at each site. We suspect that culture change such as flattened hierarchies through multidisciplinary teams,[14] which empowered nurse and respiratory therapy staff, may have facilitated consistent use of tools created locally. The synergy of interdisciplinary teams composed of physician, nurse, and respiratory therapy champions may have created accountability to perpetuate the previous year's efforts.[15] In addition, the sites adopted elements of the evidence-based toolkit, such as pathways,[16,17] forcing function tools[13,18] and order sets that limited management decision options and bronchodilator use contingent on respiratory scores,[9,19] which may have driven desired behaviors.

Moreover, the 2014 AAP CPG for the management of bronchiolitis,[20] released prior to the sustainability bronchiolitis season, may have underscored the key concepts of the collaborative. Similarly, national exposure of best practices for bronchiolitis management, including the 3 widespread Choosing Wisely recommendations related to bronchiolitis,[21] might have been a compelling reason for sites to maintain their improvement efforts and contribute to secular trends toward decreasing interventions in bronchiolitis management nationally.[3] Lastly, the mechanisms developed for local data collection may have created opportunities at each site to conduct ongoing evaluation of performance on key bronchiolitis quality measures through data-driven feedback systems.[22] Our study highlights the need for additional research in order to understand why improvements are or are not sustained.

Even with substantial, sustained improvements in this initiative, further reduction in unnecessary care may be possible. Findings from previous studies suggest that even

TABLE 3. Differences in Bronchiolitis Quality Measures at Baseline for Sites that Did and Did Not Participate in BQIP Sustainability Data Collection Season

Bronchiolitis Quality Measure	Sustaining Site (n = 9)	Nonsustaining Site (n = 12)	*P* Value
Severity Assessed Using Respiratory Score, %	5.4	35.2	<.001
Respiratory Score Use to Assess Response to Bronchodilator, %	7.7	23.2	<.001
Bronchodilator Use, %	45.7	47.6	.54
Bronchodilator Doses/Encounter, Mean	3.1	4.0	.04
Steroids Doses/Encounter, mean	0.3	0.4	.47
CXR/Encounter, Mean	0.18	0.14	.93
Presence of an Order to Transition to Intermittent Pulse Oximetry, %	39.7	47.6	.01

NOTE: Abbreviations: BQIP, Bronchiolitis Quality Improvement Project; CXR, chest radiograph.

multifaceted QI interventions, including provider education, guidelines and use of respiratory scores, may only modestly reduce bronchodilators, steroids, and chest radiograph use.[8,13] To achieve continued improvements in bronchiolitis care, additional active efforts may be needed to develop new interventions that target root causes for areas of overuse at individual sites.

Future multiinstitutional collaboratives might benefit their participants if they include a focus on helping sites develop skills to ensure that local improvement activities continue after the collaborative phases are completed. Proactively scheduling intermittent check-ins with collaborative members to discuss experiences with both sustainability and ongoing improvement may be valuable and likely needs to be incorporated into the initial collaborative planning.

As these sustainability data represent a subset of 9 of the original 21 BQIP sites, there is concern for potential selection bias related to factors that could have motivated sites to participate in the sustainability season's data collection and simultaneously influenced their performance. These concerns were mitigated to some extent through 3 specific analyses: finding limited differences in hospital characteristics, baseline performance in key bronchiolitis measures, and performance change from baseline to intervention seasons between sites that did and did not participate in the sustainability season.

Notably, sites that participated in the sustainability phase actually had lower baseline respiratory score use and fewer orders for intermittent pulse oximetry at baseline. Theoretically, if participation in the collaborative highlighted this disparity for these sites, it could have been a motivating factor for their continued participation and sustained performance across these measures. Similarly, sites that recognized their higher baseline performance through participation in the collaborative might have felt less motivation to participate in ongoing data collection during the sustainability season. Whether they might have also sustained, declined, or continued improving is not known. Additionally, the magnitude of improvement in the collaborative period might have also motivated ongoing participation during the sustainability phase. For example, although all sites improved in score use during the collaborative, sites participating in the sustainability season demonstrated significantly more improvement in these measures. Sites with a higher magnitude of improvement in collaborative measures might have more enthusiasm about the project, more commitment to the project activities, or feel a sense of obligation to respond to requests for additional data collection.

This work has several limitations. Selection bias may limit generalizability of the results, as sites that did not participate in the sustainability season may have had different results than those that did participate. It is unknown whether sites that regressed toward their baseline were deterred from participating in the sustainability season. The analyses that we were able to preform, however, suggest that the 2 groups were similar in their characteristics as well as in their baseline and improvement performance.

We have limited knowledge of the local improvement work that sites conducted between the completion of the collaborative and the sustainability season. Site-specific factors may have influenced improvement sustainability. For example, qualitative research with the original group found that team engagement had a quantitative association with better performance, but only for the bronchodilator use measure.[23] Sites were responsible for their own data collection, and despite attempts to centralize and standardize the process, data collection inconsistencies may have occurred. For instance, it is unknown how closely that orders for intermittent pulse oximetry correlate with intermittent use at the bedside. Lastly, the absence of a control group limits examination of the causal relationships of interventions and the influence of secular trends.

CONCLUSIONS

Improvements gained during the BQIP collaborative were sustained at 1 year following completion of the collabora-

tive. These findings are encouraging, as national QI collaborative efforts are increasingly common. Our findings suggest that opportunities exist to even further reduce unnecessary care in the management of bronchiolitis. Such opportunities highlight the importance of integrating strategies to both measure sustainability and plan for ongoing independent local activities after completion of the collaborative. Future efforts should focus on supporting local sites to continue individual practice-improvement as they transition from collaborative to independent quality initiatives.

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Helping Seniors Plan for Posthospital Discharge Needs Before a Hospitalization Occurs: Results from the Randomized Control Trial of PlanYourLifespan.org

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BACKGROUND: Hospitalized seniors are frequently too sick to make informed decisions about their postdischarge care. Subsequently, loved ones often make support choices (eg, skilled nursing facility placement, caregivers) at discharge. We sought to advance the timeline for postacute care decisions to before a hospitalization occurs.

OBJECTIVE: Investigate the effect of PlanYourLifespan.org (PYL) on knowledge of posthospital discharge options.

DESIGN: Multisite randomized controlled trial.

SETTING/PATIENTS: Nonhospitalized adults, aged ≥65 years, living in urban, suburban, and rural areas of Texas, Illinois, and Indiana.

INTERVENTION: PYL is a national, publicly available tool that provides education on posthospital therapy choices and local home-based resources.

MEASUREMENTS: Participants completed an in-person baseline survey, followed by exposure to intervention or attention control (AC) websites, then 1-month and 3-month telephone surveys. The primary knowledge outcome was measured with 6 items (possible 0-6 points) pertaining to hospital discharge needs.

RESULTS: Among 385 participants randomized, mean age was 71.9 years (standard deviation 5.6) and 79.5% of participants were female. At 1 month, the intervention group had a 0.6 point change (standard deviation = 1.6) versus the AC group who had a −0.1 point change in knowledge score. Linear mixed modeling results suggest sex, health literacy level, level of education, income, and history of high blood pressure/kidney disease were significant predictors of knowledge over time. Controlling for these variables, treatment effect remained significant ($P < 0.0001$).

CONCLUSION: Seniors who used PYL demonstrated an increased understanding of posthospitalization and home services compared to the control group.

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When seniors are discharged from the hospital, many will require additional support and therapy to regain their independence and return safely home.[1,2] Most seniors do not understand what their support needs will entail or the differences between therapy choices.[3] To complicate the issue, seniors are often incapacitated and unable to make discharge selections for themselves.

Consequently, discharge planners and social workers often explain options to family members and loved ones, who frequently feel overwhelmed.[4,5] While often balancing jobs, loved ones are divided between wanting to stay with the senior in the hospital and driving to area skilled nursing facilities (SNFs) for consideration. Discharges are delayed waiting for families to make visits and choose an SNF. Longer lengths of stay are detrimental to seniors due to the increased risks of infection, functional loss, and cognitive decline.[6]

Although seniors comprised only 12% of the US population in 2003,[7] they accounted for one-third of all hospitalizations, over 13.2 million hospital stays.[8] Hospital stays for seniors resulted in hospital charges totaling nearly $329 billion, or 43.6% of national hospital bills in 2003.[7] Seniors are also high consumers of postacute care services. By 2050, the number of individuals using long-term care services in any setting (eg, at home, assisted living, or SNFs) will be close to 27 million.[9-11] With the knowledge that many seniors will be hospitalized and subsequently require services thereafter, we sought to assist seniors in planning for their hospital discharge needs before they were hospitalized.

Our team developed PlanYourLifespan.org (PYL) to facilitate this planning for postdischarge needs and fill the

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TABLE 1. Participant Baseline Characteristics

	Treatment Arm				
	Attention Control		PLAN YOUR LIFESPAN		
Characteristics	N = 191	%	N = 194	%	*P* Value
Mean Age (± SD)	72.1 (5.6)		71.7 (5.6)		.51
Sex					.19
Female	157	82.2	149	76.8	
Male	34	17.8	45	23.2	
Race					.30
White	125	65.4	117	60.3	
Non-white	66	34.6	77	39.7	
Marital Status					.58
Single, never married	27	14.1	23	11.9	
Married	75	39.3	85	43.8	
Widowed	44	23.0	36	18.5	
Divorced/separated	45	23.6	50	25.8	
How would you rate your health?					.78
Poor	4	2.1	4	2.1	
Fair	22	11.5	18	9.3	
Good	76	39.8	81	41.7	
Very Good	62	32.5	70	36.1	
Excellent	27	14.1	21	10.8	
Household Income					.90
Less than $20,000	45	23.6	43	22.2	
$20,000-$40,000	50	26.2	54	27.8	
$40,001-$60,000	31	16.2	27	13.9	
$60,001-$80,000	25	13.1	26	13.4	
$80,001-$100,000	19	10.0	17	8.8	
More than $100,000	13	6.8	18	9.3	
Don't Know	4	2.1	2	1.0	
Prefer not to say	4	2.1	7	3.6	
Education					.57
High school or less	33	17.3	40	20.6	
Some college	55	28.8	59	30.4	
College graduate	103	53.9	95	49.0	
REALM Score					.85
Third grade and below	1	0.5	0	0.0	
Fourth to sixth grade	2	1.1	1	0.5	
Seventh to eighth grade	29	15.2	28	14.4	
High school	159	83.3	165	85.1	
Have you or a member of your household been hospitalized in the past 3 years?					.31
No	104	54.5	96	49.5	
Yes	86	45.0	98	50.5	
Don't know	1	0.5	0	0.00	

Continued on page E3

knowledge gap in understanding postdischarge options. With funding from the Patient Centered Outcomes Research Institute, we aimed to test the effectiveness of PYL on improving knowledge of hospital discharge resources among seniors.

METHODS

PlanYourLifespan.org

PlanYourLifespan.org (PYL) educates users on the health crises that often occur with age and connects them to post-hospital and home-based resources available locally and nationally. PYL is personalized, dynamic, and adaptable in that all the information can be changed per the senior's wishes or changing health needs.

Content of PYL

Previously, we conducted focus groups with seniors about current and perceived home needs and aging-in-place.

TABLE 1. Participant Baseline Characteristics (continued)

Characteristics	Treatment Arm: Attention Control N = 191	%	Treatment Arm: PLAN YOUR LIFESPAN N = 194	%	*P* Value
With whom do you live?					.36
Live alone	104	54.5	94	48.5	
Live with one other person	75	39.3	90	46.4	
Live with multiple other people	12	6.3	10	5.1	
If yes, with whom do you live?					
Spouse	73	38.2	86	44.3	.22
Son/daughter	15	7.9	16	8.3	.89
Other relative	10	5.2	10	5.2	.97
Friend	1	0.5	0	0.0	.50
Other	1	0.5	1	0.5	.50
High blood pressure					.28
No	71	37.2	62	32.0	
Yes	120	62.8	132	68.0	
Diabetes					.98
No	152	79.6	155	79.9	
Yes	38	19.9	39	20.1	
Don't know	1	0.5	0	0.0	
Lung Disease such as emphysema or chronic bronchitis					.11
No	178	93.2	170	87.6	
Yes	13	6.8	22	11.4	
Don't know	0	0.0	2	1.0	
Asthma					.27
No	167	87.4	162	83.5	
Yes	24	12.6	32	16.5	
Stroke					.27
No	169	88.5	177	91.2	
Yes	20	10.5	14	7.2	
Don't Know	2	1.0	3	1.6	
Cancer					.60
No	144	75.4	141	72.7	
Yes	47	24.6	52	26.8	
Don't Know	0	0.0	1	0.5	
Kidney Disease					.32
No	179	93.7	185	95.4	
Yes	11	5.8	7	3.6	
Don't Know	1	0.5	2	1.0	
Heart Failure					.50
No	176	92.1	181	93.3	
Yes	13	6.8	10	5.2	
Don't Know	2	1.1	3	1.5	
Arthritis					.47
No	72	37.7	66	34.0	
Yes	116	60.7	124	63.9	
Don't Know	3	1.6	4	2.1	
Self-Efficacy Score	68.2 (8.0)		67.4 (7.9)		.35
Social Support Score	6.4 (2.1)		6.3 (2.1)		.66

NOTE: Abbreviations: REALM, Rapid Estimate of Adult Literacy in Medicine; SD, standard deviation.

TABLE 2. Understanding of Posthospital Discharge and Home Services Over Time

Time of Assessment	Attention Control		PLAN YOUR LIFESPAN	
	Mean	Std	Mean	Std
Baseline	3.7	1.3	3.6	1.3
Post Tool	3.9	1.2	4.1	1.3
Post Tool - Baseline	0.2	1.0	0.5	1.4
Month 1	3.7	1.4	4.1	1.4
Month 1 - Baseline	–0.1	1.4	0.6	1.6
Month 3	3.7	1.4	4.2	1.5
Month 3 - Baseline	–0.1	1.4	0.6	1.6

NOTE: Abbreviations: Std, standard deviation; UHS, Understanding of Posthospital Discharge and Home Services.

Major themes of what advanced life events (ALEs) would impact aging-in-place were identified as follows: hospitalizations, falls, and Alzheimer's.[12] We organized PYL around these health-related ALEs. Our multidisciplinary team of researchers, seniors, social workers, caregiver agencies, and Area Agencies on Aging representatives then determined what information and resources should be included.

Each section of PYL starts with a video of a senior discussing their real-life personal experiences, with subsections providing interactive information on what seniors can expect, types of resources available to support home needs, and choices to be made. Descriptions of types of settings for therapy, options available, and links to national/local resources (eg, quality indicators for SNFs) are also included. For example, by entering their zip code, users can identify their neighborhood SNFs, closest Area Agency on Aging, and what home caregiver agencies exist in their area.

Users can save their preferences and revisit their choices at any time. To support communication between seniors and their loved ones, a summary of their choices can be printed or e-mailed to relevant parties. For example, a senior uses PYL and can e-mail these choices to family members, which can stimulate a conversation about future posthospital care expectations.

As inadequate health literacy and cognitive impairment are prevalent among seniors, PYL presents information understandable at all levels of health literacy and sensitive to cognitive load.[9] There is simplified, large-font, no mouse scrolling and audio available for the visually impaired.

Study Design and Randomization

To test PYL, a 2-armed (attention control [AC] and PYL intervention), parallel, randomized controlled trial was conducted. Participants were randomly assigned to 1 of the 2 conditions via a pregenerated central randomization list using equal (1:1) allocation and random permuted block design to ensure relatively equal allocation throughout the study. The AC condition exposed participants to the National Institute on Aging-sponsored website, Go4Life.nia.nih.gov, an educational website on physical activity for seniors. This website has comparable design and layout to PYL but does not include information about advanced planning. The AC condition controlled for the possibility that regular contact with the study team may improve outcomes in participants randomized to the intervention website.

The trial was conducted from October 2014 to September 2015 in Chicago, Illinois; Fort Wayne, Indiana; and Houston, Texas. Inclusion criteria were as follows: age 65 and older, English-speaking, scoring ≥4 questions correctly on the Brief Cognitive Screen,[14] and current self-reported use of a computer or smartphone with internet. Participants were excluded if they had previously participated in the focus groups or beta testing of the PYL website. Community-based patient partners/stakeholders drove subject recruitment in their communities through word of mouth, e-mail bursts, newsletters, and flyers. At the Area Agency on Aging and community centers where services such as food vouchers and case management are provided, participants were recruited on-site and given study information. At the clinical sites, staff referred potential participants. Study materials such as flyers and information sheets were also located in the clinic waiting rooms. The Villages, nonprofit, grassroots, membership organizations that are redefining aging by being a key resource to community members wishing to age in place, heavily relied on electronic recruitment using their regular e-newsletters and e-mail lists to recruit potential participants. Potential subjects were also recruited by distributing flyers at local senior centers and senior housing buildings. Interested seniors contacted research staff who explained the study and assessed their eligibility. If eligible, subjects were scheduled for a face-to-face interview.

At the face-to-face encounter, all study subjects completed a written consent, answered baseline questions, and were randomized to either arm. Next, research staff introduced all study subjects to the website to which they were randomized and provided instructions on its use. Staff were present to

TABLE 3. Linear Mixed Model Results for Evaluation of UHS over Time

Models	Estimate	Lower 95% CL	Upper 95% CL	*P* Value
Unadjusted Model Output				
Time	−0.04	−0.11	0.03	0.22
Plan Your Lifespan Arm	−0.14	−0.39	0.11	0.27
Time-by-Arm Interaction	0.23	0.14	0.33	<.0001
Adjusted Model Output				
Time	−0.05	−0.12	0.02	0.20
Plan Your Lifespan Arm	−0.14	−0.39	0.10	0.24
Time-by-Arm Interaction	0.22	0.12	0.32	<.0001
Male Sex	−0.38	−0.63	−0.14	0.002
Income Level	0.08	0.01	0.15	0.02
History of High Blood Pressure	−0.22	−0.43	−0.01	0.04
History of Kidney Disease	−0.51	−0.96	−0.06	0.03
Health Literacy Level	0.38	0.12	0.63	0.004
Education Level	0.20	0.06	0.34	0.004

NOTE: Abbreviations: CL, PLEASE DEFINE ; UHS, Understanding of Posthospital Discharge and Home Services.

assist with questions as needed on navigation but did not assist with decision making for either website. A minimum of 15 minutes and a maximum of 45 minutes was allotted for navigating either website. After navigating their website, participants were administered an immediate in-person posttest survey. One month and 3 months after the face-to-face encounter, research staff contacted all study participants over the phone to complete a follow-up survey. Staff attempted to reach participants up to 3 times by phone. Data were entered into Research Electronic Data Capture survey software.[15] This study was approved by the Northwestern University Institutional Review Board.

Understanding of Posthospital Discharge and Home Services

As part of the larger trial, which included behavioural outcomes that will be reported elsewhere, we sought to explore the effects of PYL on participants' knowledge and understanding of posthospital discharge and home services (UHS). Participants were asked to respond to 6 questions at baseline, immediate posttest, and at the 1- and 3-month follow-up time points. Knowledge items were developed by the study team in conjunction with the patient/partner stakeholders. UHS scores were calculated as the sum of the 6 questions (each scored 0 if incorrect and 1 if correct) with a possible range of 0-6.

Covariates

Demographic information, self-reported health, importance of religion, and existence of a power of attorney, living will, advanced directive (eg, Physician Orders for Life-Sustaining Treatment) were obtained via self-report. Participants were asked about their general and social self-efficacy using the validated Self-efficacy Scale[16] and their social support using the Lubben Social Network Scale–6.[17] Health literacy was assessed using the Rapid Estimate of Adult Literacy in Medicine–Short Form.[18] To measure burden of disease, participant comorbidities were measured using a nonvalidated 9-item dichotomous response condition list, which included some items adapted from the Charlson Comorbidity Index and the Elixhauser Comorbidity Index.

Statistical Analysis

Data analysis included all available data in the intention-to-treat dataset. As UHS was collected at multiple time points up to 3 months postintervention, we employed linear-mixed modeling with random participant effect and fixed arm, time, and time-by-arm interaction terms. The time-by-arm interaction allows for comparison of UHS slopes (or trajectories) across arms. Analyses explored multiple potential covariates, including current utilization of services, physical function, comorbidities, social support, health literacy, self-efficacy, and sociodemographics. Those covariates found to have a significant association ($P < 0.05$) with outcome were considered for inclusion in the overall model selection process. Ultimately, we developed a final parsimonious, adjusted longitudinal model with primary predictors of time, arm, and their interaction, controlling for only significant baseline variables following a manual backward selection method. All analyses were conducted in SAS software (version 9.4, copyright 2012, The SAS Institute Inc., Cary, North Carolina).

RESULTS

Among 470 participants screened for eligibility, 385 were randomized (Figure). All were included in intention-to-treat analysis. Of the 191 participants allocated to the AC group, 1 participant partially received the PYL intervention. The mean age of participants was 71.9 (standard deviation = 5.6), and 79.5% were female; 62.9% identified as white and 37.1% as non-white (Table 1). Baseline characteristics were similar in both of the groups.

Table 2 presents follow-up summary statistics by arm for the UHS score. At both the 1- and 3-month time points,

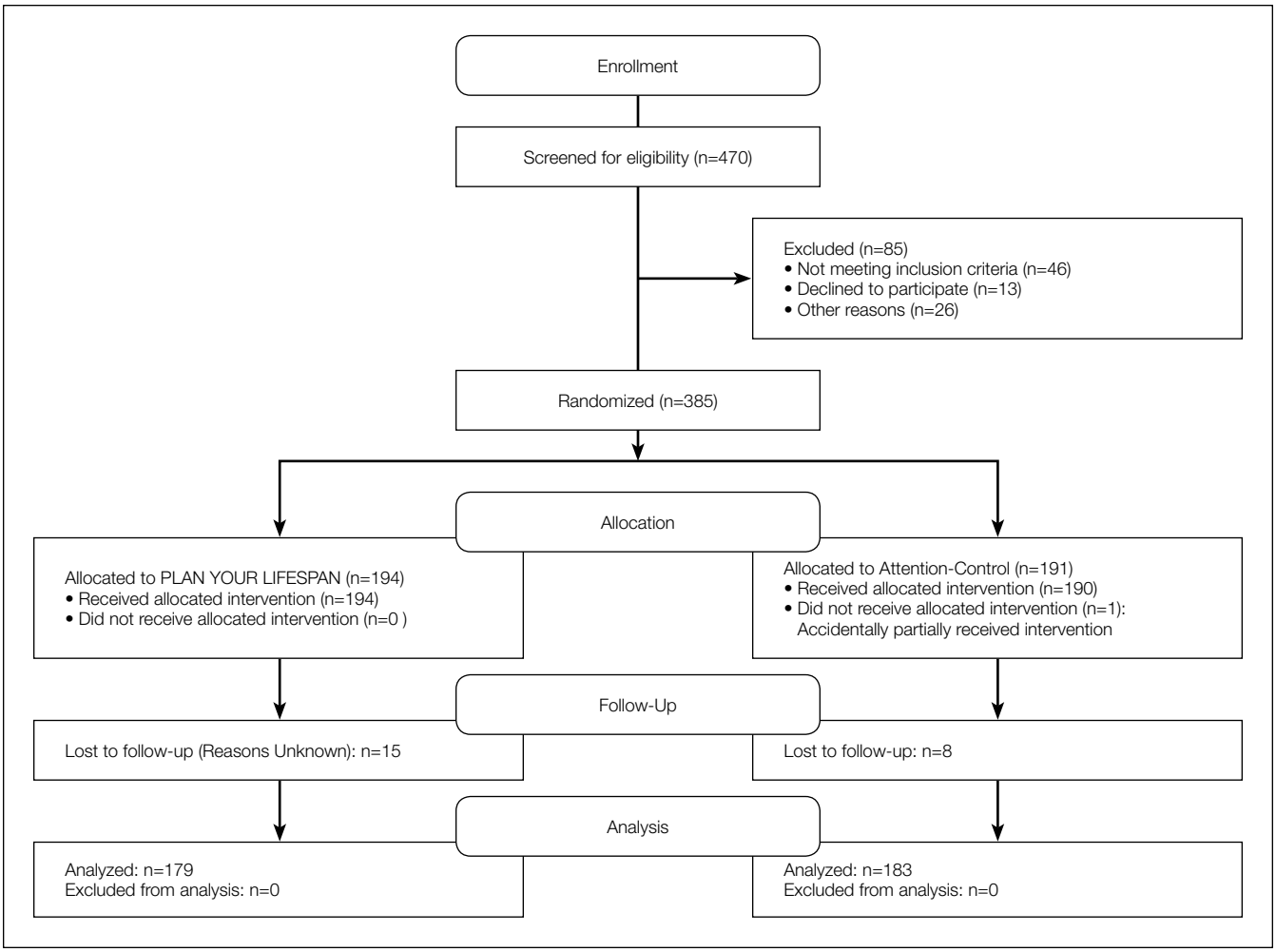

FIG. CONSORT diagram

the mean UHS score in the active intervention arm increased (by 0.56 ± 1.55 points at 1 month and 0.60 ± 1.63 at 3 months), while mean UHS score decreased in the AC arm at both time points (−0.09 ± 1.43 at 1 month and −0.07 ± 1.37 at 3 months).

Table 3 illustrates linear mixed model results both failing to adjust and adjusting for potentially influential baseline covariates. In both instances, the interaction term (arm-by-time) was highly significant ($P < 0.0001$) in predicting UHS score, suggesting that, when compared to the AC arm, the intervention arm exhibited a large mean slope in UHS score over time. That is, understanding home services score tended to increase at a faster rate for those in the active arm. Higher levels of income ($P = 0.0191$), literacy ($P = 0.0036$), and education ($P = 0.0042$) were associated with increased UHS scores; however, male sex ($P = 0.0023$) and history of high blood pressure ($P = 0.0409$) or kidney disease ($P = 0.0278$) were negatively associated with UHS scores.

CONCLUSION/DISCUSSION

The results of our study show that among seniors, PYL improved their understanding of home-based services and the services that may be required following a hospitalization. Educating seniors about what to expect regarding the transition home from a hospital before a hospitalization even occurs may enable seniors and their families to plan ahead instead of reacting to a hospitalization. PYL, a national, publicly available tool with links to local resources may potentially help in advancing transitional discharge care to prior to a hospitalization.

To our knowledge, this is one of the first websites and trials devoted to planning for seniors' health trajectory as they age into their 70s, 80s, 90s, and 100s. Clinicians regularly discuss code status and powers of attorney during their end-of-life discussions with patients. We encourage clinicians to ask patients, "What about the 10 to 20 years before you die? Have you considered what you will do if you get sick or need help at home?" While not replacing a social worker, the ability of PYL to connect seniors to local resources makes it somewhat of a "virtual social worker." With many physician practices unable to afford social workers, PYL provides a free-of-charge means of connecting seniors to area resources.

A major strength of this project was our strong community partnerships. PYL was developed with significant input from

our patient partners/stakeholders, which included seniors, senior community group leaders, Area Agencies on Aging, Villages, nurses, caregiver agency leaders, and clinicians. This patient and stakeholder engagement enabled us to create a website that was fully senior-centric, focusing specifically on what was important to seniors. Patient partners/stakeholders were tasked with recruiting participants for the trial, using multiple tactics in their communities to connect potential participants to researchers. Recruiting directly through our community partners helped us include people who would not normally participate in research studies. An additional study strength was that recruitment occurred at multiple sites, including rural and urban locales.

As with all studies, limitations exist. While using a validated outcome measure would have been ideal for measuring knowledge, none existed that assessed whether a person understood their future needs or could plan to make use of available resources. Consequently, the UHS outcome measure was not validated prior to starting this trial and it remains unclear what changes in UHS score observed mean or translate to in a real-world setting.

The study participants were in general white, educated, and in reasonably good health. This may be a limitation of this study given that it could impact the generalizability of the study results, as we are unable to know for certain if these same results would be observed with participants who have lower educational levels and are in poor health. Power considerations in this study did not account for comparison of outcomes within specific subgroups so we were unable to assess outcomes in groups such as those with limited health literacy, low social support, or low self-efficacy. The trial was also limited by our inability to collect information on whether or not the knowledge gains observed in the study led to any measureable outcomes. Due to the relatively short follow-up time, we were unable to ascertain whether any study participants were hospitalized during the study follow-up period and if so, if exposure to PYL had any impact on patient anxiety, length of hospital stay, and/or caregiver burden. We were also unable to assess patients' ability to utilize and carry out their posthospitalization discharge plans if they had one in place. Future studies with longer follow-up are needed to determine these important, measurable outcomes.

Potential implications of planning for a senior's lifespan are expansive. If hospitalized seniors knew their preferred SNF for subacute rehabilitation on the first day of their hospitalization, hospital lengths of stay could potentially be reduced. If families knew which caregiver agencies, Area Agency on Aging, or Village their senior wished to use, obtaining services would perhaps be easier to accomplish.

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Low Health Literacy Is Associated with Increased Transitional Care Needs in Hospitalized Patients

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BACKGROUND: In discharge planning, a patient needs assessment helps to identify risk factors that should be addressed to promote a safe and effective transition in care. Low health literacy is associated with worse postdischarge outcomes, but little research has examined its relation to other addressable risk factors.

OBJECTIVE: To examine the association of health literacy with the number and type of transitional care needs (TCN) among patients being discharged to home.

DESIGN, SETTING, PARTICIPANTS: A cross-sectional analysis of patients admitted to an academic medical center.

MEASUREMENTS: Nurses administered the Brief Health Literacy Screen and documented TCNs along 10 domains: caregiver support, transportation, healthcare utilization, high-risk medical comorbidities, medication management, medical devices, functional status, mental health comorbidities, communication, and financial resources.

RESULTS: Among the 384 patients analyzed, 113 (29%) had inadequate health literacy. Patients with inadequate health literacy had needs in more TCN domains (mean = 5.29 vs 4.36; $P < 0.001$). In unadjusted analysis, patients with inadequate health literacy were significantly more likely to have TCNs in 7 out of the 10 domains. In multivariate analyses, inadequate health literacy remained significantly associated with inadequate caregiver support (odds ratio [OR], 2.61; 95% confidence interval [CI], 1.37-4.99) and transportation barriers (OR, 1.69; 95% CI, 1.04-2.76).

CONCLUSIONS: Among hospitalized patients, inadequate health literacy is prevalent and independently associated with other needs that place patients at a higher risk of adverse outcomes, such as hospital readmission. Screening for inadequate health literacy and associated needs may enable hospitals to address these barriers and improve postdischarge outcomes. *Journal of Hospital Medicine* 2017;12: 918-924. Published online first September 20, 2017. © 2017 Society of Hospital Medicine

A special concern since the institution of hospital readmission penalties[1] is the transitions in care of a patient from one care setting to another, often at hospital discharge. Burke et al.[2] proposed a framework for an ideal transition in care (ITC) to study and improve transitions from the hospital to home. The features in the ITC were identified based upon their inclusion in the interventions that improved discharge outcomes.[3-5] Inspired by the ITC and other patient risk tools,[6] we identified 10 domains of transitional care needs ([TCN] specified below), which we define as patient-centered risk factors that should be addressed to foster a safe and effective transition in care.[7]

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One particularly important risk factor in patient self-management at transition points is health literacy, a patient's ability to obtain, understand, and use basic health information and services. Low health literacy affects approximately 26% to 36% of adults in the United States.[8,9] Health literacy is associated with many factors that may affect successful navigation of care transitions, including doctor-patient communication,[10,11] understanding of the medication regimen,[12] and self-management.[13-15] Research has also demonstrated an association between low health literacy and poor outcomes after hospital discharge, including medication errors,[16] 30-day hospital readmission,[17] and mortality.[18] Transitional care initiatives have begun to incorporate health literacy into patient risk assessments[6] and provide specific attention to low health literacy in interventions to reduce adverse drug events and readmission.[4,19] Training programs for medical students and nurses advise teaching skills in health literacy as part of fostering effective transitions in care.[20,21]

Although low health literacy is generally recognized as a barrier to patient education and self-management, little is known about whether patients with low health literacy

are more likely to have other risk factors that could further increase their risk for poor transitions in care. A better understanding of associated risks would inform and improve patient care. We hypothesized that TCNs are more common among patients with low health literacy, as compared with those with adequate health literacy. We also aimed to describe the relationship between low health literacy and specific TCNs in order to guide clinical care and future interventions.

METHODS

Setting

The present study is a cross-sectional analysis of data from a quality improvement (QI) intervention that was performed at Vanderbilt University Medical Center, a tertiary care facility in Nashville, Tennessee. The QI intervention, My Health Team (MHT), was funded by the Centers for Medicare and Medicaid Services Innovation Award program. The overall MHT program included outpatient care coordination for chronic disease management as well as a transitional care program that was designed to reduce hospital readmission. The latter included an inpatient needs assessment (which provided data for the present analysis), inpatient intervention, and postdischarge phone follow-up. The MHT initiative was reviewed by the institutional review board (IRB), which deemed it a QI program and granted a waiver of informed consent. The present secondary data analysis was reviewed and approved by the IRB.

Sample

Patients were identified for inclusion in the MHT transitions of care program if the presenting problem for hospital admission was pneumonia, chronic obstructive pulmonary disease (COPD) exacerbation, or decompensated heart failure, as determined by the review of clinical documentation by nurse transition care coordinators (TCCs). Adults over the age of 18 years were eligible, though priority was given to patients aged 65 years or older. This study includes the first inpatient encounter between June 2013 and December 31, 2014, for patients having a completed needs assessment and documentation of health literacy data in the medical record.

Data Collection

TCN assessment was developed from published patient risk tools and the ITC framework.[2,6,22] The assessment has 10 domains composed of 49 individual items as follows: (1) caregiver support (caregiver support not sufficient for patient needs), (2) transportation (relies on public or others for transportation and misses medical care because of transportation), (3) health care utilization (no primary care physician, unplanned hospitalization in the last year, emergency department [ED] visit in the last 6 months, or home health services in the last 60 days), (4) high-risk medical comorbidities (malnutrition or body mass index<18.5, renal failure, chronic pain, diabetes, heart failure, COPD, or stroke), (5) medication management provider or caregiver concern (cannot provide medication list, >10 preadmission medications, high-risk medications [eg, insulin, warfarin], poor medication understanding, or adherence issue identified), (6) medical devices (vascular access, urinary catheter, wounds, or home supplemental oxygen), (7) functional status (weakness of extremities, limited extremity range of motion, difficulty with mobility, falls at home, or activities of daily living challenges), (8) mental health comorbidities (over the past month has felt down, depressed, or hopeless or over the past month has felt little interest or pleasure in doing things, high-risk alcohol use, or high-risk substance use), (9) communication (limited English proficiency or at risk for limited health literacy), and (10) financial resources (no health insurance, skips or rations medicines because of cost, misses medical care because of cost, or misses medical care because of job).

The 49 items of the TCN assessment were documented as being present or absent by nurse TCCs at the time patients were enrolled in the transitional care program, based on patient and family interview and chart review, and the items were later extracted for analysis. Patients were determined to have a domain-level need if they reported a need on any individual item within that domain, resulting in a binary score (any need present, absent) for each of the 10 TCN domains.

Health literacy was assessed by using the Brief Health Literacy Screen (BHLS), which is administered routinely by nurses at hospital intake and documented in the medical record, with completion rates of approximately 90%.[23] The BHLS is a 3-question subjective health literacy assessment (scoring range 3-15) that has been validated against longer objective measures[24] and shown to predict disease control and mortality.[18,25] To improve the stability of scores (for patients who completed the BHLS more than once because of repeat hospitalizations) and to reduce missing values, we calculated the patient's mean BHLS score for assessments obtained between January 1, 2013, and December 31, 2014. Patients were then categorized as having inadequate health literacy (BHLS ≤ 9) or adequate health literacy (BHLS > 9).[18,25] Demographic information was extracted from patient records and included age, sex (male/female), marital status (married/without a partner), race (white/nonwhite), and years of education. Income level and primary language were not available for analysis.

Statistical Analysis

Patient characteristics and TCNs were summarized by using the frequency and percentages for categorical variables and the mean and standard deviation (SD) for continuous variables. We compared patient characteristics (age, sex, marital status, race, and education) between health literacy groups (inadequate vs adequate) by using χ^2 or analysis of variance as appropriate. We assessed Pearson correlations among the 10 TCN domains, and we examined differences in reported needs for each of 10 TCN domains by the level of health literacy by using the χ^2 test. Because the TCN domain of com-

TABLE 1. Patient Characteristics Overall and by Health Literacy Level

Characteristic	Overall (N = 384)	Inadequate Health Literacy (N = 113)	AdequateHealth Literacy (N = 271)	*P* Value
Age[a]	66.9 (13.0)	68.6 (13.5)	66.1 (12.7)	.081
Sex				.431
Female	209 (54.4)	58 (51.3)	151 (55.7)	
Male	175 (45.6)	55 (48.7)	120 (44.2)	
Marital status				.031
Married	172 (44.8)	41 (36.6)	131 (48.7)	
Without a partner	209 (54.4)	71 (63.4)	138 (51.3)	
Race				.164
White	291 (75.8)	80 (72.7)	211 (79.3)	
Black	85 (22.1)	30 (27.2)	55 (20.7)	
Education, y[a]	12.6 (2.9)	11.2 (2.9)	13.2 (2.7)	<.001
Health literacy				–
Adequate	271 (70.6)	–	–	
Inadequate	113 (29.4)	–	–	

[a]Values represent mean (standard deviation).

NOTE: values represent N (valid %). Missing or unknown: marital status (N = 3), race (N = 8), and education (N = 6).

munication included low health literacy as one of its items, we excluded this domain from subsequent analyses. We then compared differences in the number of TCNs documented (scoring range 0-9) by using an independent samples Student t test.

Multivariate logistic regression models were then constructed to examine the independent association of inadequate health literacy with 8 TCN domains while controlling for age, sex, marital status, race, and education. Patients with incomplete demographic data were excluded from these models. Additionally, these analyses excluded 2 TCN domains: the communication domain for reasons noted above and the high-risk medical comorbidity domain because it ended up being positive in 98.4% of patients. Statistical significance was set at an alpha of 0.05. All analyses were performed by using SPSS Statistics for Mac, version 23.0 (IBM Corp., Armonk, New York)

RESULTS

A total of 403 unique patients received the needs assessment, and 384 (95.3%) patients had health literacy data available (Table 1). The number of patients with missing or unknown values were 3 for marital status, 8 for race, and 6 for education. The patients had an average age of 66.9 years (SD = 13.0 years). Among the sample, 209 (54%) were female, 172 (45%) were married, and 291 (75.8%) were white. The average years of education was 12.6 (SD = 2.9 years), and 113 (29%) had inadequate health literacy. Patients with inadequate health literacy completed fewer years of schooling (11.2 vs 13.2; $P < 0.001$) and were less likely to be married (37% vs 49%; $P = 0.031$). There was no significant difference in age, sex, or race by level of health literacy.

Patients overall had a mean of 4.6 (SD = 1.8) TCN domains with any need reported. The most common domains were high-risk comorbidity (98%), medication management (76%), and healthcare utilization (76%; Table 2). For most domains, the presence of needs was significantly correlated with the presence of needs in multiple other domains (Table 3). Patients with inadequate health literacy had needs in a greater number of TCN domains (mean = 5.29 vs 4.36; $P < 0.001$).

In unadjusted analysis, patients with inadequate health literacy were significantly more likely to have TCNs in 7 out of the 10 domains (Table 2). These concerns related to caregiver support, transportation, healthcare utilization, presence of a medical device, functional status, mental health comorbidities, and communication. The inadequate and adequate health literacy groups were similar in needs with respect to high-risk comorbidity and finance and borderline nonsignificant for medication management.

In multivariate analyses, 371 patients had complete demographic data and were thus included. After adjustment for age, sex, marital status, race, and education, inadequate health literacy remained significantly associated with reported needs in 2 transitional care domains: inadequate caregiver support (odds ratio [OR], 2.61; 95% confidence interval [CI], 1.37-5.00) and transportation barriers (OR, 1.69; 95% CI, 1.04-2.76; Figure). Other domains approached statistical significance: medical devices (OR, 1.56; 95% CI, 0.96-2.54), functional status (OR, 1.67; 95% CI, 1.00-2.74), and mental health comorbidities (OR, 1.60; 95% CI, 0.98-2.62).

Older age was independently associated with more needs related to medical devices (OR, 1.02; 95% CI, 1.00-1.04), functional status (OR, 1.03; 95% CI, 1.02-1.05), and fewer financial needs (OR, 0.93; 95% CI, 0.91-0.96). Being married or living with a partner was associated with fewer needs related to caregiver support (OR, 0.37; 95% CI, 0.19-0.75)

TABLE 2. Transitional Care Needs Overall and by Health Literacy Level

Domain	Needs Assessment Domain	Total Patients with Need (N = 384)	Inadequate Health Literacy (N = 113)	Adequate Health Literacy (N = 271)	*P* Value
1	Caregiver support	53 (13.8)	26 (23.0)	27 (10.0)	.001
2	Transportation	187 (48.7)	70 (61.9)	117 (43.2)	.001
3	Healthcare utilization	294 (76.6)	96 (85.0)	198 (73.1)	.012
4	High-risk comorbidity	378 (98.4)	110 (97.3)	268 (98.9)	.265
5	Medication management	293 (76.3)	93 (82.3)	200 (73.8)	.074
6	Medical device	178 (46.4)	63 (55.8)	115 (42.4)	.017
7	Functional status	211 (54.9)	73 (64.6)	138 (50.9)	.014
8	Mental health comorbidity	137 (35.7)	50 (44.2)	87 (32.1)	.024
9	Communication	83 (21.6)	46 (40.7)	37 (13.7)	<.001
10	Finance	49 (12.8)	17 (15.0)	32 (11.8)	.386

NOTE: Values represent N (%). Patients were considered to have a need in a particular domain if they had a need on any item belonging to that domain (see Box).

TABLE 3. Correlation Among Transitional Care Needs

Domain	Caregiver Support	Transportation	Healthcare Utilization	High-Risk Comorbidity	Medication Management	Medical Device	Functional Status	Mental Health Comorbidity	Communication	Finance
Caregiver support	1									
Transportation	.245[a]	1								
Healthcare utilization	.132[a]	.158[a]	1							
High-risk comorbidity	−.010	.081	−.020	1						
Medication management	.170[a]	.163[a]	.096	.078	1					
Medical device	.097	.118[b]	.120[b]	.075	.051	1				
Functional status	.226[a]	.296[a]	.129[b]	.013	.111[b]	.170[a]	1			
Mental health comorbidity	.143[a]	.188[a]	.091	−.125[b]	.121[b]	.114[b]	.150[a]	1		
Communication	.303[a]	.298[a]	.156[a]	.015	.129[b]	.019	.119[b]	.032	1	
Finance	.164[a]	.096	.119[b]	−.078	−.007	−.058	−.015	.122[b]	.140[a]	1

[a]P < .01.
[b]P < .05.

and more device-related needs (OR, 1.60; 95% CI, 1.03-2.49). A higher level of education was associated with fewer transportation needs (OR, 0.89; 95% CI, 0.82-0.97).

DISCUSSION

A structured patient risk factor assessment derived from literature was used to record TCNs in preparation for hospital discharge. On average, patients had needs in about half of the TCN domains (4.6 of 9). The most common areas identified were related to the presence of high-risk comorbidities (98.4%), frequent or prior healthcare utilization (76.6%), medication management (76.3%), functional status (54.9%), and transportation (48.7%). Many of the TCNs were significantly correlated with one another. The prevalence of these needs highlights the importance of using a structured assessment to identify patient concerns so that they may be addressed through discharge planning and follow-up. In addition, using a standardized TCN instrument based on a framework for ITC promotes further research in understanding patient needs and in developing personalized interventions to address them.

As hypothesized, we found that TCNs were more common in patients with inadequate health literacy. After adjustment for demographic factors, inadequate health literacy was sig-

nificantly associated with transportation barriers and inadequate caregiver support. Analyses also suggested a relationship with needs related to medical devices, functional status, and mental health comorbidities. A review of the literature substantiates a link between inadequate health literacy and these needs and also suggests solutions to address these barriers.

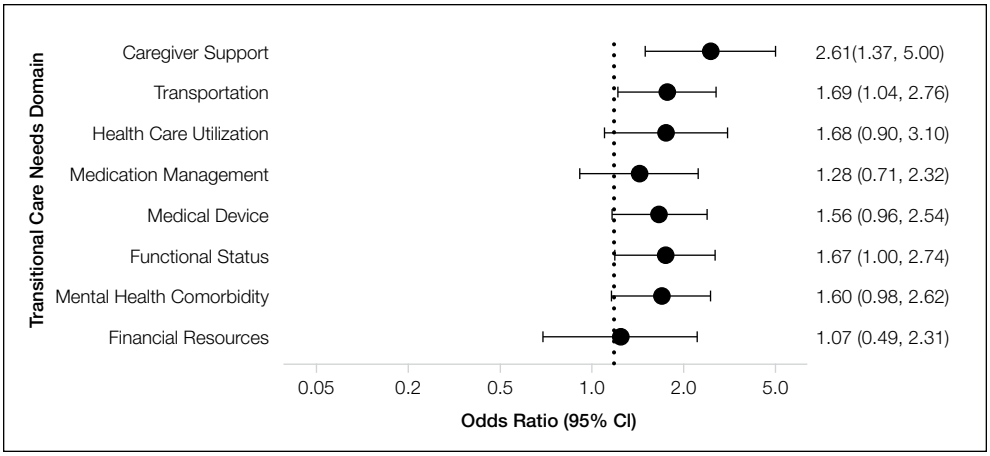

FIG. Odds of transitional care need increase for patients with inadequate health versus adequate health literacy.

NOTE: Abbreviations: CI, confidence interval; HL, health literacy; OR, odds ratio.

The association with inadequate caregiver support is concerning because there is often a high degree of reliance on caregivers at transitions in care.[3-5] Caregivers are routinely called upon to provide assistance with activities that may be difficult for patients with low health literacy, including medication adherence, provider communication, and self-care activities.[26,27] Our finding that patients with inadequate health literacy are more likely to have inadequate caregiver support indicates additional vulnerability. This may be because of the absence of a caregiver, or in many cases, the presence of a caregiver who is underprepared to assist with care. Prior research has shown that when caregivers are present, up to 33% have low health literacy, even when they are paid nonfamilial caregivers.[26,28] Other studies have noted the inadequacy of information and patient training for caregivers.[29,30] Transitional care programs to improve caregiver understanding have been developed[31] and have been demonstrated to lower rehospitalization and ED visits.[32]

Patients with inadequate health literacy were also more likely to have transportation barriers. Lack of transportation has been recorded as a factor in early hospital readmission in patients with chronic disease,[33] and it has been shown to have a negative effect on a variety of health outcomes.[34] A likely link between readmission and lack of transportation is poor follow-up care. Wheeler et al.[35] found that 59% of patients expected difficulty keeping postdischarge appointments because of transportation needs. Instead of expecting patients to navigate their own transportation, the Agency for Healthcare Research and Quality recommends identifying community resources for patients with low health literacy.[36]

In this sample, inadequate health literacy also had near significant associations with TCNs in the use of medical devices, lower functional status, and mental health comorbidities. The use of a medical device, such as home oxygen, is a risk factor for readmission,[37] and early reports suggest that interventions, including education related to home oxygen use, can dramatically reduce these readmissions.[38] Lower functional capacity and faster functional decline are associated with inadequate health literacy,[39] which may have to do with the inability to appropriately utilize health resources.[40] If so, structured discharge planning could alleviate the known connection between functional impairment and hospital readmissions.[41] A relationship between low health literacy and depression has been demonstrated repeatedly,[42] with worsened symptoms in those with addiction.[43] As has been shown in other domains where health literacy is a factor, literacy-focused interventions provide greater benefits to these depressed patients.[44]

The TCN assessment worked well overall, but certain domains proved less valuable and could be removed in the future. First, it was not useful to separately identify communication barriers, because doing so did not add to information beyond the measurement of health literacy. Second, high-risk comorbidities were ubiquitous within the sample and therefore unhelpful for group comparisons. In hindsight, this is unsurprising because the sample was comprised primarily of elderly patients admitted to medical services. Still, in a younger population or a surgical setting, identifying patients with high-risk medical comorbidities may be more useful.

We acknowledge several limitations of this study. First, the study was performed at a single center, and the TCN assessments were conducted by a small number of registered nurses who received training. Therefore, the results may not generalize to the profile of patient needs at other settings, and the instrument may perform differently when scaled across an organization. Second, the needs assessment was developed for this QI initiative and did not undergo formal validation, although it was developed from published frameworks and similar assessments. Third, for the measure of health literacy, we relied on data collected by nurses as part of their normal workflow. As is often the case with data collected during routine care, the scores are imperfect,[45] but they have proven to be a valuable and valid indicator of health literacy in our previous research.[18,24,25,46] Fourth, we chose to declare a domain as positive if any item in that domain was positive and to perform a domain-level analysis (for greater clarity). We did not take into account the variable number of items within each domain or attempt to grade their severity, as this would be a subjective exercise and impractical in

the discharge planning process. Finally, we were unable to address associations among socioeconomic status,[47] primary language,[48] and health literacy, because relevant data were not available for this analysis.

CONCLUSION

In this sample of hospitalized patients who were administered a structured needs assessment, patients commonly had needs that placed them at a higher risk of adverse outcomes, such as hospital readmission. Patients with low health literacy had more TCNs that extended beyond the areas that we normally associate with low health literacy, namely patient education and self-management. Healthcare professionals should be aware of the greater likelihood of transportation barriers and inadequate caregiver support among patients with low health literacy. Screening for health literacy and TCN at admission or as part of the discharge planning process will elevate such risks, better positioning clinicians and hospitals to address them as a part of the efforts to ensure a quality transition of care.

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Trends in Hospitalization for Opioid Overdose among Rural Compared to Urban Residents of the United States, 2007-2014

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Hospitalizations and deaths due to opioid overdose have increased over the last decades. We used data from the National Inpatient Sample and the American Community Survey to describe trends in hospitalization rates for opioid overdose among rural residents compared with urban residents in the United States from 2007 to 2014. Hospitalization rates for heroin overdose increased in all years and were higher in urban residents compared with rural residents (5.5 per 100,000 in large urban populations vs 2.1 per 100,000 in rural populations in 2014). In contrast, hospitalization rates for prescription opioid overdose were 20% to 30% higher in rural populations compared with large urban populations between 2007 and 2012, before declining in rural populations in 2013 and 2014. The proportion of rural patients admitted for overdose who are cared for in urban hospitals increased from 23.1% in 2007 to 41.2% in 2014. These trends are clinically relevant as rural patients and urban patients may have different discharge needs. *Journal of Hospital Medicine* 2017;12:925-929. Published online first August 23, 2017. © 2017 Society of Hospital Medicine

BACKGROUND

Hospitalizations and deaths due to opioid overdose have increased over the last decades, straining the healthcare system and generating substantial costs.[1-4] Hospitalizations for overdose also represent opportunities to intervene in the opioid epidemic by linking patients to resources for nonpharmacologic chronic pain treatment resources or substance use treatment services during and following hospitalization.[5,6] Studies of trends in the frequency of hospitalizations for opioid overdose in rural and urban areas are necessary to inform planning and resource allocation for inpatient and postdischarge transitional care.

Nonmedical opioid use and opioid-related deaths and injuries appear to be higher in rural areas.[7,8] As well, rural areas tend to be more under-resourced in terms of substance abuse treatment and chronic pain specialty services.[9,10] Contemporaneous with rising opioid use has been an increasing trend of rural hospital closures.[11] This may compound the impact of opioid-related hospitalizations on remaining rural hospitals and lead to increasing reliance on more distant, urban hospitals to treat and discharge patients with overdoses. Rural residents who are admitted or transferred to urban hospitals may face distinct challenges. Similarly, urban hospitals may struggle during discharge planning to link patients to substance use treatment services in less familiar rural communities.

To better define the differential impact of the opioid epidemic based on patient rurality, we described trends in rates of hospitalization for opioid overdose among rural residents compared with urban residents of the United States. We separated hospitalizations into those due to overdose of prescription opioids, and those related to heroin. Among rural residents who overdosed on opioids, we examined trends in admission to rural versus urban hospitals.

METHODS

Data Source

We analyzed data from the National Inpatient Sample (NIS) from 2007 to 2014, developed by the Healthcare Cost and Utilization Project (HCUP). NIS yields nationally representative estimates of inpatient stays in community hospitals in the United States, regardless of payer. Rehabilitation and long-term care hospital stays are excluded. Prior to 2012, NIS included data on all discharges from a 20% sample of hospitals. Beginning in 2012, NIS included a 20% sample of discharges from all HCUP hospitals. We used weights to estimate trends in the total number of hospital admissions for heroin and prescription opioid overdose (POD) in the US by year, accounting for the change in sampling design in 2012 as recommended by HCUP. Standard errors for estimates accounted for the complex sample design.[12] We used data from the US Census American Community Survey on the US population in rural versus urban areas for each year to calculate overdose admission rates per 100,000 residents.

Target Population

Following methods applied in previous analyses of NIS data,[1,4,13] we identified hospitalizations for heroin or POD

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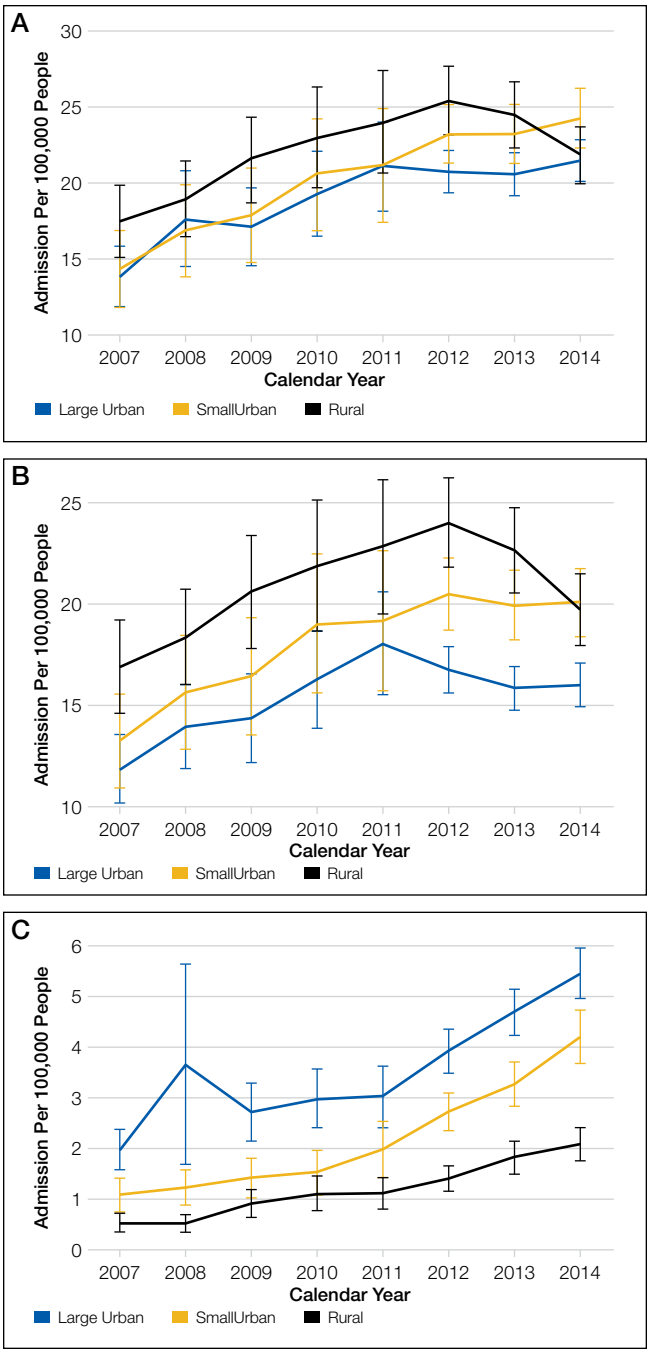

FIG 1. (A) Total opiod overdose admission trends by rurality, 2007-2014. (B) POD admission trends by rurality, 2007-2014. (C) HOD admission trends by rurality, 2007-2014.

NOTE: Abbreviations: HOD, heroin overdose; POD, prescription opioid overdose.

based on *International Classification of Diseases 9th Clinical Modification* (ICD-9-CM) codes. We use the lay term "overdose" to refer to admissions defined by the medical term "poisoning." In each year between 2007 and 2013, we determined the total number of admissions due to heroin or prescription opioid by considering ICD-9CM codes 965.00 (poisoning by opium), 965.01 (poisoning by heroin), or 965.09 (poisoning by other opiates and related narcotics); or E code E850.0 (accidental poisoning by heroin); or 850.2 (accidental poisoning by opiates and related narcotics) in any position. We defined admissions for heroin overdose (HOD) as 965.01 or E code of E850.0 in any position, and admissions for POD not related to heroin as 965.00, or 965.09, or E code 850.2 in any position excluding admissions with any heroin-related code 965.01 or E code E850.0 or E935.0 (adverse effects of heroin). We excluded hospitalizations in which a patient was transferred out to another acute care facility to avoid duplicate counting.

Analysis

We classified these admissions based on patient residence in a rural versus urban area. NIS contained a variable representing rural versus urban patient residence based on the county-level framework maintained by the Office of Management and Budget, supplemented with information from Urban Influence Codes developed by the Economic Research Service of the US Department of Agriculture.[14] We used this information to create a 3-level variable for patient residence: rural (ie, nonmetropolitan areas with a population less than 50,000), small metropolitan (ie, metropolitan areas with a population of 50,000–999,999), and large metropolitan (ie, metropolitan areas with a population of 1,000,000 or greater). We explored further separating categories (eg, breaking rural into micropolitan population centers and other), but this did not further discriminate admission rates.

For each study year, we combined results on overdose admissions with data on the total populations for each of these 3 areas in the US based on American Community Survey data in order to calculate rates of each type of admission per 100,000 persons. To compare pharmaceutical opioids to heroin, we examined pharmaceutical-only overdoses and heroin-only overdoses. We also examined patient age, sex, race and/or ethnicity, and whether they were admitted to a rural or urban hospital based on the hospital location code contained in NIS, and compared these characteristics across residence categories; we presented characteristics for years 2012 to 2014 combined as recent characteristics are most relevant.

The authors had full access to and take full responsibility for the integrity of the data. All analyses were conducted using SAS statistical software version 9.2 (SAS Institute, Cary, North Carolina). The study was reviewed by the University of Iowa Institutional Review Board and the Iowa City Veterans Affairs Healthcare System Research and Development Committee and was judged human subject research exempt.

RESULTS

Characteristics of Patients with Opioids Overdose Admissions

An estimated 43,935 individuals experienced an opioid overdose-related hospitalization in the US in 2007 and 71,280 in 2014. Characteristics of admitted patients varied by residence: a greater proportion of rural patients in older age categories were female (57.3%) and were Caucasian (90.1%; Table). The overwhelming majority of large and small urban

TABLE. Characteristics of Patients Hospitalized for Opioid- or Heroin-Related Causes, 2012-2014

Characteristics	Patient Residence		
	Large Urban	Small Urban	Rural
	N (%)	N (%)	N (%)
Age, years			
≤25	14,100 (13.13%)	8345 (12.59%)	3835 (10.48%)
26-45	33,995 (31.66%)	20,475 (30.89%)	11,480 (31.36%)
46-65	44,245 (41.21%)	27,585 (41.62%)	15,565 (42.52%)
>65	15,025 (13.99%)	9875 (14.90%)	5725 (15.64%)
Female	55,215 (51.36%)	7368 (55.52%)	20,995 (57.31%)
Race			
Caucasian	76,560 (74.65%)	52,210 (83.70%)	30,455 (90.13%)
African American	13,350 (13.02%)	4165 (6.68%)	1055 (2.12%)
Hispanic	8505 (8.29%)	4180 (6.70%)	1000 (2.96%)
Other	4140 (4.04%)	1825 (2.92%)	1280 (3.79%)
Admitted to an urban hospital	106,855 (99.35%)	65,230 (98.28%)	13,645 (37.24%)
Type of admission			
POD	83,370 (77.53%)	56,800 (85.59%)	33,930 (92.60%)
HOD	24,165 (22.47%)	9560 (14.41%)	2710 (7.40%)
Admitted as transfer from another hospital	3755 (3.52%)	2670 (4.04%)	5225 (14.34%)
Died during hospitalization	3605 (3.36%)	2045 (3.08%)	850 (2.32%)

NOTE: For comparisons across residence categories $P < .0001$. Abbreviations: HOD, heroin overdose; POD, prescription opioid overdose.

residence patients were admitted to urban hospitals (99.4% and 98.3%, respectively) compared with 37.2% of rural patients. The proportion of total opioid overdose admissions due to prescription opioids was higher among rural than urban residents (92.6% for rural residents, 85.6% small urban, and 77.5% large urban). The proportion of large urban (3.5%) and small urban (4.0%) patients admitted as hospital transfers was small in comparison to 14.3% of rural patients. The proportion of admitted patients who died in the hospital varied by patient residence (Table).

Opioid Overdose Admission Trends by Patient Residence

Opioid admission rates increased between 2007 and 2011 in all groups; trends then diverged (panel A in Figure 1). In 2007, 13.8 (95% confidence interval [CI], 11.9-15.8) people per 100,000 had opioid overdose admissions among large urban residents, compared with 17.5 (95% CI, 15.1-19.8) among rural residents. By 2014, these rates were 21.5 (95% CI, 20.1-22.9) among urban residents, and 21.8 (95% CI, 19.9-23.7) among rural residents. Rates for POD admissions followed a similar pattern. POD admission rates rose in all groups until 2011 and then started to decline among large urban residents while continuing to increase among small urban residents. Among rural residents, POD admission rates peaked in 2012 and then declined in 2013 and again in 2014 (panel B in Figure 1). Rates for HOD admissions were highest among urban residents during each study year, increasing from 2.0 per 100,000 residents (95% CI, 1.6-2.4) in 2007 to 5.5 (95% CI, 5.0-6.0) in 2014. Among rural residents, the rate increased from 0.5 (95% CI, 0.3-0.7) to 2.1 (95% CI, 1.8-2.4) over the same time period (panel C in Figure 1).

Opioid Overdose Admissions among Rural Residents to Urban and Rural Hospitals

The estimated total number of patients residing in rural areas who were admitted with opioid overdose to rural hospitals decreased from 6731 in 2007 to 6550 in 2014. Rural patients admitted to urban hospitals increased from 2014 to 4595 over that same time period; the proportion of rural patients admitted to urban hospitals increased from 23.1% in 2007 to 41.2% in 2014 (Figure 2).

DISCUSSION

Up until 2013, hospital admissions for POD occurred at a higher rate among rural US residents than their urban counterparts. Rates of admission of rural residents for POD have decreased since 2012; a similar trend was not observed among urban residents. Over this same interval, rates of hospitalization for HOD among rural residents continued to increase.

Hospital admission is one sequela of harm related to opioid use: patients experiencing opioid overdose or poisoning may be treated by emergency responders, in emergency

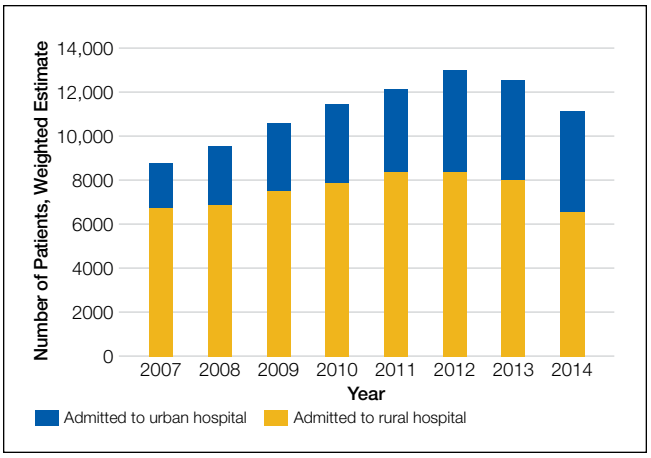

FIG 2. An increasing proportion of rural patients were admitted to urban hospitals, 2007-2014.

departments or on observation status, or may die prior to receiving medical attention or presenting for hospital admission. Factors potentially driving the trends described include patient behaviors, opioid availability, prehospital and hospital treatment practices, and hospital closures. Recent work describing increased opioid overdose deaths[15] and high opioid-related mortality in rural areas[16] suggests that overdose admission and death rates may be divergent. Changing policies governing naloxone availability and administration[17] and ongoing trends in rural hospital closures[11] may differentially affect the rates at which rural and urban residents who experience overdose are hospitalized.

Hospital admission also represents a potential point-of-entry into subsequent treatment to reduce risk of further opioid-related harms. Decreasing rates of admission could conceivably result in decreasing opportunities to engage in care. Rural and urban patient populations are distinct; an understanding of these distinctions may help to inform how hospitals structure inpatient treatment and discharge planning for overdose patients. Overdose is likely to suggest either an underlying substance use disorder or a chronic pain condition requiring risky levels of prescribed opioids, and therefore is indicative of a persistent condition requiring follow-up care. Thus, there is a need for treatment models and transition care systems aimed at providing adequate care for these populations both in the acute setting and following hospital discharge. The increasing proportion of rural residents admitted to urban hospitals with opioid overdoses highlights the need for urban hospitals to develop relationships with substance use treatment and chronic pain services in rural areas to facilitate linkage to treatment at discharge.

Limitations of this study include the use of ICD-9-CM codes from administrative data to identify hospitalizations for prescription opioid and heroin overdose. While we have used the common term "overdose," opioid adverse events may occasion hospitalization in the absence of overdose or as a result of patients taking opioid doses in the quantity prescribed. As such, the term overdose does not necessarily imply the behavior of intentional or unintentional excess use. Additionally, coding depends on providers diagnosing and documenting conditions and may be subject to secular trends independent of overdose prevalence. We included data through 2014, the most recent year of data available at time of analyses.

CONCLUSION

Hospitals can expect to continue to treat patients presenting with opioid overdose. As overdose is likely to suggest either an underlying substance use disorder or a chronic pain condition requiring risky levels of prescribed opioids, there will be a need for treatment models and transition care systems to provide adequate care for these populations both in the acute setting and following hospital discharge. Rates of admission among rural residents declined during the last 2 years of the study period, and rural residents who were hospitalized for opioid overdose were increasingly receiving care in urban hospitals. While factors driving these trends remain to be elucidated, the trends themselves highlight a need to consider the differential challenges facing rural and urban residents who overdose. Access to resources and transportation and other challenges are distinct in urban and rural areas, with rural areas being less likely to have providers in addiction medicine, psychiatry, and pain specialties. Efforts to address these challenges will need to explore models and solutions applicable to differentially resourced hospital and postdischarge settings.

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Do Bedside Visual Tools Improve Patient and Caregiver Satisfaction? A Systematic Review of the Literature

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BACKGROUND: Although common, the impact of low-cost bedside visual tools, such as whiteboards, on patient care is unclear.

PURPOSE: To systematically review the literature and assess the influence of bedside visual tools on patient satisfaction.

DATA SOURCES: Medline, Embase, SCOPUS, Web of Science, CINAHL, and CENTRAL.

DATA EXTRACTION: Studies of adult or pediatric hospitalized patients reporting physician identification, understanding of provider roles, patient–provider communication, and satisfaction with care from the use of visual tools were included. Outcomes were categorized as positive, negative, or neutral based on survey responses for identification, communication, and satisfaction. Two reviewers screened studies, extracted data, and assessed the risk of study bias.

DATA SYNTHESIS: Sixteen studies met the inclusion criteria. Visual tools included whiteboards (n = 4), physician pictures (n = 7), whiteboard and picture (n = 1), electronic medical record-based patient portals (n = 3), and formatted notepads (n = 1). Tools improved patients' identification of providers (13/13 studies). The impact on understanding the providers' roles was largely positive (8/10 studies). Visual tools improved patient–provider communication (4/5 studies) and satisfaction (6/8 studies). In adults, satisfaction varied between positive with the use of whiteboards (2/5 studies) and neutral with pictures (1/5 studies). Satisfaction related to pictures in pediatric patients was either positive (1/3 studies) or neutral (1/3 studies). Differences in tool format (individual pictures vs handouts with pictures of all providers) and study design (randomized vs cohort) may explain variable outcomes.

CONCLUSION: The use of bedside visual tools appears to improve patient recognition of providers and patient–provider communication. Future studies that include better design and outcome assessment are necessary before widespread use can be recommended. *Journal of Hospital Medicine* 2017;12:930-936. © 2017 Society of Hospital Medicine

Patient satisfaction with medical care during hospitalization is a common quality metric.[1,2] Studies showing higher patient satisfaction have reported lower 30-day hospital readmissions[3] and improved overall health.[4,5] Conversely, communication failures are associated with dissatisfaction among hospitalized patients and adverse outcomes.[6,7] A lack of familiarity with hospital providers weakens collaborative decision making and prevents high-quality patient care.[8,9]

Bedside visual tools, such as whiteboards and pictures of medical staff, have been widely used to enhance communication between patients, families, and providers.[10,11] Results of studies evaluating these tools are varied. For example, 1 study found that 98% of patients were better able to identify physicians when their names were written on whiteboards.[12] Yet in another, only 21.1% of patients were more likely to correctly identify ≥1 physicians using pictures.[13] Thus, despite widespread use,[11] whether visual tools improve patient satisfaction and patient care more broadly remains unclear.[14,15]

We performed a systematic review to answer the following 3 questions: first, what is the effect of visual tools on outcomes (ie, provider identification, understanding of providers' roles, patient–provider communication, and satisfaction); second, does impact vary by type of visual tool (eg, whiteboards vs pictures of providers); and third, what factors (eg, study design, patient population) are associated with provider identification, communication, and patient satisfaction?

METHODS

Search Strategy

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis when performing this review.[16] A research librarian (WT) conducted serial searches for studies reporting the use of bedside visual tools for hospitalized patients in Medline (via OVID), Embase, SCOPUS, Web of Science, CINAHL, and Cochrane DSR and CENTRAL. Controlled vocabularies (ie, Medical Subject Headings terms) were used to identify synonyms for visual tools of interest. Additional studies were identified manually through bibliographies and meeting abstracts. No study design, publication date, or language restrictions were placed on the

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search, which was conducted between April 2016 and February 2017 (see supplementary Appendix A).

Study Selection

Two reviewers (AG and KT) independently assessed study eligibility; discrepancies were resolved by a third reviewer (VC). We included all adult or pediatric English language studies in which the effect of visual tool(s) on patient outcomes was reported. Visual tools were defined as the bedside display of information or an instrument given to patients to convey information regarding providers or medical care. Patient-reported outcomes included the following: (a) physician identification, (b) understanding of provider roles, (c) patient–provider communication, and (d) patient satisfaction with care. Providers were defined as physicians, residents, interns, medical students, nurse practitioners, or nurses. We excluded studies that were not original research (eg, conference abstracts, not peer reviewed), reported qualitative data without quantitative outcomes, or did not include a bedside visual tool. Given our interest in hospitalized general medicine patients, studies conducted in emergency departments, surgical units, obstetrics and gynecology wards, and intensive care units were excluded.

Data Extraction and Analysis

Data were extracted independently and in duplicate from all studies by using a template adapted from the Cochrane Collaboration.[17] For all studies, we abstracted study design, type of visual tool (eg, whiteboards), unit setting (eg, medical), population studied (eg, adult vs pediatric), and outcomes reported (ie, physician identification, understanding of provider roles, communication, and satisfaction with care). Reviewers independently assessed and categorized the impact of tools on reported outcomes.

To standardize and compare outcomes across studies, the following were used to denote a positive association between visual tools and relevant outcomes: a greater number of physicians correctly identified by name/picture or title/role; the use of terms such as "high," "agreed," or "significant" on surveys; or ≥4 Likert scores for domains of identification, understanding of roles, communication, and satisfaction with care. Conversely, the inability to identify providers compared to the control/baseline; poor recall of titles/roles; lower Likert-scale scores (ie, ≤2); or survey terms such as "poor," "disagreed," or "insignificant" were considered to connote negative impact. Studies in which Likert scores were rated neither high nor low (ie, 3), or in which patients neither agreed nor disagreed on value were considered neutral.

Owing to clinical heterogeneity within studies, meta-analyses were not performed. Descriptive statistics were used to describe study outcomes. A priori[18] studies were evaluated according to the following categories: design (eg, randomized vs observational), outcomes (eg, patient satisfaction), intervention (type of visual tool), and patient population (adult or pediatric). Because pediatric patients have underdeveloped communication skills and include parents and/or guardians, data from pediatric studies were tabulated and reported separately to those from adult studies.

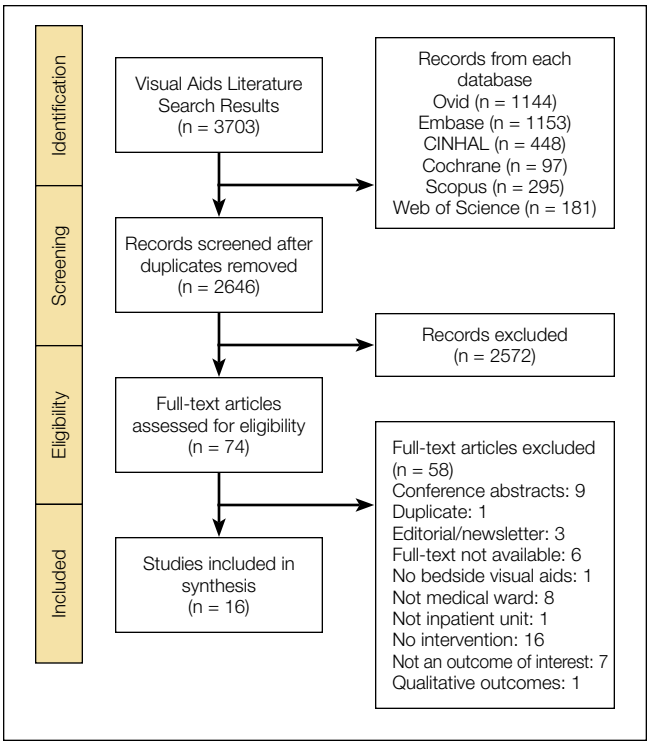

FIG 1. Study flow diagram.

Quality Assessment

As recommended by the Cochrane Collaboration, 2 reviewers (AG, KT) assessed the risk of study bias by using the Downs and Black Scale.[17,19] Discrepancies in assessment were resolved by a third reviewer (VC). This instrument uses a point-based system to estimate the quality of a study by rating domains such as internal and external validity, bias, and confounding. In keeping with prior systematic reviews,[18,20,21] studies with a score of ≥18 were considered high quality. Interrater agreement for the adjudication of study quality was calculated using the Cohen κ statistic.

RESULTS

After the removal of duplicates, 2646 articles were retrieved and 2572 were excluded at the title and/or abstract level. Following a full-text review of 74 articles, 16 studies met the inclusion criteria (Figure 1). Fifteen studies reported quantitative outcomes,[12-14,22-33] and 1 was a mixed-methods study, of which only the quantitative outcomes were included.[15] Study designs included prospective cohort (n = 7),[12,13,23,25,28,30,31] randomized controlled trials (n = 3),[14,27,33] pre-post (n = 2),[22,29] cross-sectional survey (n = 2),[24,32] and mixed methods (n = 1).[15] Interventions studied included pictures (n = 7),[13-15,23,27,31,33] whiteboards (n = 4),[12,22,29,30] electronic medical record-based patient portals (n = 3),[26,28,32] whiteboards and pictures (n = 1),[25] and formatted notepads (n = 1).[24] Eleven studies were conducted on adult units[12-14,22-24,26,27,29,30,33] and

TABLE. Characteristics of Included Studies

Author (Year)	Population Studied	Study Design	Sample Size[a]	Visual Tool Tested	Outcomes Reported			
					Provider Identification	Understanding of Roles	Patient–Provider Communication	Patient Satisfaction
Appel L et al. (2015)[14]	Adult	Randomized Controlled Trial	126	Pictures	Positive	Neutral	Neutral	NA
Arora V et al. (2009)[13]	Adult	Prospective Cohort	857	Pictures	Positive	Negative[b]	NA	NA
Brener et al. (2016)[33]	Adult	Randomized Controlled Trial	111	Pictures	Positive	Positive	NA	Positive
Carlin et al. (2008)[22]	Adult	Pre-Post Cohort	40	Whiteboards	Positive	Positive	NA	Positive
Dudas et al. (2010)[15]	Pediatric	Mixed Methods	49	Pictures	Positive	Positive	NA	Positive
Farberg et al. (2013)[24]	Adult	Cross-Sectional	440	Notepads	NA	NA	Positive	NA
Francis et al. (2001)[23]	Adult	Prospective Cohort	107	Pictures	Positive	NA	NA	Positive
Hayes et al. (2015)[25]	Pediatric	Prospective Cohort	92	Whiteboards+ Pictures	Positive	Positive	NA	NA
Kelly et al. (2017)[32]	Pediatric	Cross-Sectional	296	Patient Portal	NA	NA	Positive	NA
Maniaci et al. (2010)[12]	Adult	Prospective Cohort	96	Whiteboards	Positive	NA	NA	NA
O'Leary et al. (2016)[26]	Adult	Prospective Cohort	100	Patient Portal	Positive	Positive	NA	NA
Simons et al. (2014)[27]	Adult	Randomized Control Trial	66	Pictures	Positive	Positive	NA	Neutral
Singh A. et al. (2016)[28]	Pediatric	Prospective Cohort	59	Patient Portal	Positive	Positive	Positive	Positive
Singh S. et al. (2011)[29]	Adult	Pre-Post Cohort	146[c]	Whiteboards	NA	NA	Positive	NA
Tan et al. (2013)[30]	Adult	Prospective Cohort	56	Whiteboards	Positive	NA	NA	Positive
Unaka et al. (2014)[31]	Pediatric	Prospective Cohort	41	Pictures	Positive	Positive	NA	Neutral

[a]Sample size represents patients and caregivers in the intervention group only.

[b]The study demonstrated a negative association with use of face cards, with fewer patients rating their understanding of physicians' roles as excellent or very good in the intervention period (45.6%) compared to the baseline period (55.3%).

[c]Sample size calculated based on information provided directly by author.

NOTE: NA denotes that the outcome of interest was not measured by the study.

5 on pediatric units.[15,25,28,31,32] (Table). Outcomes reported within studies included (a) provider identification (9 adult, 4 pediatric); (b) understanding of roles (6 adult, 4 pediatric); (c) communication (3 adult, 2 pediatric); and (d) patient satisfaction (5 adult, 3 pediatric). Studies were organized by type of intervention and outcomes reported and stratified by adult versus pediatric patients (Figure 2). Interrater reliability for study abstraction was excellent (Cohen $\kappa = 0.91$).

Measurement of outcomes related to visual tools varied across studies. Patient satisfaction and patient–provider communication were measured using questions from validated instruments, such as the Patient Satisfaction Questionnaire,[15,31] ad hoc surveys,[22,23,30] free text responses,[27,32] or Likert scales,[13,24,26,32] created by authors. Similarly, measurement of provider identification varied and included picture-matching exercises[15,23,31,33] and bedside interviews.[23,26] Understanding of provider roles was assessed using multiple choice question surveys[25] or Likert scales.[13]

The influence of visual tools on provider identification was measured in 13 of 16 studies. In all of these studies, a positive impact of the tool on provider identification was reported.[12-15,22,23,25-28,30,31,33] Patient understanding of providers'

	Pictures	WB	WB +Picture	Notepads	Patient Portal	
Provider Identifiation	5	2			1	Adult
	2	1	1		1	Pediatric
Understanding of Provider Roles	2	1			1	Adult
	1					
	1					
	2		1		1	Pediatric
Patient-Provider Communication	1	1		1		Adult
				1	2	Pediatric
Patient Satisfaction	1					Adult
	2	2				
	1					Pediatric
	1				1	

FIG 2. Heatmap: studies on outcomes of visual tools on provider identification, understanding of provider roles, patient–provider communication, and patient satisfaction with care.

NOTE: In the above Figure, numbers represent total articles, while colors represent net outcomes at the intersection of each row/column (green = positive, red = negative, yellow = neutral, white = outcome not measured by study).
Abbreviation: WBs, whiteboards.

roles was positive in 8 of 10 studies that measured the outcome.[15,22,25-28,31,33] The impact of visual tools on patient–provider communication was positive in 4 of 5 studies. [24,28,29,32] The influence of visual tools on patient satisfaction with care was measured in 8 studies; of these, 6 studies reported a positive impact.[15,22,23,28,30,33]

STUDIES OF ADULT HOSPITALIZED PATIENTS

Eleven studies were conducted on adult hospitalized patients[12-14,22-24,26,27,29,30,33] and included 3 randomized controlled studies.[14,27,33]

Results by Outcomes

Provider Identification

Nine studies measured patients' ability to identify providers with the use of visual aids, and all 9 reported improvements in this outcome. Visual tools used to measure provider identification included pictures (n = 5),[13,14,23,27,33] whiteboards (n = 3),[12,22,30] and patient portals (n = 1).[26] Within studies that used pictures, individual pictures (n = 2)[13,23] and handouts with pictures of multiple providers (n = 3) were used.[14,27,33] In 2 studies, care team members such as a dietitian, physiotherapist or pharmacist, were included when measuring identification.[14,33]

Understanding Providers' Roles

Six studies assessed the effect of visual tools on patients' understanding of provider roles.[13,14,22,26,27,33] Four studies reported a positive effect with the use of pictures,[27,33] whiteboards,[22] and patient portals.[26] However, 2 studies reported either no difference or negative impressions. Appel et al.[14] reported no difference in the understanding of physician roles using a handout of providers' pictures and titles. Arora et al.[13] used individual pictures of physicians with descriptions of roles and found a negative association, as demonstrated by fewer patients rating their understanding of physicians' roles as excellent or very good in the intervention period (45.6%) compared with the baseline (55.3%).

Patient–Provider Communication

Three studies evaluated the influence of visual tools on communication.[14,24,29] Using pictures, Appel et al.[14] found no difference in the perceived quality of communication. Singh et al.[29] used whiteboards and reported improved communication scores for physicians and nurses. With notepads, patients surveyed by Farberg et al.[24] stated that the tool improved provider communication.

Patient Satisfaction

Five studies assessed patient satisfaction related to the use of visual tools. [22,23,27,30,33] One study reported satisfaction as positive with the use of individual pictures.[23] Two studies that used handouts with pictures of all team members reported either a positive[33] or neutral[27] impact on satisfaction. Studies that used whiteboards reported a positive association with satisfaction[22,30] despite differences in content, such as the inclusion of prewritten prompts for writing goals of care and scheduled tests[30] versus the name of the nurse and their education level.[22]

Results by Type of Visual Tool

Pictures

Five studies that used pictures reported a positive effect on provider identification.[13,14,23,27,33] Two[27,33] of 4 studies[13,14,27,33] that assessed patients' understanding of team member roles reported a positive influence, while 1 reported no difference.[14] A fourth study demonstrated a negative association, perhaps due to differences in the description of providers'

roles listed on the tool.[13] Only 1 study examined the influence of pictures on patient–provider communication, and this study found no difference.[14] Satisfaction with care via the use of pictures varied between positive (2 studies)[23,33] and neutral (1 study).[27]

Whiteboards

Four studies tested the use of whiteboards; of these, 3 reported a positive influence on provider identification.[12,22,30] One study reported a positive impact on patient–provider communication.[29] Two studies noted a positive effect on patient satisfaction.[22,30] Notably, the responsibility for updating whiteboards differed between the studies (ie, nurses only[22] vs residents, medical students, and nurses).[30]

Patient Portal

In 1 study, an electronic portal that included names with pictures of providers, descriptions of their roles, lists of medications, and scheduled tests and/or procedures was used as a visual tool. The portal improved patients' identification of physicians and patients' understanding of roles. However, improvements in the knowledge of medication changes and planned tests and/or procedures during hospitalization were not observed.[26] This finding would suggest limitations in the hospitalized patient's knowledge of the plan of care, which could potentially weaken patient–provider communication.

Notepads

Only 1 study assessed the use of formatted notepads on patient–provider communication and noted a positive association. Notepads used prompts for different categories (eg, diagnosis/treatment, medications, etc) to encourage patient questions for providers.[24]

STUDIES OF PEDIATRIC HOSPITALIZED PATIENTS

Five studies were conducted on hospitalized pediatric units.[15,25,28,31,32] All studies surveyed the parents, guardians, or caregivers of pediatric patients. One study excluded patients ≥12 years of age because of legal differences in access to adolescent health information,[32] while another interviewed parents and/or guardians of teenagers.[15]

Results by Outcomes

Provider Identification and Understanding of Physicians' Roles

Four studies that assessed the influence of visual tools on provider identification and understanding of roles reported a positive association.[15,25,28,31] Visual tools varied between pictures (n = 2),[15,31] patient portal (n = 1),[28] and whiteboards and pictures combined (n = 1).[25] The measurement of outcomes varied between surveys with free text responses,[28] multiple choice questions,[25] and 1-5 Likert scales.[15,31]

Patient–Provider Communication

Two studies assessed the impact of patient portal use on communication and reported a positive association.[28,32] The 2 portals autopopulated names, pictures, and roles of providers from electronic medical records. Singh et al.[28] used a portal that was also available in Spanish and accommodated for non-English speakers. Kelly et al.[32] reported that 90% of parents perceived that portal use was associated with reduced errors in care, with 8% finding errors in their child's medication list.

Patient Satisfaction

Three studies assessed patient satisfaction via the use of visual tools.[15,28,31] Singh et al.[28] noted a positive influence on satisfaction via a patient portal. Dudas et al.[15] used a single-page handout with names and pictures of each provider, along with information regarding the training and roles of each provider. Distribution of these handouts to patients by investigators led to a positive influence on satisfaction. While Unaka et al.[31] used a similar handout, they asked residents to distribute them and found no significant difference in satisfaction scores between the intervention (66%) and control group (62%).

Results by Type of Visual Tool

Pictures

Two studies reported a positive impact on provider identification and understanding of roles with the use of pictures.[15,31] Dudas et al.[15] demonstrated a 4.8-fold increase in the odds of parents identifying a medical student, as compared with the control. Similarly, after adjusting for length of stay and prior hospitalization, Unaka et al.[31] reported that a higher percentage of patients correctly identified providers using this approach.

Whiteboard and Picture

One study evaluated the simultaneous use of whiteboards and pictures to improve the identification of providers. The study noted improved identification of supervising doctors and increased recognition of roles for supervising doctors, residents, and medical students.[25]

Patient Portal

Two studies used patient portals as visual tools. Singh et al.[28] assessed the use of a patient portal with names, roles, and pictures of treatment team members. Use of this tool was positively associated with provider identification, understanding of roles, communication, and satisfaction. Kelly et al.[32] noted that 60% of parents felt that portal use improved healthcare team communication.

RISK OF STUDY BIAS

The risk of bias was assessed for both adult and pediatric studies in aggregate. The average risk of bias using the Downs and Black Scale was 17.81 (range 14-22, standard deviation [SD] 2.20). Of the 16 included studies, 9 were rated at a low risk of bias (score ≥18).[13-15,26-31] Risk of bias was greatest for measures of external validity (mean 2.88, range 2-3, SD 0.34), internal validity (mean 4.06, range 3-6, SD 1.00), and confounding

(mean 2.69, range 1-6, SD 1.35). Two of 3 randomized controlled trials had a low risk of bias.[14,27] Interrater reliability for study quality adjudication was 0.90, suggesting excellent agreement (see supplementary Appendix B).

DISCUSSION

In this systematic review, the effects of visual tools on outcomes, such as provider identification, understanding of roles, patient–provider communication, and satisfaction with care, were variable. The majority of included studies were conducted on adult patients (n = 11).[12-14,22-24,26,27,29,30,33] Pictures were the most frequently used tool (n = 7)[13-15,23,27,31,33] and consequently had the greatest sample size across the review (n = 1297). While pictures had a positive influence on provider identification in all studies, comprehension of provider roles and satisfaction were variable. Although the content of whiteboards varied between studies, they showed favorable effects on provider identification (3 of 4 studies)[12,22,30] and satisfaction (2 of 2 studies).[22,30] While electronic medical record-based tools had a positive influence on outcomes,[26,28] only 1 accounted for language preferences.[28] Formatted notepads positively influenced patient–provider communication, but their use was limited by literacy.[24] Collectively, these data suggest that visual tools have varying effects on patient-reported outcomes, likely owing to differences in study design, interventions, and evaluation methods.

Theoretically, visual tools should facilitate easier identification of providers and engender collaborative relationships. However, such tools do not replace face-to-face patient–provider and family discussions. Rather, these enhancements best serve as a medium to asynchronously display information to patients and family members. Indeed, within the included studies, we found that the use of visual tools was effective in improving satisfaction (6/8 studies), identification (13/13 studies), and understanding of provider roles (8/10 studies). Thus, it is reasonable to say that, in conjunction with excellent clinical care, these tools have an important role in improving care delivery in the hospital.

Despite this promise, we noted that the effectiveness of individual tools varied, a fact that may relate to differences across studies. First, inconsistencies in the format and/or content of the tools were noted. For example, within studies using pictures, tools varied from individual photographs of each team member[13,23] to 1-page handouts with pictures of all team members.[14,15,31] Such differences in presentation could affect spatial recognition in identifying providers, as single photos are known to be easier to process than multiple images at the same time.[34] Second, no study evaluated patient preference of a visual tool. Thus, personal preferences for pictures versus whiteboards versus electronic modalities or a combination of tools might affect outcomes. Additionally, the utility of visual tools in visually impaired, confused, or non-English-speaking patients may limit effectiveness. Future studies that address these aspects and account for patient preferences may better elucidate the role of visual tools in hospitals.

Our results should be considered in the context of several limitations. First, only 3 studies used randomized trial designs; thus, confounding from unmeasured variables inherent to observational designs is possible. Second, none of the interventions tested were blinded to providers, raising the possibility of a Hawthorne effect (ie, alteration of provider behavior in response to awareness of being observed).[35] Third, all studies were conducted at single centers, and only 9 of 16 studies were rated at a low risk of bias; thus, caution in broad extrapolations of this literature is necessary.

However, our study has several strengths, including a thorough search of heterogeneous literature, inclusion of both adult and pediatric populations, and a focus on myriad patient-reported outcomes. Second, by contrasting outcomes and measurement strategies across studies, our review helps explicate differences in results related to variation in outcome measurement or presentation of visual data. Third, because we frame results by outcome and type of visual tool used, we are able to identify strengths and weaknesses of individual tools in novel ways. Finally, our data suggest that the use of picture-based techniques and whiteboards are among the most promising visual interventions. Future studies that pair graphic designers with patients to improve the layout of these tools might prove valuable. Additionally, because the measurement of outcomes is confounded by aspects such as lack of controls, severity of illness, and language barriers, a randomized design would help provide greater clarity regarding effectiveness.

In conclusion, we found that visual tools appear to foster recognition of providers and understanding of their roles. However, variability of format, content, and measurement of outcomes hinders the identification of a single optimal approach. Future work using randomized controlled trial designs and standardized tools and measurements would be welcomed.

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Reducing Overtreatment without Backsliding

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Quality improvement is a key component of hospital medicine. The naïve assumption implicit in many quality improvement efforts is that physicians are highly trained scientists who, when shown a better way with a new practice guideline, will logically change their practice accordingly. In real life, mere education often doesn't change behavior. This human quirk is an endless surprise to some physicians but is just standard fare for those with a Master's of Business Administration.

This has especially been true when the change involves eliminating ineffective practices when there are no economic incentives to replace them with a new drug or test. For instance, the prescription of inappropriate antibiotics for adults with bronchitis[1] remained unchanged despite 40 years of scientific evidence that the practice is ineffective, although there is clear evidence that it leads to dangerous antibiotic resistance, and regardless of 15 years of educational efforts by the government.

A common paradigm for progress is Everett Rogers' theory on the diffusion of innovation.[2] There are innovators and early adopters for any new idea and also laggards. When the innovation involves clinical decision making, research shows that human thought processes are not necessarily linear or logical.[3] Changing prescribing habits is difficult. Various methodologies can be used to nudge[4] people to modify their behavior. I recommend that all hospitalists who perform quality improvement read the 3 books cited in this paragraph. (Better yet, read an executive summary of each of the books. The original books are long and repetitive.)

The Value in Pediatrics (VIP) bronchiolitis collaborative created a virtual peer group to share experiences, benchmark process measures, and collectively problem solve issues in order to provide evidence-based care for infants with bronchiolitis. Their efforts were successful and published in January 2016.[5] The multicenter project markedly reduced use, at their home institutions, of unnecessary and ineffective treatments. Those bootstrap efforts in hospital medicine compare favorably with the gigantic 4-year study[6] published a month later, which documents similar efforts of a Primary Care Practice Research Network project to reduce inappropriate prescribing of antibiotics for simple upper respiratory infections in the outpatient world. There are many parallels between those 2 projects. Both yield insight into management methods that can reduce overtreatment.

The next logical question that a skeptical hospital Chief Executive Officer would ask is, "Will these improved behaviors continue once the research projects are over?" All doctors are familiar with backsliding when it comes to alcoholism, smoking, and dieting. Bad habits often return.

The first sentence of the discussion section in the article by Shadman et al.[7] says it all. "To our knowledge, this is the first report of sustained improvements in care achieved through a multiinstitutional quality improvement collaborative of community and academic hospitals focused on bronchiolitis care." The history of medicine has many examples where a multicenter study has led to the adoption of new treatments or new diagnostic tests. The typical progress of medicine has been the replacement of less effective treatments with better ones. But it is rare and difficult to eliminate, without substitution, ineffective treatments once they are in widespread use. This is the challenge facing the Choosing Wisely™ approach. Established habits of overtesting, overdiagnosis and overtreatment are refractory to correction, other than by replacing retirees with a new generation of physicians.

The confirmation that the previously announced improvements are being sustained will encourage other hospital groups to adopt some of the management methodology of the VIP bronchiolitis collaborative. The collaborative aimed to change medical practice but didn't identify which of the many management techniques it employed led to behaviors being sustainably changed. The aforementioned much larger (and far more expensive) outpatient project by Meeker et al.[6] was designed to tease out which of 3 management methodologies promoted the most change. I anticipate those authors will publish their sustainability data in the near future.

The Shadman et al.[7] article is limited by weak statistical measures. The *P* values for the sustainability in the bottom row of Table 1 probe whether any backsliding was statistically different from 0. Because there are no corresponding power calculations, I don't find those helpful. Given that only 9 centers continued to submit data, the lack of statistical significance may reflect wide error bars rather than small changes in clinical behavior. However, by comparing the confidence intervals for the process measures during the sustainability period to the means at baseline, one can deduce that clinically significant changes were achieved and that clinically significant backsliding did not occur over the following year.

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Another limitation is that the 9 hospitals involved were still collecting and submitting data. As a result, the Hawthorne Effect (people behave differently when they know they are being observed) is still very active and may temporarily be preventing regression in behavior.

The study authors admit the limitation that there may be selection bias in the groups that chose to work the extra year. The authors do a reasonable job trying to find evidence of that selection bias and don't find it. However, all participants in the original study were self selected and dedicated to a cause, so extrapolating these results to less motivated physician groups may be suspect. Despite those limitations, the evidence for sustainability in eliminating overtreatment is encouraging for anyone involved in Choosing Wisely™ endeavors.

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Visual Tools to Increase Patient Satisfaction: Just Decorative or Actually Effective?

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Patient satisfaction and the ability to effectively communicate with hospitalized patients has become a core tenet to providing high-quality healthcare. Over the past few decades, medicine has gradually moved away from many paternalistic practices, and the profession has sought to engage patients as true partners in their own care. It is in this setting that effective communication has risen to be a key factor in the patient and provider relationship. It has also become a closely monitored quality metric tied to financial incentives and penalties. Most importantly, it has been well documented that failures in communication are a frequent cause of adverse events that compromise the ability of healthcare providers to provide safe and effective care.[1] It is in this climate that healthcare systems have worked to implement solutions designed to engage patients and their families to improve their healthcare experience. These solutions vary from low to high tech and include patient whiteboards, provider face cards, and web-based patient portals. Despite the numerous innovative solutions being implemented by hospitalists, studies supporting their effectiveness are few. There continues to be limited evidence on the value of these practices and whether they positively impact the desired outcomes of patient satisfaction and engagement.

In this issue of the *Journal of Hospital Medicine*, Goyal et al.[2] performed a systematic review to evaluate whether the use of bedside visual tools for hospitalized medical patients impacts patient satisfaction, patient–provider communication, and provider identification and understanding of roles. The authors were able to identify 16 studies that evaluated the use of these tools, which included provider face cards and whiteboards. The majority of the studies reviewed showed a positive effect on provider identification, understanding providers' role, and patient satisfaction. The authors found that of the tools evaluated, whiteboards and picture-based techniques were the most effective visually based interventions. However, the authors also highlighted the difficulty in identifying 1 optimal approach to the use of these tools as a result of variations in content, format, and outcome measurement.

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Variation in the use of visual tools to improve communication and patient satisfaction limits the ability to identify and evaluate the most effective approaches to their use. Without a streamlined approach, these tools may not produce the desired effect of improving patient and provider communication, which is essential in providing high-quality inpatient care and ensuring patient satisfaction. It has been documented that many patients cannot even identify their providers in the hospital setting, which limits the ability of the patient to be fully engaged in decisions made about their care.[3] In addition, substantial portions of hospitalized patients do not understand their plan of care.[4] Patients' understanding of their plan of care is essential for patients to provide informed consent for hospital treatments and better prepare them to assume their own care after discharge, with a full understanding of their diagnosis.[5] It has become increasingly clear that healthcare providers must incorporate effective approaches in their daily workflow to address these findings.

Aside from patient satisfaction and engagement, the effect communications failures have on patient safety have been evaluated and recognized. From the National Academy of Medicine's report emphasizing patient-centered care to the addition of patients' active engagement in their care as a National Patient Safety Goal by The Joint Commission, the medical field has committed to a continued focus in this area.[5,6]

The business case can also be made for identifying effective tools that improve patient satisfaction and patient–provider communication. Private and public health insurance providers have incentivized high performance in these areas and have now begun to levy penalties for underperformers. As patients' level of satisfaction and engagement continue to be assessed via patient surveys, healthcare systems continue to search for effective practices to improve performance in patient-perceived provider communication. Patients' reporting of their assessment of nurse and physician communication through questions such as "How often did nurses/doctors explain things in a way you could understand?" will continue to be a moving target requiring future studies of effective interventions

Are visual aids the effective tools that hospitals need to improve communication and patient satisfaction, or are they merely decorations? The whiteboard provides an excellent example of the effectiveness that can be seen with the use of these tools. Used to improve patient-provider communication

in medicine, the whiteboard has become almost ubiquitous in patient hospital rooms.[7] It is now an expected aspect of hospital design and has inspired the development of higher tech solutions, including patient tablets and media walls. It is known to enhance the interaction for both the provider and patient and facilitate the exchange of complicated medical information within an anxiety prone environment in a simple manner by using short phrases or drawings.[6] Yet, there is a scarcity of strong evidence to support the most effective approach to the use of whiteboards in improving patient satisfaction and communication. Standardizing how the whiteboard is used during the patient interaction will allow for the effectiveness of this tool to be realized and evaluated and prevent it from becoming another ornamental fixture on our hospital walls.

The systematic review by Goyal et al.[2] is a necessary step in the evaluation of common communication tools for their effectiveness and ability to improve patient satisfaction. This exhaustive review of key studies in this area is an excellent addition to the current literature, which has a paucity of extensive evaluations of these approaches. It provides an important signal that visual tools are more than decorative and can be effective when a streamlined approach is utilized. It highlights the importance of identifying effective best practices for the use of these tools that can be studied empirically and subsequently disseminated for widespread use. Continued work is necessary to fill this void and to enable healthcare professionals to provide the highest level of safe, effective, and engaging care that our patients deserve.

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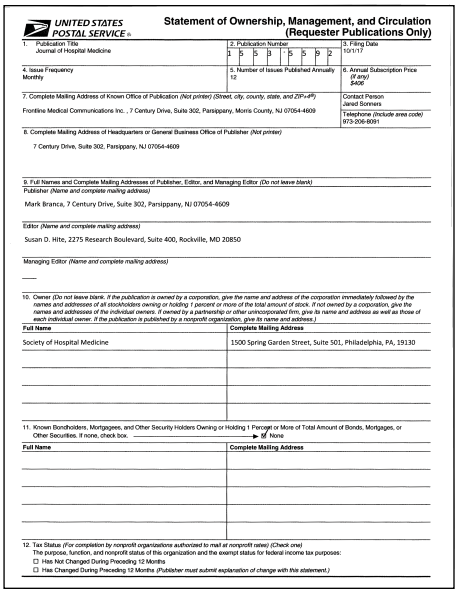

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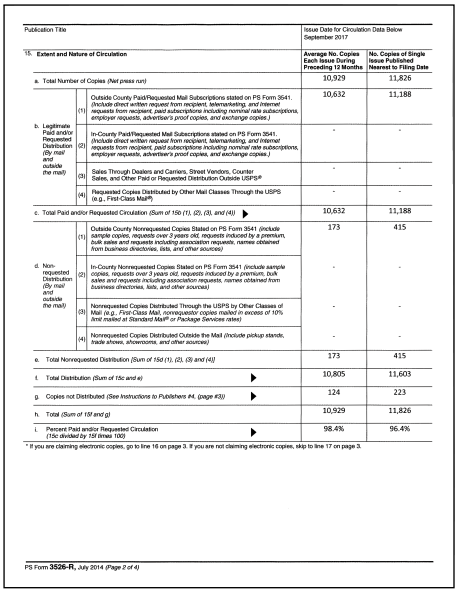

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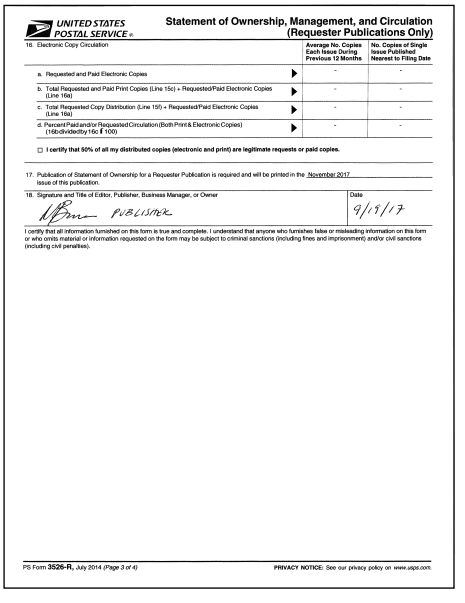

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Low Health Literacy and Transitional Care Needs: Beyond Screening

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Health literacy (HL) is the ability of individuals to obtain, process, and understand health information in a way that enables them to make health decisions.[1] Approximately one-third of adults in the United States are considered to have inadequate HL,[2] and its prevalence is even higher among hospitalized patients.[3] Low HL has been associated with higher rates of hospital readmission[4] and higher mortality.[5,6] Inadequate HL has been identified as a barrier to communication and is associated with poorer outcomes for communication-sensitive behaviors, such as adherence to medications, chronic disease self-efficacy and self-management,[7-10] and understanding hospital discharge instructions.[11,12] It has been largely understood that the association between HL and hospital outcomes has been mediated by these communication challenges.

In this issue of the journal, Boyle et al.[13] demonstrate that inadequate HL is not only a communication barrier but also an indicator of other social support needs during a transition from the hospital. In particular, the authors found that hospitalized patients with inadequate HL had needs in more social support domains than those with adequate HL. After multivariable adjustment for sociodemographic factors that likely impact social support, such as age and marital status, inadequate HL remained associated specifically with insufficient caregiver support and transportation barriers. These findings suggest that, along with the more direct comprehension barriers previously associated with inadequate HL, the identified social support needs may mediate prior established associations between inadequate HL and poor health outcomes.

The authors concluded that screening for HL along with transitional care needs will allow hospitals to ensure a quality care transition. Indeed, screening for these gaps is the first step in identifying important postdischarge social needs and will be necessary in order to track improvements for at-risk populations. However, screening alone will not likely change outcomes; for this, we will need effective interventions.

In fact, it remains an open question how best to intervene to improve care transitions for patients with social needs and low HL. The recent focus of HL interventions in the literature has been on "universal precautions," such as the teach-back technique, to ensure patient comprehension of information, and writing patient informational materials at a low literacy level.[14] This approach to make all materials and communication accessible to all patients, rather than to tailor HL interventions, has become more prevalent in efforts to address the adverse communication and resultant health impacts of inadequate HL.[15-17]

Meanwhile, the focus of care transition interventions has been on transition coaching or case management in the hospital, medication reconciliation prior to discharge, and postdischarge telephone calls from pharmacists or nurses, often utilizing the HL "universal precautions."[18-20] While these approaches have been impactful to improve discharge preparedness and decrease readmission rates,[21] they may not adequately address individual social support and social service needs when the patient leaves the hospital.

Recently, the National Academy of Medicine published the Accountable Health Community Screening Tool, designed to screen for the following 5 areas of unmet social need that are known to be impactful for health: housing stability, food insecurity, transportation needs, utility needs, and interpersonal violence.[22] This screener is being used as part of the Center for Medicare & Medicaid Services' Accountable Health Communities Model and is being tested by the Center for Medicare and Medicaid Innovation (CMMI). The goal of the CMMI evaluation is to test whether systematically identifying social service needs and closing the gap between clinical care and community services for patients with the highest levels of need will improve health outcomes.

Screening for HL and social determinants in the hospital will not, in and of itself, improve the quality of care transitions or prevent subsequent readmissions, morbidity, or mortality. However, measurement is the first step toward identifying individuals with the greatest need and can help direct hospitals' utilization of limited resources, such as transition managers. The CMMI Accountable Health Communities Model evaluation will provide hospital and healthcare systems with best practices for building clinical–social services networks and connecting at-risk patients with high levels of need to appropriate services in the community.

No longer can a patient's hospital care end with writing prescriptions and scheduling follow-up appointments. For some, using teach-back and low literacy-appropriate discharge materials will be enough; others will require a postdischarge telephone call to review medications and

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symptoms and ensure follow-up. But for those highest-risk patients, connection to a network of ongoing community social support will be necessary to guide their transition back to health in the community.

Disclosure: The author reports no conflicts of interest.

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ERRATUM

Erratum to: Morbo Serpentino

Helene Møller Nielsen, MD[1]*, Shakil Shakar, MD[1], Ulla Weinreich MD[1], Mary Hansen MD[2], Rune Fisker, MD[3], Thomas E. Baudendistel, MD[4], Paul Aronowitz MD[5]

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The authors would like to correct the error in the publication of the original article with the inclusion of an additional author (Dr. Henrik Nielsen). The corrected detail is published with this erratum for your reading.

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