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Prognostic Value of Braden Activity Subscale for Mobility Status in Hospitalized Older Adults

Vincenzo Valiani, MD[1,2*], Zhiguo Chen, PHHP-BIO[1-3], Gigi Lipori, MT, MBA[4], Marco Pahor, MD[1], Carlo Sabbá, MD[2], Todd M. Manini, PhD, FACSM[1*]

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OBJECTIVES: To evaluate the predictive value of the Activity subscale of the Braden Scale for Predicting Pressure Sore Risk in assessing mobility impairment and recovery among hospitalized older adults.

DESIGN: Retrospective cohort study.

SETTING: UF Health Shands Hospital, University of Florida, Gainesville, Florida.

PATIENTS: 19,769 older adults (≥65 years) hospitalized between January 2009 and April 2014.

MEASUREMENTS: Incident mobility impairment and recovery were assessed with the Braden Activity subscale (BAS) score that nurses use to grade patients at every shift change (~3 times/d). Posthospital mortality rate and discharge disposition were used to assess the prognostic value of the BAS.

RESULTS: Of the 10,717 study patients observed "walking frequently" at admission, 2218 (20.7%) developed incident mobility impairment. Of the other 9052 study patients, who were impaired at admission, 4734 (52.3%) recovered to a state of walking occasionally or frequently. Older adults who developed mobility impairment during hospitalization had an odds of death higher than that of those who remained mobile (odds ratio [OR], 1.23; 95% confidence interval [CI], 1.08-1.39). This effect predominately occurred within the first 6 follow-up months. Older adults who recovered from mobility impairment had an odds of death lower than that of those who did not recover mobility in the hospital (OR, 0.54; 95% CI, 0.49-0.59). This effect was slightly stronger within the first 6 months after hospitalization.

CONCLUSIONS: Nurses' BAS assessment of mobility status during hospitalization provides substantial prognostic value in hospitalized older adults. The BAS could be an efficient and valuable source of information about mobility status for targeting posthospital care of older adults. *Journal of Hospital Medicine* 2017;12:396-401. © 2017 Society of Hospital Medicine

In-hospital mobility (walking and transferring) is an important modifiable factor for posthospital functional outcomes and mortality among older adults.[1-4] In fact, daily mobility assessment has been considered for a standard clinical evaluation of the hospitalized older adult.[5,6] This would provide a ready source for targeting patients at risk for mobility impairment and identifying strategies to prevent in-hospital mobility limitation and posthospital functional decline. Despite their potential importance, mobility assessment tools have not been readily adopted in the hospital setting.

There are various ways to assess mobility in hospital settings. Mobility tracking technology (radar and accelerometers) has demonstrated older adults have extremely low mobility during hospitalization. Although these objective methods provide an unbiased way to monitor physical activity level and track in-hospital mobility change,[6-8] and have provided important information about mobility in the hospital, they are largely impractical in real-world settings.

While mobility technology appears to be advancing, there is a potential to assess in-hospital mobility using commonly administered and inexpensive tools. Many hospitals ask staff to regularly rate physical function (Braden and Morse score) as part of their standard-of-care procedures. The rating scales used have the potential to provide valuable information about mobility variations without using special equipment or burdening patients. The Braden Scale for Predicting Pressure Sore Risk is a good example of a validated assessment instrument that is better than nurses' judgment, which is often confounded by nursing experience.[9] This scale, which has 6 subscales (Sensory Perception, Moisture, Activity, Mobility, Nutrition, Friction and Shear), has shown high sensitivity in detecting patient condition changes in the clinical setting.[10] The scale typically is used holistically to evaluate pressure ulcer risk, but the Activity subscale, which assesses mobility, could serve as a useful tool for predicting posthospital recovery and identifying needs for posthospital mobility interventions.

We conducted a study to evaluate the prognostic value of using the Braden Activity subscale (BAS) to identify in-hospital incident mobility impairment and recovery for

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predicting mortality and discharge status among hospitalized older adults.

METHODS

The University of Florida Gainesville Health Science Center Institutional Review Board reviewed and approved the study protocol as exempt from human subjects' research.

Design and Setting

The design followed a retrospective cohort study in which hospitalized patients were evaluated at admission (baseline) and assessed throughout their stay for incident mobility impairment and recovery. Data were collected in older adults (≥65 years old) hospitalized at UF Health Shands Hospital (University of Florida), an 852-bed level I trauma center in Gainesville, Florida.

Data Sources

Patient data from electronic medical records were warehoused in an integrated data repository (IDR) between January 1, 2009 and April 20, 2014. The IDR aggregates clinical and administrative system data, which can subsequently be used for research. The data were compiled in a de-identified longitudinal dataset that included demographics, Charlson Comorbidity Index,[11] hospital length of stay, BAS scores (at admission, during hospitalization, at discharge), discharge disposition (including in-hospital death), and mortality after hospitalization (from the national Social Security Death Index).

Patients

The study population consisted of 19,769 older adults (≥65 years old) hospitalized between January 1, 2009 and April 20, 2014.

Outcomes

The major outcomes were patients' primary discharge disposition and posthospital mortality over 4.5-year follow-up. Discharge dispositions were divided into 9 categories: expired in hospital, other hospital admission, home, home care, hospice, rehabilitation, skilled nursing home, healthcare facility, or other, which included psychiatric facilities, court, or law enforcement.

Predictors

The BAS was used to identify incident mobility impairment and incident mobility recovery during hospitalization and subsequently was used to predict discharge disposition and mortality. The Braden scale,[12] which is commonly administered to predict pressure sores, has 6 subscales: Sensory Perception, Moisture, Activity, Mobility, Nutrition, and Friction and Shear. Each subscale has a score of 1 to 4, with higher scores representing higher activity levels. In particular, the BAS measures the mobility (walking and transferring) level of the hospitalized patient with a score of 1 ("patient is confined to bed"), 2 ("severely limited or nonexistent ability to walk; patient cannot bear his own weight and/or must be assisted into chair or wheelchair"), 3 ("patient walks occasionally during the day, but for very short distances, with or without assistance; he spends majority of each shift in bed or chair"), or 4 ("patient walks outside the room at least twice a day and inside the room at least once every 2 hours during waking hours"). The BAS is correlated with the total Braden scale[10] and has shown excellent interrater reliability (interclass correlation coefficient, 0.96) among hospital staff.[13] Analysis of the current dataset revealed excellent rater agreement across 3 working shifts ($\kappa = 0.76$ for first day of hospitalization in those hospitalized <3 days; $\kappa = 0.70$ for first day in those hospitalized ≥3 days).

UF Health Shands Hospital nursing staff administered the BAS at each shift change during a hospital stay (~3 times/d). Mobility scores were averaged across an entire day to reduce potential interrater variation. A daily average BAS score cutpoint was chosen to capture an absorbing mobility state. Average BAS score ≥3 was selected, as it indicates a patient is mobile most of the day, whereas average BAS score <3 indicates significant mobility impairment most of the day. The average daily score was calculated with a minimum of 3 determinations per day. Incident mobility impairment was defined as first transition from "being able to walk occasionally or twice a day outside or at least once every 2 hours during waking hours" to "severely limited or nonexistent ability to walk or confined to bed." Numerically speaking, daily average BAS score transition from ≥3 at admission to <3 during hospitalization constituted a mobility impairment event. Incident mobility recovery was evaluated in those patient hospital observations that were "severely limited or nonexistent ability to walk or confined to bed" at admission. Incident mobility recovery was defined as first transition to "ability to walk occasionally or twice a day outside or at least once every 2 hours during waking hours." A mobility recovery event was operationally defined as daily average BAS score transition from <3 at admission to daily average of ≥3 during hospitalization.

Data Analysis

Patient baseline characteristics are reported as counts, means, or medians. Chi-square statistics were used to test group differences for categorical variables, and analysis of variance was performed for continuous variables. Posthospital outcomes were evaluated descriptively and with time-to-event analyses. Kaplan-Meier curves and Wilcoxon *P* were also used to compare the survival probability for the mobility impairment and recovery groups. Although Cox proportional hazard regression is appropriate for these data, we found the proportionality assumption tenuous. As an alternative, logistic regression was used to model the probability of impairment/recovery outcomes. In addition, a survival time estimate that is robust to the proportionality assumption was derived according to Royston and Parmar[14,15] and Zhao et al.[16] This approach reports the difference between 2 survival curves using the restricted mean—a measure of average

TABLE 1. Selected Baseline Characteristics of Study In-Hospital Patients

Characteristic	Overall Sample (N = 19,769)	Normal Mobility at Admission (n = 10,717)	Impaired Mobility at Admission (n = 9052)
Admission age, y	74.65 ± 7.46	73.73 ± 7.00	75.73 ± 7.84
Diagnosis count	13.09 ± 6.76	11.75 ± 6.17	14.67 ± 7.09
Median (IQR) length of stay	4 (2, 7)	3 (2, 6)	5 (3, 9)
Charlson Comorbidity Index	2.39 ± 2.33	2.22 ± 2.31	2.59 ± 2.34
Myocardial infarction	2032 (10.28%)	1037 (9.68%)	995 (10.99%)
Congestive heart failure	3545 (17.93%)	1674 (15.62%)	2871 (22.67%)
Peripheral vascular disease	2606 (13.18%)	1139 (10.63%)	1467 (16.21%)
Cerebrovascular disease	2800 (14.16%)	1021 (9.53%)	1779 (19.65%)
Dementia	706 (3.57%)	197 (1.84%)	509 (5.62%)
Diabetes	5225 (26.43%)	2679 (25.00%)	2546 (28.13%)
Cancer	3076 (15.56%)	1895 (17.68%)	1181 (13.05%)

NOTE: Except where indicated otherwise, values are n (%) for categorical variables and mean ± SD for continuous variables. All comparisons statistically different at $P < 0.001$. Abbreviation: IQR, interquartile range.

TABLE 2. Odds Ratios, Confidence Intervals, and Restricted Mean Survival Time

Mobility	OR (95% CI) for Total Follow-Up Time	Survival Time for Total Follow-Up Time[a]	OR (95% CI) for ≤6 Months	Survival Time for ≤6 Months[a]	OR (95% CI) for >6 Months	Survival Time for >6 Months[a]
Decline	1.23[b] (1.08, 1.39)	39.7 (38.9, 40.4)	1.67[b] (1.40, 1.96)	2.1 (1.9, 2.3)	1.01 (0.86, 1.29)	45.4 (44.9, 45.9)
Recovery	0.54[b] (0.49, 0.59)	42.2 (41.7, 42.7)	0.38[b] (0.34, 0.43)	2.4 (2.2, 2.5)	0.84[b] (0.73, 0.96)	46.0 (45.7, 46.3)

[a]Survival time calculated as months using restricted mean survival time as outlined in Methods section.

[b]Statistically different at $P < 0.05$.

NOTE: Values are adjusted for covariates age, sex, race, and hospital length of stay. Abbreviations: CI, confidence interval; OR, odds ratio.

survival using the area under the survival curve from time point zero to last observed follow-up time. All models were adjusted for age, sex, race, and hospital length of stay. Analyses were performed with R 3.1.1.[17] All analyses were 2-tailed, and an α of 0.05 was considered statistically significant.

RESULTS

Table 1 lists the baseline characteristics of the hospitalized patients: 10,717 (54%) with normal mobility at admission and 9052 (46%) admitted with impaired mobility. Compared with patients admitted with normal mobility, those with impaired mobility at admission were older, mean (SD) 75.73 (7.84) years versus 73.73 (7.00) years; spent more days in the hospital, median 5 days versus 3 days; and had a higher Charlson Comorbidity Index, mean (SD) 2.59 (2.34) versus 2.22 (2.31). Patients with impaired mobility at admission had a significantly higher prevalence of myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, and diabetes. However, cancer was significantly more prevalent among patients admitted with normal mobility compared with those admitted with impaired mobility.

Of the 10,717 patients with normal mobility at admission, 2218 (20.7%) had incident mobility impairment over a median follow-up of 3 days (interquartile range, 2-5 days). Of the 9052 patients admitted with impaired mobility, 4734 (52.3%) recovered from their impairment over a median follow-up of 5 days (interquartile range, 3-9 days).

The Kaplan-Meier curves in Figure 1 show survival probability between patients who did and did not develop incident mobility impairment during hospitalization, as well as between patients who did and did not recover incident mobility. Table 2 lists the odds ratios (ORs) and restricted mean survival times for patients who developed impairment and patients who recovered. The results are provided for the entire follow-up period and for before and after 6 months of follow-up. Older adults who became mobility impaired in the hospital had an odds of death higher than that of those who remained mobile (OR, 1.23; 95% confidence interval [CI], 1.08-1.39). This effect predominately occurred within the first 6 follow-up months (OR, 1.67; 95% CI, 1.40-1.96). Older adults who recovered from mobility impairment had an odds of death lower than that of those who did not recover mobility in the hospital (OR, 0.54; 95% CI, 0.49-0.59). This effect was slightly stronger within the first 6 months after hospitalization but remained significant after 6 months. Figure 2 shows the percentages of different discharge dispositions for mobility impairment and recovery. Older adults with mobility impairment were more likely to die in the hospital or to be discharged to hospice. Otherwise, patients who recovered their mobility during hospitalization were more likely to be discharged home and to home care.

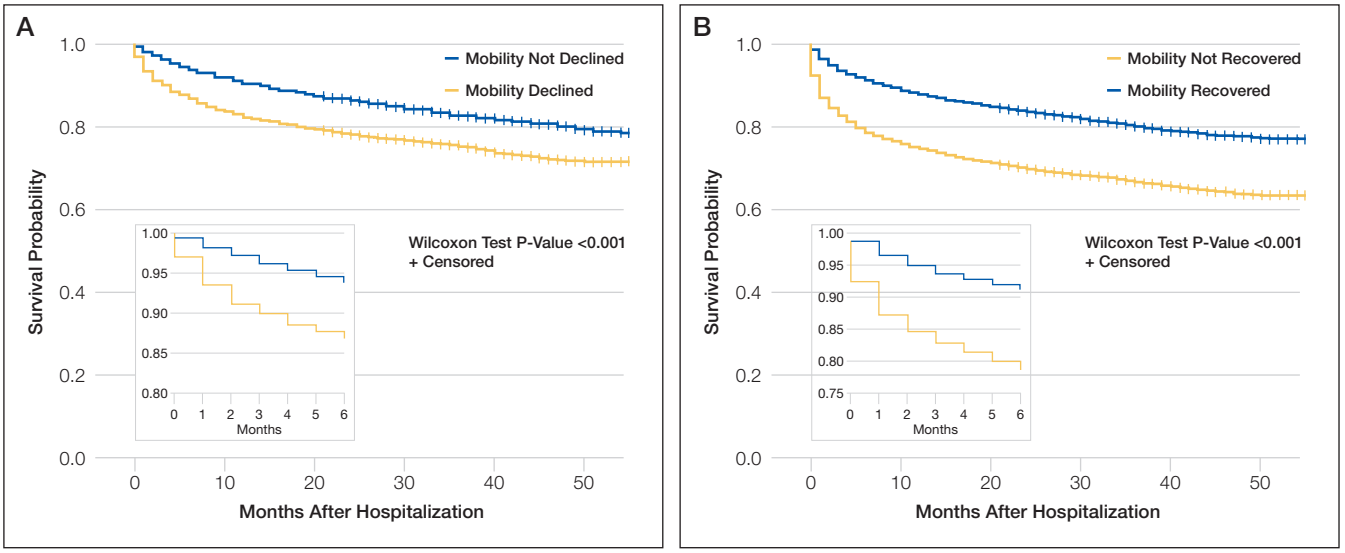

FIG. 1. Kaplan-Meier plot of survival probability (A) between patients with and without incident mobility impairment during hospitalization and (B) between patients with and without incident mobility recovery during hospitalization.

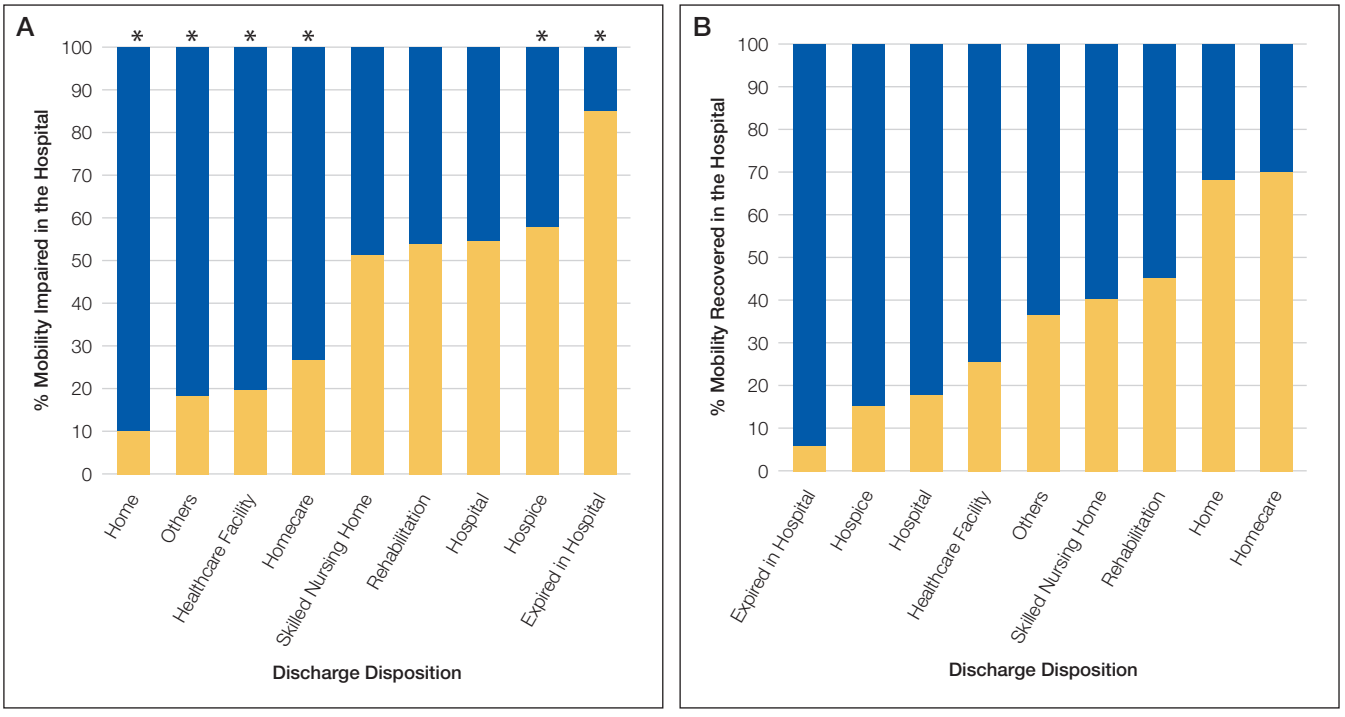

FIG. 2. Percentage of patients discharged to various locations for (A) incident mobility impairment and (B) incident mobility recovery during hospitalization. *Proportions significantly different from chance alone ($P < 0.05$). All percentages in B are statistically different ($P < 0.05$).

DISCUSSION

In this study, we evaluated the predictive value of the BAS in assessing incident mobility impairment and recovery during hospitalization among older adults. Patients admitted with impaired mobility were older, spent more days in the hospital, and had more comorbidities than those admitted with normal mobility. Compared with older adults who did not develop incident mobility impairment during hospitalization, those who became mobility impaired had a higher posthospital mortality risk and a higher prevalence of in-hospital death and hospice discharge. In addition, compared with older adults who did not recover mobility in the hospital, those who recovered mobility had a lower posthospital mortality risk and a higher prevalence of home discharge. It is interesting that incident in the hospital appears to have a finite effect. The association was largely erased 6 months after discharge. This was also observed in patients who recovered their mobility in the hospital, but to a lesser extent. Overall, the results suggest that

developing mobility impairment or recovering from mobility impairment in the hospital is an important predictor of discharge status and posthospital mortality.

The large number of patient observations and repeated evaluation of in-hospital mobility made this analysis possible. To our knowledge, this is the first large-scale study to evaluate the predictive value of the BAS in assessing mobility impairment and recovery during hospitalization among older adults. Such a test provides a simple and efficient assessment of in-hospital mobility changes that are sensitive to discharge locations and posthospital mortality risk.

Poor mobility in the hospital is associated with higher posthospital mortality. Kasotakis et al.[18] evaluated the predictive value of a nursing staff–assessed clinical mobility score for surgical critically ill patients whose functional mobility was unimpaired on presentation. The Surgical Intensive Care Unit Optimal Mobility Score has been shown to be a reliable and valid tool for predicting mortality in a relatively young population (average age, 60 years). Using accelerometer technology with older adults, Ostir et al.[7] found that each 100-step increase was associated with 2% and 3% lower risk of death over 2 years in the first and last 24 hours of hospitalization, respectively. The present mortality results show that mobility patterns in the hospital are crucially important for patients' health the first 6 months after discharge. This finding suggests that developing mobility impairment in the hospital is a sign for significant and rapid health decline. It also suggests that interventions need to be started relatively early in order to reduce the risk of death. In contrast, patients who recover mobility in the hospital obtain a substantial mortality risk reduction. In-hospital interventions to enhance mobility recovery and prevent mobility impairment could have a large impact on posthospital adverse events, particularly for older patients, who are susceptible to disease complications.

Regarding discharge disposition, Sommerfeld and von Arbin[19] found that the ability to rise from a chair (a component of mobility) during hospitalization was a strong predictor of early discharge home. Similarly, Vochteloo et al.[20] found that limited mobility as assessed with a questionnaire was associated with discharge to a location other than home among patients with hip fracture. We utilized existing information, collected at a relatively high resolution (3 times per day) that is often readily available without added patient burden. This is particularly important in the hospital setting, where added assessments in frail older adults and in those with multimorbid conditions is challenging. Although our approach is appealing, we should note that BAS scores were modified to reduce interrater variation and capture more absorbing mobility states over a hospitalized day, and that a similar approach would be required to replicate these results and provide clinical value to the BAS as a prognostic indicator of posthospital mortality.

Despite the strengths of this study, it had notable limitations. Pooling BAS scores could have modified the interpretation and clinical implications of the results. Although we had a large number of patient observations, this retrospective analysis may have had biases that were not completely considered. In addition, the results of this single-center study cannot be generalized across all hospital systems. The Braden activity sub score has demonstrated good validity and reliability for activity changes[13], but this measure was not objectively ascertained as demonstrated by others using accelerometers[6-7]. Moreover, the medical records used did not provide prehospital patient mobility status, limiting adjustments for prehospital mobility function. Despite these limitations, this study represents an important initial step in validating a simple and efficient clinical tool for identifying in-hospital mobility impairment and recovery and predicting posthospital adverse outcomes.

BAS assessment of incident mobility impairment and recovery in the hospital setting has prognostic value in predicting discharge disposition, in-hospital death, and posthospital mortality risk. That the majority of the effect appears to occur within the first 6 months after discharge suggests that interventions to improve mobility should be started during hospitalization or expeditiously after discharge. Overall, this study's results showed that a simple and efficient mobility status assessment can become a valuable clinical and administrative tool for targeting and improving mobility in the hospital and after discharge in older adults.

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Does Provider Self-Reporting of Etiquette Behaviors Improve Patient Experience? A Randomized Controlled Trial

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BACKGROUND: There is a glaring lack of published evidence-based strategies to improve the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient experience scores on the physician domain. Strategies that have been used are resource intensive and difficult to sustain.

OBJECTIVE: We hypothesized that prompting providers to assess their own etiquette-based practices every 2 weeks over the course of 1 year would improve patient experience on the physician domain.

DESIGN: Randomized controlled trial.

SETTING: 4 acute care hospitals.

PARTICIPANTS: Hospitalists.

INTERVENTION: Hospitalists were randomized to the study or the control arm. The study arm was prompted every 2 weeks for 12 months to report how frequently they engaged in 7 best-practice bedside etiquette behaviors. Control arm participants received similarly worded questions on quality improvement behaviors.

MEASUREMENT: Provider experience scores were calculated from the physician HCAHPS and Press Ganey survey provider items.

RESULTS: Physicians reported high rates of etiquette-based behavior at baseline, and this changed modestly over the study period. Self-reported etiquette behaviors were not associated with experience scores. The difference in difference analysis of the baseline and postintervention physician experience scores between the intervention arm and the control arm was not statistically significant ($P = 0.71$).

CONCLUSION: In this 12-month study, biweekly reflection and reporting of best-practice bedside etiquette behaviors did not result in significant improvement on physician domain experience scores. It is likely that hospitalists' self-assessment of their bedside etiquette may not reflect patient perception of these behaviors. Furthermore, hospitalists may be resistant to improvement in this area since they rate themselves highly at baseline. *Journal of Hospital Medicine* 2017;12:402-406. © 2017 Society of Hospital Medicine

Physicians have historically had limited adoption of strategies to improve patient experience and often cite suboptimal data and lack of evidence-driven strategies. [1,2] However, public reporting of hospital-level physician domain Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) experience scores, and more recent linking of payments to performance on patient experience metrics, have been associated with significant increases in physician domain scores for most of the hospitals. [3] Hospitals and healthcare organizations have deployed a broad range of strategies to engage physicians. These include emphasizing the relationship between patient experience and patient compliance, complaints, and malpractice lawsuits; appealing to physicians' sense of competitiveness by publishing individual provider experience scores; educating physicians on HCAHPS and providing them with regularly updated data; and development of specific techniques for improving patient-physician interaction. [4-8]

Studies show that educational curricula on improving etiquette and communication skills for physicians lead to improvement in patient experience, and many such training programs are available to hospitals for a significant cost.[9-15] Other studies that have focused on providing timely and individual feedback to physicians using tools other than HCAHPS have shown improvement in experience in some instances. [16,17] However, these strategies are resource intensive, require the presence of an independent observer in each patient room, and may not be practical in many settings. Further, long-term sustainability may be problematic.

Since the goal of any educational intervention targeting physicians is routinizing best practices, and since resource-intensive strategies of continuous assessment and feedback may not be practical, we sought to test the impact of periodic physician self-reporting of their etiquette-based behavior on their patient experience scores.

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TABLE 1. Self-Reported Frequency of Best-Practice Bedside Etiquette Behaviors

	Introduce Yourself: Always or Usually (%)	Smile: Always or Usually (%)	Visitor Etiquette: Always or Usually (%)	Sit Down: Always or Usually (%)	Body Language: Always or Usually (%)	Wrap-up: Always or Usually (%)	Coverage: Always or Usually (%)
Baseline	59.0	88.3	85.2	62.9	66.7	96.2	92.5
Quarter 1	77.66	95.01	87.77	67.56	83.03	97.34	85.82
Quarter 2	91.02	97.88	94.18	72.61	83.65	99.47	90.44
Quarter 3	88.56	97.58	96.36	80.61	89.66	99.32	90.35
Quarter 4	90.37	96.51	95.34	70.93	87.77	97.67	92.41

METHODS

Subjects

Hospitalists from 4 hospitals (2 community and 2 academic) that are part of the same healthcare system were the study subjects. Hospitalists who had at least 15 unique patients responding to the routinely administered Press Ganey experience survey during the baseline period were considered eligible. Eligible hospitalists were invited to enroll in the study if their site director confirmed that the provider was likely to stay with the group for the subsequent 12-month study period.

Randomization, Intervention and Control Group

Hospitalists were randomized to the study arm or control arm (1:1 randomization). Study arm participants received biweekly etiquette behavior (EB) surveys and were asked to report how frequently they performed 7 best-practice bedside etiquette behaviors during the previous 2-week period (Table 1). These behaviors were pre-defined by a consensus group of investigators as being amenable to self-report and commonly considered best practice as described in detail below. Control-arm participants received similarly worded survey on quality improvement behaviors (QIB) that would not be expected to impact patient experience (such as reviewing medications to ensure that antithrombotic prophylaxis was prescribed, Table 1).

Baseline and Study Periods

A 12-month period prior to the enrollment of each hospitalist was considered the baseline period for that individual. Hospitalist eligibility was assessed based on number of unique patients for each hospitalist who responded to the survey during this baseline period. Once enrolled, baseline provider-level patient experience scores were calculated based on the survey responses during this 12-month baseline period. Baseline etiquette behavior performance of the study was calculated from the first survey. After the initial survey, hospitalists received biweekly surveys (EB or QIB) for the 12-month study period for a total of 26 surveys (including the initial survey).

Survey Development, Nature of Survey, Survey Distribution Methods

The EB and QIB physician self-report surveys were developed through an iterative process by the study team. The EB survey included elements from an etiquette-based medicine checklist for hospitalized patients described by Kahn et al. [18] We conducted a review of literature to identify evidence-based practices.[19-22] Research team members contributed items on best practices in etiquette-based medicine from their experience. Specifically, behaviors were selected if they met the following 4 criteria: 1) performing the behavior did not lead to significant increase in workload and was relatively easy to incorporate in the work flow; 2) occurrence of the behavior would be easy to note for any outside observer or the providers themselves; 3) the practice was considered to be either an evidence-based or consensus-based best-practice; 4) there was consensus among study team members on including the item. The survey was tested for understandability by hospitalists who were not eligible for the study.

The EB survey contained 7 items related to behaviors that were expected to impact patient experience. The QIB survey contained 4 items related to behaviors that were expected to improve quality (Table 1). The initial survey also included questions about demographic characteristics of the participants.

Survey questionnaires were sent via email every 2 weeks for a period of 12 months. The survey questionnaire became available every other week, between Friday morning and Tuesday midnight, during the study period. Hospitalists received daily email reminders on each of these days with a link to the survey website if they did not complete the survey. They had the opportunity to report that they were not on service in the prior week and opt out of the survey for the specific 2-week period. The survey questions were available online as well as on a mobile device format.

Provider Level Patient Experience Scores

Provider-level patient experience scores were calculated from the physician domain Press Ganey survey items, which included the time that the physician spent with patients, the physician addressed questions/worries, the physician kept patients informed, the friendliness/courtesy of physician, and the skill of physician. Press Ganey responses were scored from 1 to 5 based on the Likert scale responses on the survey such that a response "very good" was scored 5 and a

response "very poor" was scored 1. Additionally, physician domain HCAHPS item (doctors treat with courtesy/respect, doctors listen carefully, doctors explain in way patients understand) responses were utilized to calculate another set of HCAHPS provider level experience scores. The responses were scored as 1 for "always" response and "0" for any other response, consistent with CMS dichotomization of these results for public reporting. Weighted scores were calculated for individual hospitalists based on the proportion of days each hospitalist billed for the hospitalization so that experience scores of patients who were cared for by multiple providers were assigned to each provider in proportion to the percent of care delivered.[23] Separate composite physician scores were generated from the 5 Press Ganey and for the 3 HCAHPS physician items. Each item was weighted equally, with the maximum possible for Press Ganey composite score of 25 (sum of the maximum possible score of 5 on each of the 5 Press Ganey items) and the HCAHPS possible total was 3 (sum of the maximum possible score of 1 on each of the 3 HCAHPS items).

ANALYSIS AND STATISTICAL METHODS

We analyzed the data to assess for changes in frequency of self-reported behavior over the study period, changes in provider-level patient experience between baseline and study period, and the association between the these 2 outcomes. The self-reported etiquette-based behavior responses were scored as 1 for the lowest response (never) to 4 as the highest (always). With 7 questions, the maximum attainable score was 28. The maximum score was normalized to 100 for ease of interpretation (corresponding to percentage of time etiquette behaviors were employed, by self-report). Similarly, the maximum attainable self-reported QIB-related behavior score on the 4 questions was 16. This was also converted to 0-100 scale for ease of comparison.

Two additional sets of analyses were performed to evaluate changes in patient experience during the study period. First, the mean 12-month provider level patient experience composite score in the baseline period was compared with the 12-month composite score during the 12-month study period for the study group and the control group. These were assessed with and without adjusting for age, sex, race, and U.S. medical school graduate (USMG) status. In the second set of unadjusted and adjusted analyses, changes in biweekly composite scores during the study period were compared between the intervention and the control groups while accounting for correlation between observations from the same physician using mixed linear models. Linear mixed models were used to accommodate correlations among multiple observations made on the same physician by including random effects within each regression model. Furthermore, these models allowed us to account for unbalanced design in our data when not all physicians had an equal number of observations and data elements were collected asynchronously.[24] Analyses were performed in R version 3.2.2 (The R Project for Statistical Computing, Vienna, Austria); linear mixed models were performed using the 'nlme' package.[25]

We hypothesized that self-reporting on biweekly surveys would result in increases in the frequency of the reported behavior in each arm. We also hypothesized that, because of biweekly reflection and self-reporting on etiquette-based bedside behavior, patient experience scores would increase in the study arm.

RESULTS

Of the 80 hospitalists approached to participate in the study, 64 elected to participate (80% participation rate). The mean response rate to the survey was 57.4% for the intervention arm and 85.7% for the control arm. Higher response rates were not associated with improved patient experience scores. Of the respondents, 43.1% were younger than 35 years of age, 51.5% practiced in academic settings, and 53.1% were female. There was no statistical difference between hospitalists' baseline composite experience scores based on gender, age, academic hospitalist status, USMG status, and English as a second language status. Similarly, there were no differences in poststudy composite experience scores based on physician characteristics.

Physicians reported high rates of etiquette-based behavior at baseline (mean score, 83.9+/-3.3), and this showed moderate improvement over the study period (5.6 % [3.9%-7.3%, $P < 0.0001$]). Similarly, there was a moderate increase in frequency of self-reported behavior in the control arm (6.8% [3.5%-10.1%, $P < 0.0001$]). Hospitalists reported on 80.7% (77.6%-83.4%) of the biweekly surveys that they "almost always" wrapped up by asking, "Do you have any other questions or concerns" or something similar. In contrast, hospitalists reported on only 27.9% (24.7%-31.3%) of the biweekly survey that they "almost always" sat down in the patient room.

The composite physician domain Press Ganey experience scores were no different for the intervention arm and the control arm during the 12-month baseline period (21.8 vs. 21.7; $P = 0.90$) and the 12-month intervention period (21.6 vs. 21.5; $P = 0.75$). Baseline self-reported behaviors were not associated with baseline experience scores. Similarly, there were no differences between the arms on composite physician domain HCAHPS experience scores during baseline (2.1 vs. 2.3; $P = 0.13$) and intervention periods (2.2 vs. 2.1; $P = 0.33$).

The difference in difference analysis of the baseline and postintervention composite between the intervention arm and the control arm was not statistically significant for Press Ganey composite physician experience scores (-0.163 vs. -0.322; $P = 0.71$) or HCAHPS composite physician scores (-0.162 vs. -0.071; $P = 0.06$). The results did not change when controlled for survey response rate (percentage biweekly surveys completed by the hospitalist), age, gender, USMG status, English as a second language status, or percent clinical effort. The difference in difference analysis of the individual Press Ganey and HCAHPS physician domain items that were used to calculate the composite score was

TABLE 2. Difference in Difference Analysis of Pre-Intervention and Postintervention Physician Domain HCAHPS and Press Ganey Scores

Physician Domain Patient Satisfaction Item (score range)	Difference in Intervention Group	Difference in Control Group	*P* value
	HCAHPS Items		
Doctors treat with courtesy/respect (0-1)	-0.088	-0.007	0.06
Doctors listen carefully (0-1)	-0.067	0.030	0.06
Doctors explain in way you understand (0-1)	-0.006	-0.048	0.20
HCAHPS physician composite score (0-3)	-0.162	-0.071	0.06
	Press Ganey Items		
Time physician spent with you (0-5)	-0.062	-0.045	0.88
Physician addressed questions/worries (0-5)	-0.038	-0.144	0.24
Physician kept you informed (0-5)	-0.010	-0.115	0.35
Friendliness/courtesy of physician (0-5)	-0.048	-0.020	0.71
Skill of physician (0-5)	-0.047	-0.002	0.93
Press Ganey physician composite (0-25)	-0.163	-0.322	0.71

NOTE: Abbreviation: HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems.

also not statistically significant (Table 2).

Changes in self-reported etiquette-based behavior were not associated with any changes in composite Press Ganey and HCAHPS experience score or individual items of the composite experience scores between baseline and intervention period. Similarly, biweekly self-reported etiquette behaviors were not associated with composite and individual item experience scores derived from responses of the patients discharged during the same 2-week reporting period. The intra-class correlation between observations from the same physician was only 0.02%, suggesting that most of the variation in scores was likely due to patient factors and did not result from differences between physicians.

DISCUSSION

This 12-month randomized multicenter study of hospitalists showed that repeated self-reporting of etiquette-based behavior results in modest reported increases in performance of these behaviors. However, there was no associated increase in provider level patient experience scores at the end of the study period when compared to baseline scores of the same physicians or when compared to the scores of the control group. The study demonstrated feasibility of self-reporting of behaviors by physicians with high participation when provided modest incentives.

Educational and feedback strategies used to improve patient experience are very resource intensive. Training sessions provided at some hospitals may take hours, and sustained effects are unproved. The presence of an independent observer in patient rooms to generate feedback for providers is not scalable and sustainable outside of a research study environment.[9-11,15,17,26-29] We attempted to use physician repeated self-reporting to reinforce the important and easy to adopt components of etiquette-based behavior to develop a more easily sustainable strategy. This may have failed for several reasons.

When combining "always" and "usually" responses, the physicians in our study reported a high level of etiquette behavior at baseline. If physicians believe that they are performing well at baseline, they would not consider this to be an area in need of improvement. Bigger changes in behavior may have been possible had the physicians rated themselves less favorably at baseline. Inflated or high baseline self-assessment of performance might also have led to limited success of other types of educational interventions had they been employed.

Studies published since the rollout of our study have shown that physicians significantly overestimate how frequently they perform these etiquette behaviors.[30,31] It is likely that was the case in our study subjects. This may, at best, indicate that a much higher change in the level of self-reported performance would be needed to result in meaningful actual changes, or worse, may render self-reported etiquette behavior entirely unreliable. Interventions designed to improve etiquette-based behavior might need to provide feedback about performance.

A program that provides education on the importance of etiquette-based behaviors, obtains objective measures of performance of these behaviors, and offers individualized feedback may be more likely to increase the desired behaviors. This is a limitation of our study. However, we aimed to test a method that required limited resources. Additionally, our method for attributing HCAHPS scores to an individual physician, based on weighted scores that were calculated according to the proportion of days each hospitalist billed for the hospitalization, may be inaccurate. It is possible that each interaction does not contribute equally to the overall score. A team-based intervention and experience measurements could overcome this limitation.

CONCLUSION

This randomized trial demonstrated the feasibility of self-assessment of bedside etiquette behaviors by hospitalists but failed to demonstrate a meaningful impact on patient experience through self-report. These findings suggest that more intensive interventions, perhaps involving direct observation, peer-to-peer mentoring, or other techniques may be required to impact significantly physician etiquette behaviors.

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Prospective Cohort Study of Hospitalized Adults With Advanced Cancer: Associations Between Complications, Comorbidity, and Utilization

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BACKGROUND: Inpatient hospital stays account for more than a third of direct medical cancer care costs. Evidence on factors driving these costs can inform planning of services, as well as consideration of equity in access.

OBJECTIVE: To measure the association between hospital costs, and demographic, clinical, and system factors, for a cohort of adults with advanced cancer.

DESIGN: Prospective multisite cohort study.

SETTING: Four medical and cancer centers.

PATIENTS: Adults with advanced cancer admitted to a participating hospital between 2007 and 2011, excluding those with dementia. Final analytic sample included 1020 patients.

METHODS: With receipt of palliative care controlled for, the associations between hospital cost and patient factors were estimated. Factors covered the domains of demographics (age, sex, race), socioeconomics and systems (education, insurance, living will, proxy), clinical care (diagnoses, complications deemed to pose a threat to life or bodily functions, comorbidities, symptom burden, activities of daily living), and prior healthcare utilization (home help, analgesic prescribing).

OUTCOME MEASURE: Direct hospital costs.

RESULTS: A major (markedly abnormal) complication (+$8267; $P < 0.01$), a minor but not a major complication (+$5289; $P < 0.01$), and number of comorbidities (+$852; $P < 0.01$) were associated with higher cost, and admitting diagnosis of electrolyte disorders (–$4759; $P = 0.01$) and increased age (–$53; $P = 0.03$) were associated with lower cost.

CONCLUSIONS: Complications and comorbidity burden drive inhospital utilization for adults with advanced cancer. There is little evidence of sociodemographic associations and no apparent impact of advance directives. Attempts to control growth of hospital cancer costs require consideration of how the most resource-intensive patients are identified promptly and prioritized for cost-effective care. *Journal of Hospital Medicine* 2017;12:407-413. © 2017 Society of Hospital Medicine

Of the major chronic conditions that affect adult patients in the United States, cancer accounts for the highest levels of per capita spending.[1] Cost growth for cancer treatment has been substantial and persistent, from $72 billion in 2004 to $125 billion in 2010, and is projected to increase to $173 billion by 2020.[2] Thirty-five percent of US direct medical cancer costs are attributable to inpatient hospital stays.[3] Policy responses that can provide financially sustainable, high-quality models of care for patients with advanced cancer and other serious illness are urgently sought.[4-7]

Patterns and levels of resource utilization in providing healthcare to patients with serious illness reflect not only treatment choices but a complex set of relationships among demographic, clinical, and system factors.[8-10] Patient-level factors previously identified as potentially significant drivers of resource utilization among cancer populations specifically include age,[11] sex,[12] primary diagnosis,[13] and comorbidities.[11] Among end-of-life populations, significant associations have been found between cost and ethnicity,[14] socioeconomic status,[15] advance directive status,[16] insurance status,[16] and functional status.[17]

Evidence on factors strongly associated with cost of hospital admission for patients with advanced cancer can therefore inform provision and planning of healthcare. For example, when a specific diagnosis or clinical condition is found to be associated with high cost, then improving coordination and provision of care for this patient group may reduce avoidable utilization. Determining associations between sociodemographics and hospital care cost can help in identifying possible disparities in care, such as those that might occur when care differs by race, class, or insurance status.

We conducted the Palliative Care for Cancer (PC4C) study, a prospective multisite cohort study of the palliative care consultation team intervention for hospitalized adults with advanced cancer.[18,19] In our primary analysis, we controlled for receipt of palliative care and analyzed a rich patient-reported dataset to examine associations between hospital care cost, and sociodemographic factors, clinical variables,

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TABLE 1. Baseline Covariates for Analytic Sample (N = 1020)

	Continuous		Binary	
	Mean	SD	N	%
Age, y	60.4	12.1		
Female sex			562	55
Race				
White			680	67
Black			272	27
Education				
Elementary[a]			72	7
College[a]			504	49
Insurance				
Medicare only			191	19
Medicaid and Medicare			173	17
Advance directive				
Living will			443	43
Healthcare proxy			541	53
Primary diagnosis				
Solid tumor			683	67
Hematologic (leukemia or multiple myeloma)			25	2
Gynecologic			114	11
Central nervous system			17	2
Lymphoma			54	5
Admitting diagnosis				
Cancer			331	32
Electrolyte disorder			31	3
Infection			51	5
Symptom			385	38
Hematologic			27	3
Respiratory failure			22	2
Intestinal obstruction			24	2
Renal failure			15	1
Complication				
Major			53	5
Minor			169	17
Comorbidities: Elixhauser index	3.7	1.9		
Activities of daily living, total	10.4	2.4		
Symptom burden				
Number	7.9	3.5		
Severity	12.3	9.8		
Visiting nurse services, yes[b]			115	11
Home health aide, yes[b]			77	8
Prior analgesic use, yes[c]			529	52

[a]Highest level attained.

[b]Within 2 weeks before hospitalization.

[c]In morphine sulfate equivalents within week before hospitalization.

NOTE: References cases: Race: Neither white nor black; Insurance: Neither Medicare nor Medicaid; Education: High School; Primary diagnosis: Other cancer diagnosis; Admitting diagnosis: Other diagnosis; Complication: None.

Clinical interviewers observed each patient daily and reviewed the medical record to identify complications occurring prior to consultation day (palliative care) or reference day (usual care), where reference day is the day they had the most similar symptom severity to PC patients. Complications that were identified were reviewed by two physicians and categorized as described below; where there was disagreement, a third physician reviewed the complication and the majority decision was used. Complications were defined as medical events that occurred during hospitalization but were not present as comorbid conditions prior to admission. We included only complications that were deemed to pose a threat to life or bodily functions, and that were typically treated with parenteral medications, procedures, or intensive monitoring. Examples of complications include: (1) pneumonia if both respiratory symptoms and/or hypoxia were documented; and (2) arrhythmias if their occurrence increased the risk of ischemia or hemodynamic compromise (eg, atrial fibrillation with rapid ventricular response). Complications were further categorized as major (markedly abnormal or minor (mildly abnormal) (25).

Comorbidities: The Elixhauser index includes three cancer diagnoses: lymphoma, metastatic cancer, and solid tumor without metastasis. It was therefore possible for a patient to have an Elixhauser total of 0 (with a different advanced cancer diagnosis, eg, myeloma), or to have more than one cancer type counted in their Elixhauser total (if they had more than one of the counted cancers). Cancer diagnoses were therefore kept in the Elixhauser index to capture this variability.

Severity: The Condensed Memorial Symptom Assessment Scale (CMSAS) is a 14-item inventory on a 5 point scale of acuteness; 'Number' is an additive count of presence of 14 conditions (Yes|No), 'Severity' is the total of acuteness scale for all 14 conditions.

and prior healthcare utilization. The results provide evidence regarding the factors most associated with the cost of hospital-based cancer care.

METHODS

Design, Setting, Participants, Data Sources

The PC4C study has been described in detail by authors who

estimated the impact of specialist palliative care consultation teams on hospitalization cost.[19-21] We prospectively collected sociodemographic, clinical, prior utilization, and cost data for adult patients with a primary diagnosis of advanced cancer admitted to 4 large US hospitals between 2007 and 2011.

All 4 of these high-volume tertiary-care medical centers were selected for their high patient volume (to facilitate sample size) and research capacity (to facilitate proficient recruitment and data collection). Before the study was initiated, it was approved by the institutional review board of each facility. In addition, approval was sought from each attending physician at each hospital site; patients whose physician did not grant approval were not considered for enrollment. More than 95% of physicians gave their approval.

Patients were at least 18 years old and had a primary diagnosis of metastatic solid tumor; central nervous system malignancy; locally advanced head, neck, or pancreas cancer; metastatic melanoma; or transplant-ineligible lymphoma or multiple myeloma. Patients were excluded if they did not speak English, had a diagnosis of dementia, were unresponsive or nonverbal, had been admitted for routine chemotherapy, died or were discharged within 48 hours of admission, or had had a previous palliative care consultation.

Eligible patients were identified through daily review of admissions records and administrative databases. For each potential study patient identified, that patient's bedside nurse inquired about willingness to participate in the study. Then, for each willing patient, a trained clinical interviewer approached to explain the study and obtain informed consent. With the patient's consent, family members were also approached and enrolled with written informed consent.

Quantitative Variables

Independent variables. In the dataset, we identified 17 patient-level variables we hypothesized could be significantly associated with hospitalization cost. These variables covered 4 domains:

- Demographics: age, sex, race.
- Socioeconomics/systems: education level, insurance status, presence of advance directive (living will or healthcare proxy).
- Clinical care: primary cancer diagnosis, admitting diagnosis, comorbidities (Elixhauser index[22]), symptom burden and severity (Condensed Memorial Symptom Assessment Scale [CMSAS][23]), and activities of daily living[24] or presence of a hospital-acquired condition or complication.[25]
- Prior utilization: visiting homecare nurse and home health aide within 2 weeks before admission, and analgesic use in morphine sulfate equivalents within week before admission.

Data were collected through a combination of medical record review (age, sex, diagnoses, comorbidities, complications), patient interview (race, education, advance directive, CMSAS, activities of daily living, prior utilization), and hospital administrative databases (insurance). For use in regression, variables were divided into categories when appropriate. Table 1 lists these predictors and their prevalence in the analytic sample.

TABLE 2. Summary of Utilization for Analytic Sample (N = 1020)

	Mean	25th/50th/75th Percentiles
Direct cost of hospital stay, $	10,364	4950/7525/12,325
Hospital length of stay, d	8.5	5/7/9
Intensive care unit admission	12.1%	—
Palliative care consultation within 2 days	20%	—

Dependent variable. The outcome of interest in this analysis was total direct cost of hospital stay. Direct costs are those attributable to the care of a specific patient, as distinct from indirect costs, the shared overhead costs of running a hospital.[26] Cost data were extracted from hospital accounting databases and therefore reflect actual costs, the US dollar cost to the hospitals of care provided, also known as direct measurement.[27] Costs were standardized for geographical region using the Medicare Wage Index[28] and year using the Consumer Price Index[29] and are presented here in US dollars for 2011, the final year of data collection.

Statistical Methods

Primary analyses. We regressed total direct hospital costs against all predictors listed in Table 1. To control for receipt of palliative care, we used additional independent variables—a fixed-effects variable for each of 3 hospitals (the fourth hospital was used as the reference case) and a binary treatment variable (whether or not the patient was seen by a palliative care consultation team within 2 days of hospital admission).[19,20]

Associations between cost and patient-level covariates were derived with use of a generalized linear model with a γ distribution and a log link,[30] selected after comparative evaluation of performance for multiple linear and nonlinear modeling options.[31]

For each patient-level covariate, we estimated average marginal effects. For continuous variables, we estimated the marginal increase in cost associated with a 1-unit increase in the variable. For binary variables, we estimated the average incremental effect, the increase in cost associated with a move from the reference group, holding all other covariates to their original values. All analyses were performed with Stata Version 12.[32]

Secondary analyses. Primary analyses showed that number of patient comorbidities (Elixhauser index) was strongly associated with complications and comorbidity count. Prior analyses with these data have shown that palliative care had a larger cost-saving effect for patients with a larger number of comorbidities.[20] Additional analyses were therefore performed to examine associations between complications, utilization, and palliative care. First, we cross-tabulated the

TABLE 3. Associations Between Patient-Level Baseline Factors and Hospitalization Costs (N = 1020)

	Average Marginal Effect, $	P	95% Confidence Interval	
Age, y	–53	0.03	–99	–6
Female sex	–470	0.39	–1535	596
Race				
White	81	0.94	–1967	2128
Black	–163	0.89	–2392	2066
Education				
Elementary[a]	–1197	0.21	–3065	671
College[a]	271	0.63	–841	1382
Insurance				
Medicare only	139	0.85	–1302	1581
Medicaid and Medicare	–795	0.27	–2210	621
Advance directive				
Living will	–252	0.72	–1640	1137
Healthcare proxy	–623	0.39	–2034	789
Primary diagnosis				
Solid tumor	–1102	0.18	–2704	499
Hematologic (leukemia or multiple myeloma)	1437	0.48	–2524	5398
Gynecologic	–881	0.39	–2870	1108
Central nervous system	3425	0.22	–1994	8843
Lymphoma	–117	0.93	–2708	2475
Admitting diagnosis				
Cancer	698	0.39	–891	2287
Electrolyte disorder	–4759	<0.01	–7928	–1590
Infection	–880	0.51	–3473	1712
Symptom	–1446	0.07	–3021	128
Hematologic	–2051	0.23	–5386	1285
Respiratory failure	–506	0.78	–4126	3114
Intestinal obstruction	852	0.64	–2712	4416
Renal failure	–4160	0.06	–8461	141
Complication				
Major	8267	<0.01	4509	12,025
Minor	5289	<0.01	3480	7097
Comorbidities: Elixhauser index	852	<0.01	550	1153
Activities of daily living, total	–68	0.52	–277	141
Symptom burden				
Number	207	0.18	–92	507
Severity	–32	0.56	–142	77
Visiting nurse services, yes[b]	–591	0.50	–2300	1118
Home health aide, yes[b]	–696	0.51	–2752	1359
Prior analgesic use, yes[c]	370	0.48	–664	1405

[a]Highest level attained.

[b]Within 2 weeks before hospitalization.

[c]In morphine sulfate equivalents within week before hospitalization.

NOTE: See Table 1 footnote. Statistical model used was a generalized linear model with a γ distribution and a log link. For continuous variables, average marginal effect is the estimated marginal increase in cost associated with a 1-unit increase in the variable; for binary variables, it is the increase in cost associated with a move from the reference group, holding all other covariates to their original values.

sample by complications status (none; minor or major) and receipt of timely palliative care, and we present their summary utilization data. Second, we estimated the effect for each complications stratum (none; minor or major) of receiving timely palliative care on cost. These estimates are calculated consistent with prior work with these data: We used propensity scores to balance patients who received the treatment (palliative care) with patients who did not (usual care only),[33,34] and we used a generalized linear model with a γ distribution and a log link to regress the direct hospital care cost on the binary treatment variable and all predictors listed in Table 1.[19-21]

RESULTS

Participants

We have previously detailed that in our study there were 1023 patients eligible for cost analysis,[19] of whom three were missing data in a field in Table 1 and excluded from this paper. The final analytic sample (N = 1020) is presented according to baseline covariates in Table 1 and according to summary utilization measures in Table 2.

Main Results

The results of the primary analysis, estimating the association between patient-level factors and cost of hospitalization, are presented in Table 3.

These results show the evidence of an association with cost is strongest for 3 clinical factors: a major complication (+$8267; 95% confidence interval [CI], $4509-$12,025), a minor but not a major complication (+$5289; CI, $3480-$7097), and number of comorbidities (+$852; CI, $550-$1153). In addition, there is evidence of associations between lower cost and admitting diagnosis of electrolyte disorders (–$4759; CI, –$7928 to –$1590) and older age (–$53; CI, –$99 to –$6). There is no significant association between primary diagnosis, symptom burden or other clinical factors, sociodemographic factors or healthcare utilization prior to admission and direct hospitalization costs.

Results of the secondary analyses of associations between complications, utilization, and palliative care are listed in Table 4. Patients are stratified by complication (none; major | minor) and their direct cost of hospital care and hospital length of stay (LOS) presented by treatment group (palliative care; usual care only). The data show that within each strata patients who received palliative care had lower costs and LOS than those who received usual care only. Estimated effects of palliative care on utilization is found to be statistically significant in all four quadrants, with a larger cost-effect in the complications stratum than the non-complications stratum.

Sensitivity Analysis

Fifty-one patients died during admission. After removing these cases, because of concerns about possible unobserved heterogeneity,[35] we checked our primary (Table 3) and secondary (Table 4) results. Patients discharged alive had results substantively similar to those of the entire sample.

TABLE 4. Utilization Stratified by Complication Status and Palliative Care Receipt, Weighted Samples (N = 1020)

	No Complication (N = 798)		Minor or Major Complication (N = 222)	
	Palliative Care (n = 184)	Usual Care Only (n = 684)	Palliative Care (n = 25)	Usual Care Only (n = 197)
Mean cost of hospital care, $	8572	10,597	15,706	18,734
Estimated effect of palliative care	–$1506 ($P = 0.01$) 95% CI, –$2647 to –$366		–$5617 ($P = 0.02$) 95% CI, –$10,134 to –$1101	
Mean hospital length of stay, d	7.2	7.9	11.6	14.6
Estimated effect of palliative care	–0.8 ($P = 0.03$) 95% CI, –1.5 to –0.8		–3.6 ($P < 0.01$) 95% CI, –6.1 to –1.1	

NOTE: Patients with a major complication (n = 53) and patients with a minor complication (n = 169) were merged for this analysis to provide sufficient sample size for matching and estimating effects of palliative care. Estimated effects were derived in a fashion consistent with previous methods used with these data: Within each stratum (no complication; minor or major complication), the palliative care and usual care only groups were matched using propensity scores for all variables listed in Table 1 (except admitting diagnosis). Estimated effect of palliative care represents the average treatment effect (estimated effect on outcome of moving a patient from the usual care only group to the palliative care group, holding all other values constant) and was calculated with a generalized linear model with all propensity score variables as predictors in regression. Abbreviation: CI, confidence interval.

DISCUSSION

Results from our primary analysis (Table 3) suggest that complications and number of comorbidities are the key drivers of hospitalization cost for adults with advanced cancer. Hospitalization for electrolyte disorders and age are both negatively associated with cost.

The association found between higher cost and hospital-acquired complications (HACs) is consistent with other studies' finding that HACs often result in higher cost, longer LOS, and increased inhospital mortality.[36] Since those studies were reported, policy attention has been increasingly focused on HACs.[37] Our findings are notable in that, though prior evidence has also suggested high hospital cost is multifactorial, driven by a diversity of demographic, socioeconomic, and clinical factors, this rich patient-reported dataset suggests that, compared with other variables, HACs are emphatically the largest driver of cost. Moreover, cancer patients typically are a vulnerable population, more prone to complications and thus also to potentially avoidable treatments and higher cost. Our prior work suggested earlier palliative care consultation can reduce cost, in part by shortening LOS and reducing the opportunity for HACs to develop[19,20]; our secondary analysis (Table 4) suggested a palliative care team's involvement in HAC treatment can significantly reduce cost of care as well. These associations possibly derive from changed treatment choices and shorter LOS. Further work is needed to better elucidate the role of palliative care in the prevention of HACs in seriously ill patients.

That the number of comorbidities was found to be a key driver of hospitalization cost is consistent with recent findings that high spending on seriously ill patients is associated with having multiple chronic conditions rather than any specific primary diagnosis.[38,39] It is important to note that, unlike impending complications, serious chronic conditions generally are known at admission and can be addressed prospectively through provision and policy. A prior analysis with these data found that palliative care consultation was more cost-effective for patients with a larger number of comorbidities.[20] Our 2 studies together suggest that, notwithstanding the preferable alternative of avoiding hospitalization entirely, palliative care and other skilled coordination of care services ought to be prioritized for inpatients with multiple serious illnesses and the highest medical complexity. This patient group has both the highest costs and the greatest amenability to skilled transdisciplinary intervention, possibly because multiple chronic conditions affect patients interactively, complicating identification of appropriate polypharmacy responses and prioritization of treatments.

Our findings also may help direct appropriate use of palliative care services. The recently published American Society of Clinical Oncology palliative care guidelines note that all patients with advanced cancer (eg, those enrolled in our study) should receive dedicated palliative care services, early in the disease course, concurrent with active treatment.[40] Workforce estimates suggest that the current and future numbers of palliative care practitioners will be unable to meet the ASCO recommendations alone never mind patients with other serious illnesses (eg, advanced heart failure, COPD, CKD).[41] As such, specialized palliative care services will need to be targeted to the patient populations that can benefit most from these services. Whereas cost should not be the principle driver specialized palliative care provision, it will likely be an important component due to both the necessity of allocating scarce resources in the most effective way and the evidence that in care of the seriously-ill lower costs are often a proxy for improved patient experience.

These findings also have implications for research: Different conditions and presumably different combinations of conditions have very different implications for hospital care costs for a cohort of adults with advanced cancer. Given the increasing number of co-occurring conditions among seriously ill patients, and the increasing costs of cancer care and of treating multimorbidity cases, it is essential to further our understanding of the relationship between comorbidities and costs in order to plan and finance care for advanced cancer patients.

Limitations and Generalizability

In this observational study, reported associations may be attributable to unobserved confounding that our analyses failed to control.

Our results reflect associations in a prospective multisite study of advanced cancer patients hospitalized in the United States. It is not clear how generalizable our findings are to patients without cancer, to patients in nonhospital settings, and to patients in other health systems and countries. Analyzing cost from the hospital perspective does not take into account that the most impactful way to reduce cost is to avoid hospitalization entirely.

Results of our secondary analysis will not necessarily be robust to patient groups, as specific weights likely will vary by sample. The idea that costs vary by condition, however, is important nevertheless. Elixhauser total was derived with use of the enhanced *ICD-9-CM* (*International Classification of Diseases, Ninth Revision, Clinical Modification*) algorithm from Quan et al.[42] and does not include subsequent Elixhauser Comorbidity Software updates recommended by the Healthcare Cost and Utilization Project (HCUP; Agency for Healthcare Research and Quality).[43] The Elixhauser index is recommended over Charlson and other comorbidity indices by both HCUP[45] and a recent systematic review.[44]

One possible unobserved factor is prior chemotherapy, which is associated with increased hospitalization risk. Related factors that are somewhat controlled for in the study include cancer stage (advanced cancer was an eligibility criterion) and receipt of analgesics within the week before admission (patients admitted for routine chemotherapy were excluded from analyses at the outset).

CONCLUSION

Other studies have identified a wide range of sociodemographic, clinical, and health system factors associated with healthcare utilization. Our results suggest that, for cost of hospital admission among adults with advanced cancer, the most important drivers of utilization are complications and comorbidities. Hospital costs for patients with advanced cancer constitute a major part of US healthcare spending, and these results suggest the need to prioritize high-quality, cost-effective care for patients with multiple serious illnesses.

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Quality of Care of Hospitalized Infective Endocarditis Patients: Report from a Tertiary Medical Center

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OBJECTIVE: There have been no recent studies describing the management and outcomes of patients with infective endocarditis (IE).

PATIENTS AND METHODS: We conducted a retrospective cohort study of adult patients admitted to a tertiary medical center from 2007 to 2011 with a Duke criteria consistent discharge diagnosis of IE. We examined concordance with guideline recommendations. Outcomes included embolic events, inhospital and 1-year mortality, length of stay (LOS) and cardiac surgery. We used descriptive statistics to describe the cohort and Fisher exact and unpaired t tests to compare native valve endocarditis (NVE) with prosthetic valve endocarditis (PVE).

RESULTS: Of 170 patients, definite IE was present in 135 (79.4%) and possible IE in 35 (20.6%); 74.7% had NVE, and 25.3% had PVE. Mean ± standard deviation age was 60.0 ± 17.9 years. Comparing PVE to NVE, patients with PVE were less likely to have embolic events (14.0% vs. 32.3%; $P = 0.03$), had shorter LOS (median 12.0 days vs. 14.0 days; $P = 0.047$), but they did not show a statistically significant difference in inhospital mortality (20.9% vs. 12.6%; $P = 0.21$). Of 170, patients 27.6% (n = 47) underwent valve surgery. Most patients received timely blood cultures and antibiotics. Guideline-recommended consults were underused, with 86.5%, 54.1%, and 47.1% of patients receiving infectious disease, cardiac surgery, and cardiology consultation, respectively. As the number of consultations increased (from 0 to 3), we observed a nonsignificant trend toward reduction in 6-month readmission and 12-month mortality.

CONCLUSION: IE remains a disease with significant morbidity and mortality. There are gaps in the care of IE patients, most notably underuse of specialty consultation. *Journal of Hospital Medicine* 2017;12:414-420. © 2017 Society of Hospital Medicine

Infective endocarditis (IE) affected an estimated 46,800 Americans in 2011, and its incidence is increasing due to greater numbers of invasive procedures and prevalence of IE risk factors.[1-3] Despite recent advances in the treatment of IE, morbidity and mortality remain high: in-hospital mortality in IE patients is 15% to 20%, and the 1-year mortality rate is approximately 40%.[2,4,5]

Poor IE outcomes may be the result of difficulty in diagnosing IE and identifying its optimal treatments. The American Heart Association (AHA), the American College of Cardiology (ACC), and the European Society of Cardiology (ESC) have published guidelines to address these challenges. Recent guidelines recommend a multidisciplinary approach that includes cardiology, cardiac surgery, and infectious disease (ID) specialty involvement in decision-making.[5,6]

In the absence of published quality measures for IE management, guidelines can be used to evaluate the quality of care of IE. Studies have showed poor concordance with guideline recommendations but did not examine agreement with more recently published guidelines.[7,8] Furthermore, few studies have examined the management, outcomes, and quality of care received by IE patients. Therefore, we aimed to describe a modern cohort of patients with IE admitted to a tertiary medical center over a 4-year period. In particular, we aimed to assess quality of care received by this cohort, as measured by concordance with AHA and ACC guidelines to identify gaps in care and spur quality improvement (QI) efforts.

METHODS

Design and Study Population

We conducted a retrospective cohort study of adult IE patients admitted to Baystate Medical Center (BMC), a 716-bed tertiary academic center that covers a population of 800,000 people throughout western New England. We used the International Classification of Diseases (ICD)–Ninth Revision, to identify IE patients discharged with a principal or secondary diagnosis of IE between 2007 and 2011 (codes 421.0, 421.1, 421.9, 424.9, 424.90, and 424.91). Three co-authors confirmed the diagnosis by conducting

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a review of the electronic health records.

We included only patients who met modified Duke criteria for definite or possible IE.[5] Definite IE defines patients with pathological criteria (microorganisms demonstrated by culture or histologic examination or a histologic examination showing active endocarditis); or patients with 2 major criteria (positive blood culture and evidence of endocardial involvement by echocardiogram), 1 major criterion and 3 minor criteria (minor criteria: predisposing heart conditions or intravenous drug (IVD) use, fever, vascular phenomena, immunologic phenomena, and microbiologic evidence that do not meet the major criteria) or 5 minor criteria. Possible IE defines patients with 1 major and 1 minor criterion or 3 minor criteria.[5]

Data Collection

We used billing and clinical databases to collect demographics, comorbidities, antibiotic treatment, 6-month readmission and 1-year mortality. Comorbid conditions were classified into Elixhauser comorbidities using software provided by the Healthcare Costs and Utilization Project of the Agency for Healthcare Research and Quality.[9,10]

We obtained all other data through electronic health record abstraction. These included microbiology, type of endocarditis (native valve endocarditis [NVE] or prosthetic valve endocarditis [PVE]), echocardiographic location of the vegetation, and complications involving the valve (eg, valve perforation, ruptured chorda, perivalvular abscess, or valvular insufficiency).

Using 2006 AHA/ACC guidelines,[11] we identified quality metrics, including the presence of at least 2 sets of blood cultures prior to start of antibiotics and use of transthoracic echocardiogram (TTE) and transesophageal echocardiogram (TEE). Guidelines recommend using TTE as first-line to detect valvular vegetations and assess IE complications. TEE is recommended if TTE is nondiagnostic and also as first-line to diagnose PVE. We assessed the rate of consultation with ID, cardiology, and cardiac surgery specialties. While these consultations were not explicitly emphasized in the 2006 AHA/ACC guidelines, there is a class I recommendation in 2014 AHA/ACC guidelines[5] to manage IE patients with consultation of all these specialties.

We reported the number of patients with intracardiac leads (pacemaker or defibrillator) who had documentation of intracardiac lead removal. Complete removal of intracardiac leads is indicated in IE patients with infection of leads or device (class I) and suggested for IE caused by *Staphylococcus aureus* or fungi (even without evidence of device or lead infection), and for patients undergoing valve surgery (class IIa).[5] We entered abstracted data elements into a RedCap database, hosted by Tufts Clinical and Translational Science Institute.[12]

Outcomes

Outcomes included embolic events, strokes, need for cardiac surgery, LOS, inhospital mortality, 6-month readmission, and 1-year mortality. We identified embolic events using documentation of clinical or imaging evidence of an embolic event to the cerebral, coronary, peripheral arterial, renal, splenic, or pulmonary vasculature. We used record extraction to identify incidence of valve surgery. Nearly all patients who require surgery at BMC have it done onsite. We compared outcomes among patients who received less than 3 vs. 3 consultations provided by ID, cardiology, and cardiac surgery specialties. We also compared outcomes among patients who received 0, 1, 2, or 3 consultations to look for a trend.

Statistical Analysis

We divided the cohort into patients with NVE and PVE because there are differences in pathophysiology, treatment, and outcomes of these groups. We calculated descriptive statistics, including means/standard deviation (SD) and n (%). We conducted univariable analyses using Fisher exact (categorical), unpaired t tests (Gaussian), or Kruskal-Wallis equality-of-populations rank test (non-Gaussian). Common language effect sizes were also calculated to quantify group differences without respect to sample size.[13,14] Analyses were performed using Stata 14.1. (StataCorp LLC, College Station, Texas). The BMC Institutional Review Board approved the protocol.

RESULTS

We identified a total of 317 hospitalizations at BMC meeting criteria for IE. Of these, 147 hospitalizations were readmissions or did not meet the clinical criteria of definite or possible IE. Thus, we included a total of 170 patients in the final analysis. Definite IE was present in 135 (79.4%) and possible IE in 35 (20.6%) patients.

Patient Characteristics

Of 170 patients, 127 (74.7%) had NVE and 43 (25.3%) had PVE. Mean ± SD age was 60.0 ± 17.9 years, 66.5% (n = 113) of patients were male, and 79.4% (n = 135) were white (Table 1). Hypertension and chronic kidney disease were the most common comorbidities. The median Gagne score[15] was 4, corresponding to a 1-year mortality risk of 15%. Predisposing factors for IE included previous history of IE (n = 14 or 8.2%), IVD use (n = 23 or 13.5%), and presence of long-term venous catheters (n = 19 or 11.2%). Intracardiac leads were present in 17.1% (n = 29) of patients. Bicuspid aortic valve was reported in 6.5% (n = 11) of patients with NVE. Patients with PVE were older (+11.5 years, 95% confidence interval [CI] 5.5, 17.5) and more likely to have intracardiac leads (44.2% vs. 7.9%; $P < 0.001$; Table 1).

Microbiology and Antibiotics

Staphylococcus aureus was isolated in 40.0% of patients (methicillin-sensitive: 21.2%, n = 36; methicillin-resistant: 18.8%, n = 32) and vancomycin (88.2%, n = 150) was the most common initial antibiotic used. Nearly half (44.7%, n = 76) of patients received gentamicin as part of their initial antibiotic regimen. Appendix 1 provides information on

TABLE 1. Characteristics of 170 Hospitalized Patients with Infective Endocarditis

	Overall (n = 170)	NVE (n = 127)	PVE (n = 43)		
Variable	n (%)	n (%)	n (%)	CLES	*P* value[a]
Age (mean/SD; y)	60.0/17.9	57.1/17.3	68.7/16.8	0.68	<0.001
Male vs. female	113 (66.5)	80 (63.0)	33 (76.7)	0.25	0.13
Race					
White	135 (79.4)	99 (78.0)	36 (83.7)		
Black	19 (11.2)	15 (11.8)	4 (9.3)		
Hispanic	13 (7.7)	10 (7.9)	3 (7.0)		
Other	3 (1.8)	3 (2.4)	0 (0.0)	0.18	0.93
Comorbidities					
Hypertension	101 (59.4)	74 (58.3)	27 (62.8)	0.08	0.72
Chronic kidney disease	61 (35.9)	40 (31.5)	21 (48.8)	0.30	0.045
Requiring hemodialysis	27 (15.9)	22 (17.3)	5 (11.6)	0.14	0.47
Chronic lung disease	27 (15.9)	22 (17.3)	5 (11.6)	0.14	0.47
Congestive heart failure	38 (22.4)	26 (20.5)	12 (27.9)	0.16	0.40
Insulin-dependent diabetes	38 (22.4)	26 (20.5)	12 (27.9)	0.16	0.40
HIV/AIDS	4 (2.4)	2 (1.6)	2 (4.7)	0.09	0.27
Cancer	26 (15.3)	16 (12.6)	10 (23.3)	0.13	0.14
Bicuspid aortic valve	11 (6.5)	11 (8.7)	-		
1-yr Gagne mortality risk (median/interquartile range)	15%/8%,25%	15%/8%,25%	15%/8%,25%	0.10	0.57
Previous endocarditis	14 (8.2)	7 (5.5)	7 (16.3)	0.34	0.048
Intracardiac lead present[b]	29 (17.1)	10 (7.9)	19 (44.2)	0.80	<0.001
Intravenous drug user	23 (13.5)	19 (15.0)	4 (9.3)	0.15	0.45
Long-term venous catheter	19 (11.2)	16 (12.6)	3 (7.0)	0.15	0.41
Intensive care unit admission	41 (24.1)	33 (26.0)	8 (18.6)	0.15	0.41
Mechanical ventilation in first 2 days	11 (6.5)	10 (7.9)	1 (2.3)	0.19	0.29
Inotrope/vasopressor use in first 2 days	11 (6.5)	11 (8.7)	0 (0.0)	0.31	0.07
Blood culture isolates					
MSSA	36 (21.2)	27 (21.3)	9 (20.9)		
MRSA	32 (18.8)	25 (19.7)	7 (16.3)		
CNS	10 (5.9)	6 (4.7)	4 (9.3)		
Viridans *streptococci*	29 (17.1)	24 (18.9)	5 (11.6)		
Group B *streptococci*	10 (5.9)	9 (7.1)	1 (2.3)		
Enterococcus	26 (15.3)	14 (11.0)	12 (27.9)		
Polymicrobial	3 (1.8)	3 (2.4)	0 (0.0)		
Other isolate[c]	14 (8.2)	10 (7.9)	4 (9.3)		
Culture negative	10 (5.9)	9 (7.1)	1 (2.3)	0.53	0.21
Initial antibiotics					
Vancomycin	150 (88.2)	113 (89.0)	37 (86.1)	0.08	0.59
Gentamicin	76 (44.7)	51 (40.2)	25 (58.1)	0.30	0.051
Piperacillin-tazobactam	68 (40.0)	52 (40.9)	16 (37.2)	0.07	0.72
Ejection fraction <40%	22 (12.9)	11 (8.7)	11 (25.6)	0.44	0.008
Infected valve if determined	(n=143)	(n=100)	(n=43)		
Mitral	59 (41.3)	51 (51.0)	8 (18.6)		
Aortic	41 (28.7)	22 (22.0)	19 (44.2)		
Aortic and mitral	24 (16.8)	12 (12.0)	12 (27.9)		
Pulmonic	1 (0.7)	1 (1.0)	0 (0.0)		
Tricuspid	8 (5.6)	6 (6.0)	2 (4.7)		
Multiple[d]	10 (7.0)	8 (8.0)	2 (4.7)	0.77	0.001
Location of infected valve could not be determined	27 (15.9)	27 (21.3%)	0 (0.0%)	0.51	<0.001
Vegetation size					
<10 mm	119 (70.0)	87 (68.5)	32 (74.4)		
>10 to <15mm	23 (13.5)	19 (15.0)	4 (9.3)		
≥15 mm	28 (16.5)	21 (16.5)	7 (16.3)	0.11	0.54

[a]Independent samples t test (normal); Fisher exact test (categorical).

[b]Intracardiac lead includes permanent pacemaker and implantable cardioverter defibrillator.

[c]"Other" includes *Peptostreptococcus* (n = 1), *Streptococcus pneumoniae* (n = 2), *Abiotrophia defectiva* (n = 1), *Granulicatella adiacens* (n = 1), *Streptococcus bovis* (n = 2), HACEK: *Haemophilus parainfluenza* (n = 1), *Enterobacter cloacae* (n = 1), *Escherichia coli* (n = 1), *Proteus mirabilis* (n = 1), *Pseudomonas aeruginosa* (n = 1); Proteus unspecified (n = 1), Serratia unspecified (n = 1).

[d]Mitral and tricuspid (n = 4); mitral and pulmonic (n = 1); aortic and tricuspid (n = 4); aortic, mitral and tricuspid (n = 1).

NOTE: Abbreviations: AIDS, acquired immunodeficiency syndrome; CLES, common language effect size, 0.2 small, 0.5 medium, 0.8+ large; CNS, coagulase-negative *Staphylococcus* species; HIV, human immunodeficiency virus; MRSA, methicillin-resistant *Staphylococcus aureus;* MSSA, methicillin-sensitive *Staphylococcus aureus;* NVE, native valve endocarditis; PVE, prosthetic valve endocarditis; SD, standard deviation.

TABLE 2. Quality of Care of Patients Hospitalized with Infective Endocarditis

	Overall (n = 170)	NVE (n = 127)	PVE (n = 43)	CLES	*P* value[a]
	n (%)	n (%)	n (%)		
Blood cultures and microbiology					
2+ sets of blood cultures drawn	165 (97.1)	122 (96.1)	43 (100.0)	0.20	0.33
Blood cultures drawn 1st admission day	121 (71.2)	91 (71.7)	30 (69.8)	0.04	0.85
Antibiotics started 1st admission day	152 (89.4)	113 (89.0)	39 (90.7)	0.05	1.00
Echocardiography					
TTE	125 (73.5)	101 (79.5)	24 (55.8)	0.47	0.005
TEE	100 (58.8)	72 (56.7)	28 (65.1)	0.15	0.37
Both	67 (39.4)	52 (40.9)	15 (34.9)	0.11	0.59
TTE performed before TEE	62/67 (92.5)	50/52 (96.2)	12/15 (80.0)	0.50	0.07
Consultations					0.61
Infectious disease	147 (86.5)	111 (87.4)	36 (83.7)	0.15	0.16
Cardiac surgery	92 (54.1)	73 (57.5)	19 (44.2)	0.37	0.60
Cardiology	80 (47.1)	58 (45.7)	22 (51.2)	0.15	
Intracardiac lead removed	6/29 (20.7)	5/10 (50.0)	1/19(5.3)	1.00	0.02

[a]Independent samples t test (normal); Fisher exact test (categorical) among observations with complete documentation

NOTE: Abbreviations: CLES, common language effect size, 0.2 small, 0.5 medium, 0.8+ large; NVE, native valve endocarditis; PVE, prosthetic valve endocarditis; TEE, transesophageal echocardiography; TTE, transthoracic echocardiography

final blood culture results, prosthetic versus native valve IE, and antimicrobial agents that each patient received. PVE patients were more likely to receive gentamicin as their initial antibiotic regimen than NVE (58.1% vs. 40.2%; *P* = 0.051; Table 1).

Echocardiography and Affected Valves

As per study inclusion criteria, all patients received echocardiography (either TTE, TEE, or both). Overall, the most common infected valve was mitral (41.3%), n = 59), followed by aortic valve (28.7%), n = 41). Patients in whom the location of infected valve could not be determined (15.9%, n = 27) had echocardiographic features of intracardiac device infection or intracardiac mass (Table 1).

Quality of Care

Nearly all (n = 165, 97.1%) of patients had at least 2 sets of blood cultures drawn, most on the first day of admission (71.2%). The vast majority of patients (n = 152, 89.4%) also received their first dose of antibiotics on the day of admission. Ten (5.9%) patients did not receive any consults, and 160 (94.1%) received at least 1 consultation. An ID consultation was obtained for most (147, 86.5%) patients; cardiac surgery consultation was obtained for about half of patients (92, 54.1%), and cardiology consultation was also obtained for nearly half of patients (80, 47.1%). One-third (53, 31.2%) did not receive a cardiology or cardiac surgery consult, two-thirds (117, 68.8%) received either a cardiology or a cardiac surgery consult, and one-third (55, 32.4%) received both.

Of the 29 patients who had an intracardiac lead, 6 patients had documentation of the device removal during the index hospitalization (5 or 50.0% of patients with NVE and 1 or 5.3% of patients with PVE; *P* = 0.02; Table 2).

Outcomes

Evidence of any embolic events was seen in 27.7% (n = 47) of patients, including stroke in 17.1% (n = 29). Median LOS for all patients was 13.5 days, and 6-month readmission among patients who survived their index admission was 51.0% (n = 74/145; 95% CI, 45.9%-62.7%). Inhospital mortality was 14.7% (n = 25; 95% CI: 10.1%-20.9%) and 12-month mortality was 22.4% (n = 38; 95% CI, 16.7%-29.3%). Inhospital mortality was more frequent among patients with PVE than NVE (20.9% vs. 12.6%; *P* = 0.21), although this difference was not statistically significant. Complications were more common in NVE than PVE (any embolic event: 32.3% vs. 14.0%, *P* = 0.03; stroke, 20.5% vs. 7.0%, *P* = 0.06; Table 3).

Although there was a trend toward reduction in 6-month readmission and 12-month mortality with incremental increase in the number of specialties consulted (ID, cardiology and cardiac surgery), the difference was not statistically significant (Figure 1). In addition, comparing outcomes of embolic events, stroke, 6-month readmission, and 12-month mortality between those who received 3 consults (28.8%, n = 49) to those with fewer than 3 (71.2%, n = 121) did not show statistically significant differences.

Of 92 patients who received a cardiac surgery consult, 73 had NVE and 19 had PVE. Of these, 47 underwent valve surgery, 39 (of 73) with NVE (53.42%) and 8 (of 19) with PVE (42.1%). Most of the NVE patients (73.2%) had more than 1 indication for surgery. The most common indications for surgery among NVE patients were significant valvular dysfunction resulting in heart failure (65.9%), followed by mobile vegetation (56.1%) and recurrent embolic events (26.8%). The most common indication for surgery in PVE was persistent bacteremia or recurrent embolic events (75.0%).

TABLE 3. Outcome of Hospitalized Patients with Infective Endocarditis

	Overall (n = 170)	NVE (n = 127)	PVE (n = 43)		
	n (%)	n (%)	n (%)	CLES	*P* value[a]
Outcomes					
Any embolic event	47 (27.7)	41 (32.3)	6 (14.0)	0.18	0.03
Stroke	29 (17.1)	26 (20.5)	3 (7.0)	0.16	0.06
Complications seen in echocardiography					
Ruptured chordae	8/127 (6.3)	8 (6.3)	NA	NA	NA
Severe valvular insufficiency	94 (55.3)	80 (63.0)	14 (32.6)	0.50	0.001
Perivalvular abscess	16 (9.4)	10 (7.9)	6 (14.0)	0.18	0.24
Valve perforation	19 (11.2)	17 (13.4)	2 (4.7)	0.24	0.16
Shunt or fistula	1 (0.6)	1 (0.8)	0 (0.0)	0.14	1.00
Inhospital mortality	25 (14.7)	16 (12.6)	9 (20.9)	0.20	0.21
Length of stay, d (median/IQR)	13.5/9.0,22.0	14.0/9.0,24.0	12.0/8.0,18.0	0.36	0.047
6-mo readmission[b]	74 (51.0)	52 (46.9)	22 (64.7)	0.30	0.08
12-mo mortality	38 (22.4%)	25 (19.7%)	13 (30.2%)	0.22	0.20
Cardiac surgery					
None	123 (72.4)	88 (69.3)	35 (81.4)		
Current admission	43 (25.3)	36 (28.4)	7 (16.3)		
Other admission	4 (2.4)	3 (2.4)	1 (2.3)	0.24	0.21

[a]Independent samples t test (normal); Fisher exact test (categorical).

[b]Among 145 subjects who did not die during index admission.

NOTE: Abbreviations: CLES, common language effect size, 0.2 small, 0.5 medium, 0.8+ large; IQR, interquartile range; NA, not applicable; NVE, native valve endocarditis; PVE, prosthetic valve endocarditis.

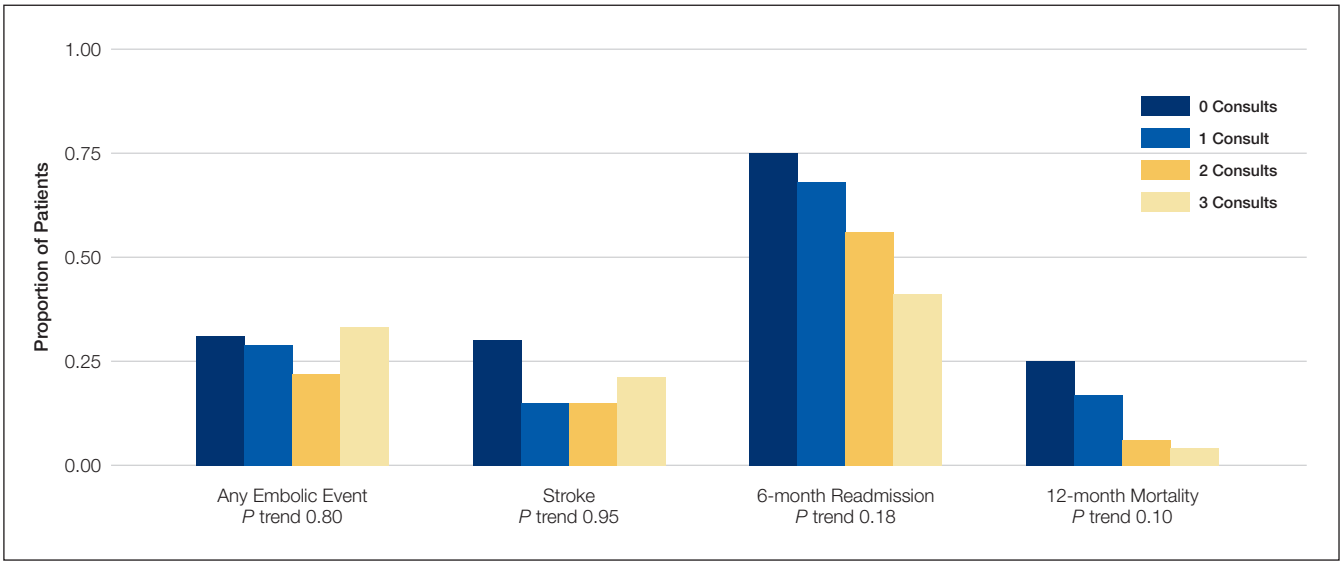

FIG. Comparison of outcomes of any embolic event, stroke, 6-month readmission and 12-month mortality between infective endocarditis patients who received infectious disease, cardiology, and cardiac surgery consultations.

DISCUSSION

In this study, we described the management, quality of care, and outcomes of IE patients in a tertiary medical center. We found that the majority of hospitalized patients with IE were older white men with comorbidities and IE risk factors. The complication rate was high (27.7% with embolic events) and the inhospital mortality rate was in the lower range reported by prior studies [14.7% vs. 15%-20%].[5] Nearly one-third of patients (n = 47, 27.7%) received valve surgery. Quality of care received was generally good, with most patients receiving early blood cultures, echocardiograms, early antibiotics, and timely ID consultation. We identified important gaps in care, including a failure to consult cardiac surgery in nearly half of patients and failure to consult cardiology in more than half of patients.

Our findings support work suggesting that IE is no longer primarily a chronic or subacute disease of younger patients with IVD use, positive human immunodeficiency virus status, or bicuspid aortic valves.[1,4,16,17] The International Collaboration on Endocarditis-Prospective Cohort Study,[4] a

multinational prospective cohort study (2000-2005) of 2781 adults with IE, reported a higher prevalence of patients with diabetes or on hemodialysis, IVD users, and patients with long-term venous catheter and intracardiac leads than we found. Yet both studies suggest that the demographics of IE are changing. This may partially explain why IE mortality has not improved in recent years:[2,3] patients with older age and higher comorbidity burden may not be considered good surgical candidates.

This study is among the first to contribute information on concordance with IE guidelines in a cohort of U.S. patients. Our findings suggest that most patients received timely blood culture, same-day administration of empiric antibiotics, and ID consultation, which is similar to European studies.[7,18] Guideline concordance could be improved in some areas. Overall documentation of the management plan regarding the intracardiac leads could be improved. Only 6 of 29 patients with intracardiac leads had documentation of their removal during the index hospitalization.

The 2014 AHA/ACC guidelines[5] and the ESC guidelines[6] emphasized the importance of multidisciplinary management of IE. As part of the Heart Valve Team at BMC, cardiologists provide expertise in diagnosis, imaging and clinical management of IE, and cardiac surgeons provide consultation on whether to pursue surgery and optimal timing of surgery. Early discussion with surgical team is considered mandatory in all complicated cases of IE.[6,18] Infectious disease consultation has been shown to improve the rate of IE diagnosis, reduce the 6-month relapse rate,[19] and improve outcomes in patients with *S aureus* bacteremia.[20] In our study 86.5% of patients had documentation of an ID consultation; cardiac surgery consultation was obtained in 54.1% and cardiology consultation in 47.1% of patients.

We observed a trend towards lower rates of 6-month readmission and 12-month mortality among patients who received all 3 consults (Figure 1), despite the fact that rates of embolic events and stroke were higher in patients with 3 consults compared to those with fewer than 3. Obviously, the lack of confounder adjustment and lack of power limits our ability to make inferences about this association, but it generates hypotheses for future work. Because subjects in our study were cared for prior to 2014, multidisciplinary management of IE with involvement of cardiology, cardiac surgery, and ID physicians was observed in only one-third of patients. However, 117 (68.8%) patients received either cardiology or cardiac surgery consults. It is possible that some physicians considered involving both cardiology and cardiac surgery consultants as unnecessary and, therefore, did not consult both specialties. We will focus future QI efforts in our institution on educating physicians about the benefits of multidisciplinary care and the importance of fully implementing the 2014 AHA/ACC guidelines.

Our findings around quality of care should be placed in the context of 2 studies by González de Molina et al[8] and Delahaye et al[7] These studies described considerable discordance between guideline recommendations and real-world IE care. However, these studies were performed more than a decade ago and were conducted before current recommendations to consult cardiology and cardiac surgery were published.

In the 2014 AHA/ACC guidelines, surgery prior to completion of antibiotics is indicated in patients with valve dysfunction resulting in heart failure; left-sided IE caused by highly resistant organisms (including fungus or *S aureus*); IE complicated by heart block, aortic abscess, or penetrating lesions; and presence of persistent infection (bacteremia or fever lasting longer than 5 to 7 days) after onset of appropriate antimicrobial therapy. In addition, there is a Class IIa indication of early surgery in patients with recurrent emboli and persistent vegetation despite appropriate antibiotic therapy and a Class IIb indication of early surgery in patients with NVE with mobile vegetation greater than 10 mm in length. Surgery is recommended for patients with PVE and relapsing infection.

It is recommended that IE patients be cared for in centers with immediate access to cardiac surgery because the urgent need for surgical intervention can arise rapidly.[5] We found that nearly one-third of included patients underwent surgery. Although we did not collect data on indications for surgery in patients who did not receive surgery, we observed that 50% had a surgery consult, suggesting the presence of 1 or more surgical indications. Of these, half underwent valve surgery. Most of the NVE patients who underwent surgery had more than 1 indication for surgery. Our surgical rate is similar to a study from Italy[3] and overall in the lower range of reported surgical rate (25%-50%) from other studies.[21] The low rate of surgery at our center may be related to the fact that the use of surgery for IE has been hotly debated in the literature,[21] and may also be due to the low rate of cardiac surgery consultation.

Our study has several limitations. We identified eligible patients using a discharge ICD-9 coding of IE and then confirmed the presence of Duke criteria using record review. Using discharge diagnosis codes for endocarditis has been validated, and our additional manual chart review to confirm Duke criteria likely improved the specificity significantly. However, by excluding patients who did not have documented evidence of Duke criteria, we may have missed some cases, lowering sensitivity. The performance on selected quality metrics may also have been affected by our inclusion criteria. Because we included only patients who met Duke criteria, we tended to include patients who had received blood cultures and echocardiograms, which are part of the criteria. Thus, we cannot comment on use of diagnostic testing or specialty consultation in patients with suspected IE. This was a single-center study and may not represent patients or current practices seen in other institutions. We did not collect data on some of the predisposing factors to NVE (for example, baseline rheumatic heart disease or preexisting valvular heart disease) because it is estimated that less than 5% of IE in the U.S. is superimposed on rheumatic heart disease.[4] We likely underestimated 12-month mortality rate because we did not cross-reference our findings again

the National Death Index; however, this should not affect the comparison of this outcome between groups.

CONCLUSION

Our study confirms reports that IE epidemiology has changed significantly in recent years. It also suggests that concordance with guideline recommendations is good for some aspects of care (eg, echocardiogram, blood cultures), but can be improved in other areas, particularly in use of specialty consultation during the hospitalization. Future QI efforts should emphasize the role of the heart valve team or endocarditis team that consists of an internist, ID physician, cardiologist, cardiac surgeon, and nursing. Finally, efforts should be made to develop strategies for community hospitals that do not have access to all of these specialists (eg, early transfer, telehealth).

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Do HCAHPS Doctor Communication Scores Reflect the Communication Skills of the Attending on Record? A Cautionary Tale from a Tertiary-Care Medical Service

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BACKGROUND: Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores measure patient satisfaction with hospital care. It is not known if these reflect the communication skills of the attending physician on record. The Four Habits Coding Scheme (4HCS) is a validated instrument that measures bedside physician communication skills according to 4 habits, namely: investing in the beginning, eliciting the patient's perspective, demonstrating empathy, and investing in the end.

OBJECTIVE: To investigate whether the 4HCS correlates with provider HCAHPS scores.

METHODS: Using a cross-sectional design, consenting hospitalist physicians (n = 28), were observed on inpatient rounds during 3 separate encounters. We compared hospitalists' 4HCS scores with their doctor communication HCAHPS scores to assess the degree to which these correlated with inpatient physician communication skills. We performed sensitivity analysis excluding scores returned by patients cared for by more than 1 hospitalist.

RESULTS: A total of 1003 HCAHPS survey responses were available. Pearson correlation between 4HCS and doctor communication scores was not significant, at 0.098 (-0.285, 0.455; $P = 0.619$). Also, no significant correlations were found between each habit and HCAHPS. When including only scores attributable to 1 hospitalist, Pearson correlation between the empathy habit and the HCAHPS respect score was 0.515 (0.176, 0.745; $P = 0.005$). Between empathy and overall doctor communication, it was 0.442 (0.082, 0.7; $P = 0.019$).

CONCLUSION: Attending-of-record HCAHPS scores do not correlate with 4HCS. After excluding patients cared for by more than 1 hospitalist, demonstrating empathy did correlate with the doctor communication and respect HCAHPS scores. *Journal of Hospital Medicine* 2017;12:421-427. © 2017 Society of Hospital Medicine

Communication is the foundation of medical care.[1] Effective communication can improve health outcomes, safety, adherence, satisfaction, trust, and enable genuine informed consent and decision-making.[2-9] Furthermore, high-quality communication increases provider engagement and workplace satisfaction, while reducing stress and malpractice risk.[10-15]

Direct measurement of communication in the healthcare setting can be challenging. The "Four Habits Model," which is derived from a synthesis of empiric studies[8,16-20] and theoretical models[21-24] of communication, offers 1 framework for assessing healthcare communication. The conceptual model underlying the 4 habits has been validated in studies of physician and patient satisfaction.[1,4,25-27] The 4 habits are: investing in the beginning, eliciting the patient's perspective, demonstrating empathy, and investing in the end. Each habit is divided into several identifiable tasks or skill sets, which can be reliably measured using validated tools and checklists.[28] One such instrument, the Four Habits Coding Scheme (4HCS), has been evaluated against other tools and demonstrated overall satisfactory inter-rater reliability and validity.[29,30]

The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, developed under the direction of the Centers for Medicare and Medicaid Services (CMS) and the Agency for Healthcare Research and Quality, is an established national standard for measuring patient perceptions of care. HCAHPS retrospectively measures global perceptions of communication, support and empathy from physicians and staff, processes of care, and the overall patient experience. HCAHPS scores were first collected nationally in 2006 and have been publicly reported since 2008.[31] With the introduction of value-based purchasing in 2012, health system revenues are now tied to HCAHPS survey performance.[32] As a result, hospitals are financially mo-

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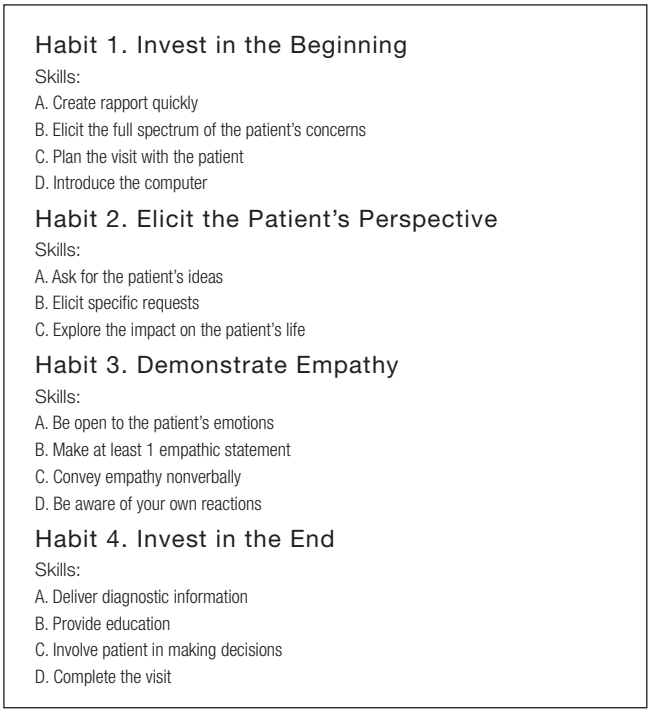

FIG. 1. The Four Habits Model.

tivated to improve HCAHPS scores but lack evidence-based methods for doing so. Some healthcare organizations have invested in communication training programs based on the available literature and best practices.[2,33-35] However, it is not known how, if at all, HCAHPS scores relate to physicians' real-time observed communication skills.

To examine the relationship between physician communication, as reported by global HCAHPS scores, and the quality of physician communication skills in specific encounters, we observed hospitalist physicians during inpatient bedside rounds and measured their communication skills using the 4HCS.

METHODS

Study Design

The study utilized a cross sectional design; physicians who consented were observed on rounds during 3 separate encounters, and we compared hospitalists' 4HCS scores to their HCAHPS scores to assess the correlation. The study was approved by the Institutional Review Board of the Cleveland Clinic.

Population

The study was conducted at the main campus of the Cleveland Clinic. All physicians specializing in hospital medicine who had received 10 or more completed HCAHPS survey responses while rounding on a medicine service in the past year were invited to participate in the study. Participation was voluntary; night hospitalists were excluded. A research nurse was trained in the Four Habits Model[28] and in the use of the 4HCS coding scheme by the principal investigator. The nurse observed each physician and ascertained the presence of communication behaviors using the 4HCS tool. Physicians were observed between August 2013 and August 2014. Multiple observations per physician could occur on the same day, but only 1 observation per patient was used for analysis. Observations consisted of a physician's first encounter with a hospitalized patient, with the patient's consent. Observations were conducted during encounters with English-speaking and cognitively intact patients only. Resident physicians were permitted to stay and conduct rounds per their normal routine. Patient information was not collected as part of the study.

Measures

HCAHPS. For each physician, we extracted all HCAHPS scores that were collected from our hospital's Press Ganey database. The HCAHPS survey contains 22 core questions divided into 7 themes or domains, 1 of which is doctor communication. The survey uses frequency-based questions with possible answers fixed on a 4-point scale (4=always, 3=usually, 2=sometimes, 1=never). Our primary outcome was the doctor communication domain, which comprises 3 questions: 1) During this hospital stay, how often did the doctors treat you with respect? 2) During this hospital stay, how often did the doctors listen to you? and 3) During this hospital stay, how often did the doctors explain things in a language you can understand? Because CMS counts only the percentage of responses that are graded "always," so-called "top box" scoring, we used the same measure.

The HCAHPS scores are always attributed to the physician at the time of discharge even if he may not have been responsible for the care of the patient during the entire hospital course. To mitigate contamination from patients seen by multiple providers, we cross-matched length of stay (LOS) data with billing data to determine the proportion of days a patient was seen by a single provider during the entire length of stay. We stratified patients seen by the attending providers to less than 50%, 50% to less than 100%, and at 100% of the LOS. However, we were unable to identify which patients were seen by other consultants or by residents due to limitations in data gathering and the nature of the database.

The Four Habits. The Four Habits are: invest in the beginning, elicit the patient's perspective, demonstrate empathy, and invest in the end (Figure 1). Specific behaviors for Habits 1 to 4 are outlined in the Appendix, but we will briefly describe the themes as follows. Habit 1, invest in the beginning, describes the ability of the physician to set a welcoming environment for the patient, establish rapport, and collaborate on an agenda for the visit. Habit 2, elicit the patient's perspective, describes the ability of the physician to explore the patients' worries, ideas, expectations, and the impact of the illness on their lifestyle. Habit 3, demonstrate empathy, describes the physician's openness to the patient's emotions as well as the ability to explore, validate; express curiosity, and openly accept these feelings. Habit 4, invest in the end, is a measure of

TABLE 1. Overall 4HCS Score Distribution

	Habit 1		Habit 2		Habit 3		Habit 4		Total	
Bedside Observation Order	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Observation 1	4.39	0.83	3.64	0.78	4.68	0.55	4.68	0.61	17.39	2.33
Observation 2	4.32	0.72	3.50	0.88	4.57	0.57	4.61	0.63	17.00	2.37
Observation 3	4.46	0.74	3.61	0.83	4.71	0.53	4.64	0.68	17.43	2.36

NOTE: Abbreviations: 4HCS, 4 Habits Coding Scheme; SD, standard deviation.

the physician's ability to counsel patients in a language built around their original concerns or worries, as well as the ability to check the patients' understanding of the plan.[2,29-30]

4HCS. The 4HCS tool (Appendix) measures discreet behaviors and phrases based on each of the Four Habits (Figure 1). With a scoring range from a low of 4 to a high of 20, the rater at bedside assigns a range of points on a scale of 1 to 5 for each habit. It is an instrument based on a teaching model used widely throughout Kaiser Permanente to improve clinicians' communication skills. The 4HCS was first tested for interrater reliability and validity against the Roter Interaction Analysis System using 100 videotaped primary care physician encounters.[29] It was further evaluated in a randomized control trial. Videotapes from 497 hospital encounters involving 71 doctors from a variety of clinical specialties were rated by 4 trained raters using the coding scheme. The total score Pearson's R and intraclass correlation coefficient (ICC) exceeded 0.70 for all pairs of raters, and the interrater reliability was satisfactory for the 4HCS as applied to heterogeneous material.[30]

STATISTICAL ANALYSIS

Physician characteristics were summarized with standard descriptive statistics. Pearson correlation coefficients were computed between HCAHPS and 4HCS scores. All analyses were performed with RStudio (Boston, MA). The Pearson correlation between the averaged HCAHPS and 4HCS scores was also computed. A correlation with a *P* value less than 0.05 was considered statistically significant. With 28 physicians, the study had a power of 88% to detect a moderate correlation (greater than 0.50) with a 2-sided alpha of 0.05. We also computed the correlations based on the subgroups of data with patients seen by providers for less than 50%, 50% to less than 100%, and 100% of LOS. All analyses were conducted in SAS 9.2 (SAS Institute Inc., Cary, NC).[36]

RESULTS

There were 31 physicians who met our inclusion criteria. Of 29 volunteers, 28 were observed during 3 separate inpatient encounters and made up the final sample. A total of 1003 HCAHPS survey responses were available for these physicians. Participants were predominantly female (60.7%), with an average age of 39 years. They were in practice for an average of 4 years (12 were in practice more than 5 years), and 9 were observed on a teaching rotation.

TABLE 2. Overall HCAHPS Score Distribution

HCAHPS	Median	Range
Explain	87.6	78.0-93.5
Listen	87.1	75.9-95.8
Respect	93.7	86.8-100
Overall	89.6	80.9-93.7

NOTE: Abbreviation: HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems.

The means of the overall 4HCS scores per observation were 17.39 ± 2.33 for the first, 17.00 ± 2.37 for the second, and 17.43 ± 2.36 for third bedside observation. The mean 4HCS scores per observation, broken down by habit, appear in Table 1. The ICC among the repeated scores within the same physician was 0.81. The median number of HCAHPS survey returns was 32 (range = [8, 85], with mean = 35.8, interquartile range = [16, 54]). The median overall HCAHPS doctor communication score was 89.6 (range = 80.9-93.7). Participants scored the highest in the respect subdomain and the lowest in the explain subdomain. Median HCAHPS scores and ranges appear in Table 2.

Because there were no significant associations between 4HCS scores or HCAHPS scores and physician age, sex, years in practice, or teaching site, correlations were not adjusted. Figure 2A and 2B show the association between mean 4HCS scores and HCAHPS scores by physician. There was no significant correlation between overall 4HCS and HCAHPS doctor communication scores (Pearson correlation coefficient 0.098; 95% confidence interval [CI], -0.285, 0.455). The individual habits also were not correlated with overall HCAHPS scores or with their corresponding HCAHPS domain (Table 3).

For 325 patients, 1 hospitalist was present for the entire LOS. In sensitivity analysis limiting observations to these patients (Figure 2C, Figure 2D, Table 3), we found a moderate correlation between habit 3 and the HCAHPS respect score (Pearson correlation coefficient 0.515; 95% CI, 0.176, 0.745; $P = 0.005$), and a weaker correlation between habit 3 and the HCAHPS overall doctor communication score (0.442; 95% CI, 0.082, 0.7; $P = 0.019$). There were no other significant correlations between specific habits and HCAHPS scores.

Table 3. 4HCS vs. HCAHPS: Pearson Correlations, CI, and *P* Values for Each Strata of Hospitalist Involvement. All returns; <50%, 50%-<100%, and 100% LOS

	All returns, N = 1003	<50% of LOS, n = 246	50%-<100% of LOS, n = 432	100% LOS, n = 325
Overall 4HCS vs. overall doctor communication	0.098 (-0.285, 0.455) *P* = 0.619	-0.2 (-0.533, 0.187) *P* = 0.307	0.024 (-0.360, 0.400) *P* = 0.907	0.283 (-0.101, 0.593) *P* = 0.145
Habit 1 vs. respect domain	0.249 (-0.136, 0.569) *P* = 0.201	-0.065 (-0.428, 0.316) *P* = 0.743	0.096 (-0.295, 0.459) *P* = 0.633	0.343 (-0.034, 0.635) *P* = 0.074
Habit 2 vs. listen domain	-0.019 (-0.389, 0.357) *P* = 0.923	-0.245 (-0.566, 0.141) *P* = 0.21	-0.021 (-0.398, 0.362) *P* = 0.916	0.178 (-0.209, 0.517) *P* = 0.364
Habit 3 vs. respect domain	0.296 (-0.087, 0.602) *P* = 0.126	-0.038 (-0.405, 0.34) *P* = 0.85	-0.037 (-0.412, 0.348) *P* = 0.853	0.515 (0.176, 0.745) *P* = 0.005
Habit 4 vs. explain domain	-0.094 (-0.451, 0.289) *P* = 0.633	-0.316 (-0.616, 0.065) *P* = 0.101	0.159 (-0.235, 0.508) *P* = 0.429	-0.042 (-0.409, 0.336) *P* = 0.831
Habit 1 vs. overall doctor communication	0.163 (-0.224, 0.505) *P* = 0.408	-0.145 (-0.492, 0.241) *P* = 0.46	0.040 (-0.345, 0.414) *P* = 0.843	0.301 (-0.081, 0.606) *P* = 0.119
Habit 2 vs. overall doctor communication	0.048 (-0.331, 0.414) *P* = 0.808	-0.222 (-0.549, 0.165) *P* = 0.257	0.065 (-0.323, 0.434) *P* = 0.747	0.211 (-0.176, 0.541) *P* = 0.282
Habit 3 vs. overall doctor communication	0.203 (-0.184, 0.536) *P* = 0.299	-0.099 (-0.455, 0.285) *P* = 0.617	-0.069 (-0.437, 0.320) *P* = 0.734	0.442 (0.082, 0.7) *P* = 0.019
Habit 4 vs. overall doctor communication	-0.040 (-0.407, 0.338) *P* = 0.839	-0.218 (-0.547, 0.169) *P* = 0.265	0.010 (-0.371, 0.389) *P* = 0.960	0.097 (-0.287, 0.454) *P* = 0.624

NOTE: Abbreviations: 4HCS, 4 Habits Coding Scheme; CI, confidence interval; HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems; LOS, length of stay.

DISCUSSION

In this observational study of hospitalist physicians at a large tertiary care center, we found that communication skills, as measured by the 4HCS, varied substantially among physicians but were highly correlated within patients of the same physician. However, there was virtually no correlation between the attending physician of record's 4HCS scores and their HCAHPS communication scores. When we limited our analysis to patients who saw only 1 hospitalist throughout their stay, there were moderate correlations between demonstration of empathy and both the HCAHPS respect score and overall doctor communication score. There were no trends across the strata of hospitalist involvement. It is important to note that the addition of even 1 different hospitalist to the LOS removes any association. Habits 1 and 2 are close to significance in the 100% subgroup, with a weak correlation. Interestingly, Habit 4, which focuses on creating a plan with the patient, showed no correlation at all with patients reporting that doctors explained things in language they could understand.

Development and testing of the HCAHPS survey began in 2002, commissioned by CMS and the Agency for Healthcare Research and Quality for the purpose of measuring patient experience in the hospital. The HCAHPS survey was endorsed by the National Quality Forum in 2005, with final approval of the national implementation granted by the Office of Management and Budget later that year. The CMS began implementation of the HCAHPS survey in 2006, with the first required public reporting of all hospitals taking place in March 2008.[37-41] Based on CMS' value-based purchasing initiative, hospitals with low HCAHPS scores have faced substantial penalties since 2012. Under these circumstances, it is important that the HCAHPS measures what it purports to measure. Because HCAHPS was designed to compare hospitals, testing was limited to assessment of internal reliability, hospital-level reliability, and construct validity. External validation with known measures of physician communication was not performed.[41] Our study appears to be the first to compare HCAHPS scores to directly observed measures of physician communication skills. The lack of association

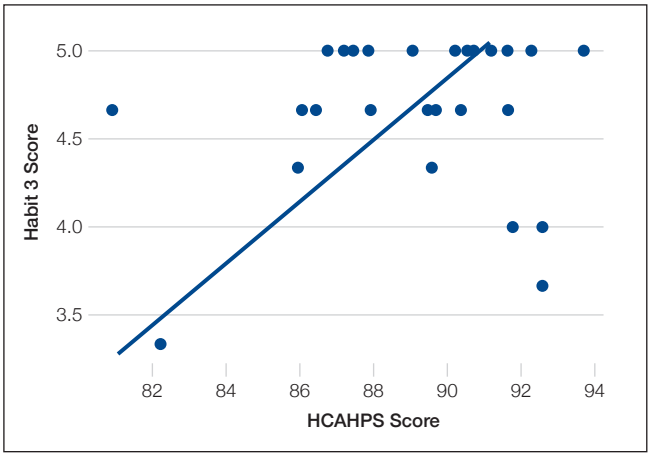

FIG. 2A. Habit 3 vs. Doctor Communication HCAHPS Scores for 28 Physicians. All returns, N = 1003; Pearson 0.203 CI, -0.184, 0.536; *P* = 0.299.

NOTE: Abbreviations: CI, confidence interval; HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems.

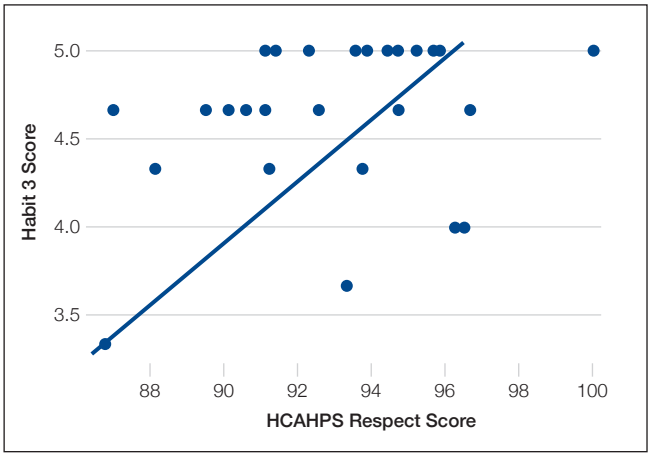

FIG. 2B. Habit 3 vs. Respect Domain for 28 physicians. All returns, N = 1003, Pearson 0.296 CI, -0.087, 0.602; *P* = 0.126.

NOTE: Abbreviations: CI, confidence interval; HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems.

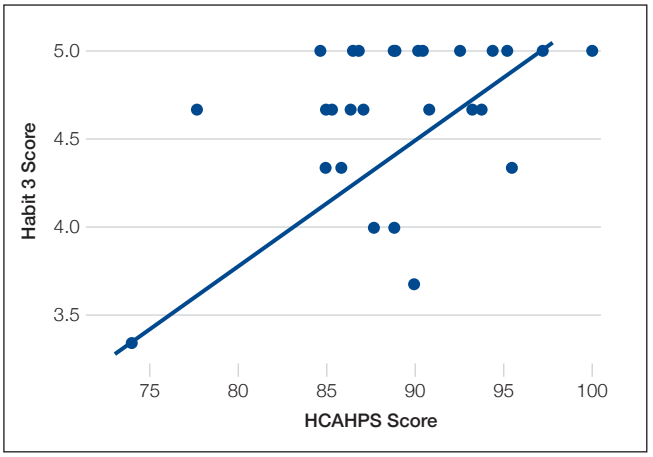

FIG. 2C. Habit 3 vs. Doctor Communication HCAHPS Scores for 28 physicians. 100% involvement in LOS; n = 325; Pearson 0.442 CI, 0.082, 0.7; *P* = 0.019

NOTE: Abbreviations: CI, confidence interval; LOS, length of stay; HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems.

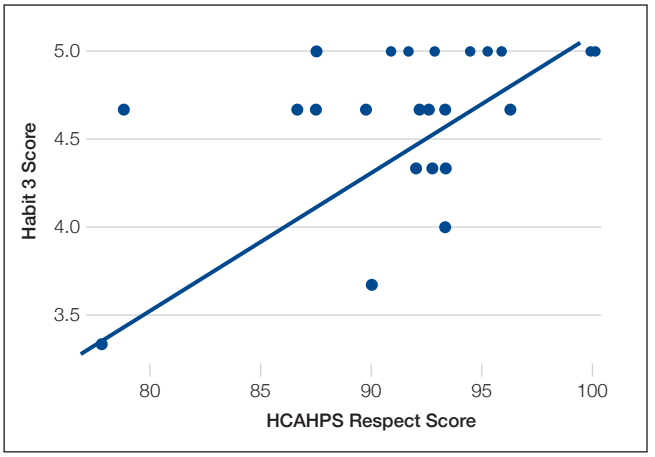

FIG. 2D. Habit 3 vs. Respect Domain for 28 physicians. 100% involvement in LOS; n = 325; Pearson 0.515 CI, 0.176, 0.745; *P* = 0.005

NOTE: Abbreviations: CI, confidence interval; LOS, length of stay; HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems.

between the 2 should sound a cautionary note to hospitals who seek to tie individual compensation to HCAHPS scores to improve them. In particular, the survey asks for a rating for all the patient's doctors, not just the primary hospitalist. We found that, for hospital stays with just 1 hospitalist, the HCAHPS score reflected observed expression of empathy, although the correlation was only moderate, and HCAHPS were not correlated with other communication skills. Of all communication skills, empathy may be most important. Almost the entire body of research on physician communication cites empathy as a central skill. Empathy improves patient outcomes[1-9,13-14,16-18,42] such as adherence to treatment, loyalty, and perception of care; and provider outcomes[10-12,15] such as reduced burnout and a decreased likelihood of malpractice litigation.

It is less clear why other communication skills did not correlate with HCAHPS, but several differences in the measures themselves and how they were obtained might be responsible. It is possible that HCAHPS measures something broader than physician communication. In addition, the 4HCS was developed and normed on outpatient encounters as is true for virtually all doctor-patient coding schemes.[43] Little is known about inpatient communication best practices. The timing of HCAHPS may also degrade the relationship between observed and reported communication. The HCAHPS questionnaires, collected after discharge, are retrospective reconstructions that are subject to recall bias and recency effects.[44,45] In contrast, our observations took place in real time and were specific to the face-to-face interactions that take place when physicians engage patients at the bedside. Third, the response rate for HCAHPS surveys is only 30%, leading to potential sample bias.[46] Respondents represent discharged patients who are willing and able to answer surveys, and may not be representative of all hospitalized pa-

tients. Finally, as with all global questions, the meaning any individual patient assigns to terms like "respect" may vary.

Our study has several limitations. The HCAHPS and 4HCS scores were not obtained from the same sample of patients. It is possible that the patients who were observed were not representative of the patients who completed the HCAHPS surveys. In addition, the only type of encounter observed was the initial visit between the hospitalist and the patient, and did not include communication during follow-up visits or on the day of discharge. However, there was a strong ICC among the 4HCS scores, implying that the 4HCS measures an inherent physician skill, which should be consistent across patients and encounters. Coding bias of the habits by a single observer could not be excluded. High intra-class correlation could be due in part to observer preferences for particular communication styles. Our sample included only 28 physicians. Although our study was powered to rule out a moderate correlation between 4HCS scores and HCAHPS scores (Pearson correlation coefficient greater than 0.5), we cannot exclude weaker correlations. Most correlations that we observed were so small that they would not be clinically meaningful, even in a much larger sample.

CONCLUSIONS

Our findings that HCAHPS scores did not correlate with the communication skills of the attending of record have some important implications. In an environment of value-based purchasing, most hospital systems are interested in identifying modifiable provider behaviors that optimize efficiency and payment structures. This study shows that directly measured communication skills do not correlate with HCAHPS scores as generally reported, indicating that HCAHPS may be measuring a broader domain than only physician communication skills. Better attribution based on the proportion of care provided by an individual physician could make the scores more useful for individual comparisons, but most institutions do not report their data in this way. Given this limitation, hospitals should refrain from comparing and incentivizing individual physicians based on their HCAHPS scores, because this measure was not designed for this purpose and does not appear to reflect an individual's skills. This is important in the current environment in which hospitals face substantial penalties for underperformance but lack specific tools to improve their scores. Furthermore, there is concern that this type of measurement creates perverse incentives that may adversely alter clinical practice with the aim of improving scores.[46]

Training clinicians in communication and teaming skills is one potential means of increasing overall scores.[15] Improving doctor-patient and team relationships is also the right thing to do. It is increasingly being demanded by patients and has always been a deep source of satisfaction for physicians.[15,47] Moreover, there is an increasingly robust literature that relates face-to-face communication to biomedical and psychosocial outcomes of care.[48] Identifying individual physicians who need help with communication skills is a worthwhile goal. Unfortunately, the HCAHPS survey does not appear to be the appropriate tool for this purpose.

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Association Between Opioid and Benzodiazepine Use and Clinical Deterioration in Ward Patients

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BACKGROUND: Opioids and benzodiazepines are frequently used in hospitals, but little is known about outcomes among ward patients receiving these medications.

OBJECTIVE: To determine the association between opioid and benzodiazepine administration and clinical deterioration.

DESIGN: Observational cohort study.

SETTING: 500-bed academic urban tertiary-care hospital.

PATIENTS: All adults hospitalized on the wards from November 2008 to January 2016 were included. Patients who were "comfort care" status, had tracheostomies, sickle-cell disease, and patients at risk for alcohol withdrawal or seizures were excluded.

MEASUREMENTS: The primary outcome was the composite of intensive care unit transfer or ward cardiac arrest. Discrete-time survival analysis was used to calculate the odds of this outcome during exposed time periods compared to unexposed time periods with respect to the medications of interest, with adjustment for patient demographics, comorbidities, severity of illness, and pain score.

RESULTS: In total, 120,518 admissions from 67,097 patients were included, with 67% of admissions involving opioids, and 21% involving benzodiazepines. After adjustment, each equivalent of 15 mg oral morphine was associated with a 1.9% increase in the odds of the primary outcome within 6 hours (odds ratio [OR], 1.019; 95% confidence interval [CI], 1.013-1.026; $P < 0.001$), and each 1 mg oral lorazepam equivalent was associated with a 29% increase in the odds of the composite outcome within 6 hours (OR, 1.29; CI, 1.16-1.45; $P < 0.001$).

CONCLUSION: Among ward patients, opioids were associated with increased risk for clinical deterioration in the 6 hours after administration. Benzodiazepines were associated with even higher risk. These results have implications for ward-monitoring strategies. *Journal of Hospital Medicine* 2017;12:428-434. © 2017 Society of Hospital Medicine

Chronic opioid and benzodiazepine use is common and increasing.[1-5] Outpatient use of these medications has been associated with hospital readmission and death,[6-12] with concurrent use associated with particularly increased risk.[13,14] Less is known about outcomes for hospitalized patients receiving these medications.

More than half of hospital inpatients in the United States receive opioids,[15] many of which are new prescriptions rather than continuation of chronic therapy.[16,17] Less is known about inpatient benzodiazepine administration, but the prevalence may exceed 10% among elderly populations.[18] Hospitalized patients often have comorbidities or physiological disturbances that might increase their risk related to use of these medications. Opioids can cause central and obstructive sleep apneas,[19-21] and benzodiazepines contribute to respiratory depression and airway relaxation.[22] Benzodiazepines also impair psychomotor function and recall,[23] which could mediate the recognized risk for delirium and falls in the hospital.[24,25] These findings suggest pathways by which these medications might contribute to clinical deterioration.

Most studies in hospitalized patients have been limited to specific populations[15,26-28] and have not explicitly controlled for severity of illness over time. It remains unclear whether associations identified within particular groups of patients hold true for the broader population of general ward inpatients. Therefore, we aimed to determine the independent association between opioid and benzodiazepine administration and clinical deterioration in ward patients.

MATERIALS AND METHODS

Setting and Study Population

We performed an observational cohort study at a 500-bed urban academic hospital. Data were obtained from all adults hospitalized on the wards between November 1, 2008, and January 21, 2016. The study protocol was approved by the University of Chicago Institutional Review Board (IRB#15-0195).

Data Collection

The study utilized de-identified data from the electronic health record (EHR; Epic Systems Corporation, Verona,

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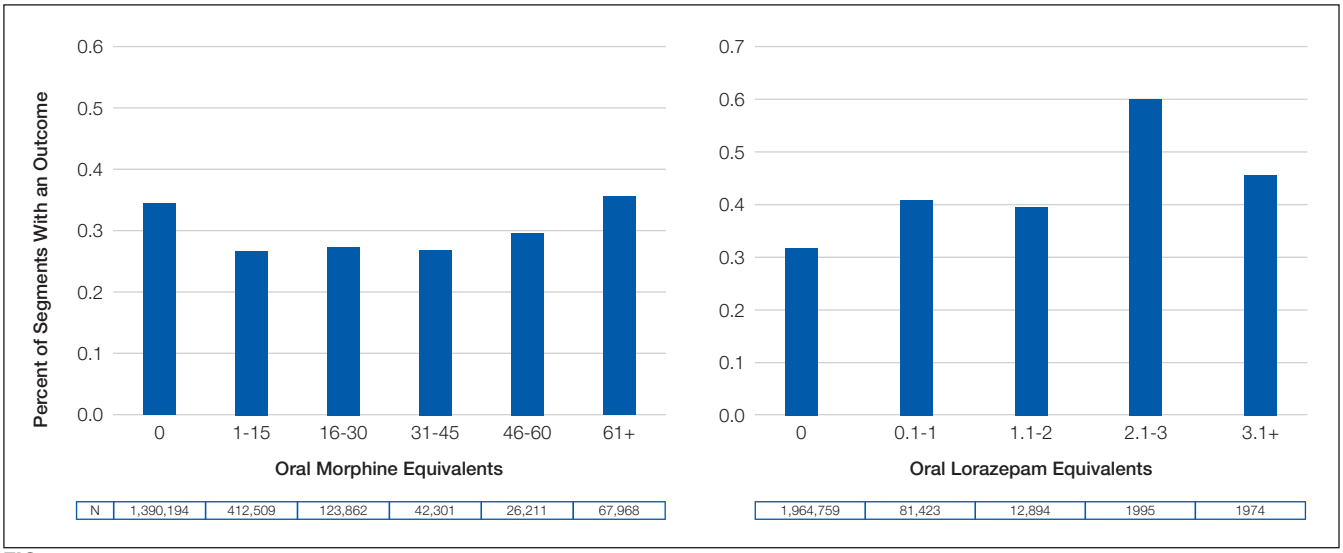

FIG. Unadjusted frequency of composite outcome stratified by medication dose.[a]

[a]Ward cardiac arrest or intensive care unit transfer.

NOTE: N reflects the number of 6-hr ward segments associated with each dosing range, and the Y-axis shows the percentage of 6-hr segments in which an outcome occurred.

Wisconsin) and administrative databases collected by the University of Chicago Clinical Research Data Warehouse. Patient age, sex, race, body mass index (BMI), and ward admission source (ie, emergency department (ED), transferred from the intensive care unit (ICU), or directly admitted to the wards) were collected. International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes were used to identify Elixhauser Comorbidity Index categories.[29,30] Because patients with similar diagnoses (eg, active cancer) are cohorted within particular areas in our hospital, we obtained the ward unit for all patients. Patients who underwent surgery were identified using the hospital's admission-transfer-discharge database.

To determine severity of illness, routinely collected vital signs and laboratory values were utilized to calculate the electronic cardiac arrest risk triage (eCART) score, an accurate risk score we previously developed and validated for predicting adverse events among ward patients.[31] If any vital sign or laboratory value was missing, the next available measurement was carried forward. If any value remained missing after this change, the median value for that location (ie, wards, ICU, or ED) was imputed.[32,33] Additionally, patient-reported pain scores at the time of opioid administration were extracted from nursing flowsheets. If no pain score was present at the time of opioid administration, the patient's previous score was carried forward.

We excluded patients with sickle-cell disease or seizure history and admissions with diagnoses of alcohol withdrawal from the analysis, because these diagnoses were expected to be associated with different medication administration practices compared to other inpatients. We also excluded patients with a tracheostomy because we expected their respiratory monitoring to differ from the other patients in our cohort. Finally, because ward deaths resulting from a comfort care scenario often involve opioids and/or benzodiazepines, ward segments involving comfort care deaths (defined as death without attempted resuscitation) were excluded from the analysis (Supplemental Figure 1). Patients with sickle-cell disease were identified using ICD-9 codes, and encounters during which a seizure may have occurred were identified using a combination of ICD-9 codes and receipt of anti-epileptic medication (Supplemental Table 1). Patients at risk for alcohol withdrawal were identified by the presence of any Clinical Institute Withdrawal Assessment for Alcohol score within nursing flowsheets, and patients with tracheostomies were identified using documentation of ventilator support within their first 12 hours on the wards. In addition to these exclusion criteria, patients with obstructive sleep apnea (OSA) were identified by the following ICD-9 codes: 278.03, 327.23, 780.51, 780.53, and 780.57.

Medications

Ward administrations of opioids and benzodiazepines—dose, route, and administration time—were collected from the EHR. We excluded all administrations in nonward locations such as the ED, ICU, operating room, or procedure suite. Additionally, because patients emergently intubated may receive sedative and analgesic medications to facilitate intubation, and because patients experiencing cardiac arrest are frequently intubated periresuscitation, we a priori excluded all administrations within 15 minutes of a ward cardiac arrest or an intubation.

For consistent comparisons, opioid doses were converted to oral morphine equivalents[34] and adjusted by a factor of 15 to reflect the smallest routinely available oral morphine tablet in our hospital (Supplemental Table 2). Benzodiazepine doses were converted to oral lorazepam equivalents (Supplemental Table 2).[34] Thus, the independent variables were oral

TABLE 1. Characteristics of Patient Admissions During Which Opioids and Benzodiazepines Were and Were Not Administered

	Opioids			Benzodiazepines		
Patient Characteristics	Received (n = 80,463)	Never received (n = 40,055)	*P* value	Received (n = 25,279)	Never received (n = 95,239)	*P* value
Age, y (median, IQR)	56 (40-67)	61 (42-73)	<0.001	58 (47-68)	57 (38-69)	<0.001
Female, n (%)	46,244 (57.5)	22,479 (56.1)	<0.001	12,866 (50.9)	55,857 (58.7)	<0.001
Race, n (%)						
Black/African American	38,715 (48.1)	23,594 (58.9)	<0.001	10,539 (41.7)	51,770 (54.4)	<0.001
White	34,037 (42.3)	13,134 (32.8)	<0.001	12,706 (50.3)	34,465 (36.2)	<0.001
Asian	1733 (2.2)	956 (2.4)	0.01	532 (2.1)	2157 (2.3)	0.125
>1 race	1,247 (1.6)	511 (1.3)	<0.001	387 (1.5)	1,371 (1.4)	0.281
Race unknown	4731 (5.9)	1860 (4.6)	<0.001	1115 (4.4)	5476 (5.8)	<0.001
Location prior to wards, n (%)						
Operating room	14,139 (17.6)	2401 (6.0)	<0.001	1626 (6.4)	14,914 (15.7)	<0.001
Intensive care unit	8079 (10.0)	4343 (10.8)	<0.001	2408 (9.5)	10,014 (10.5)	<0.001
Emergency department	14,677 (18.2)	10,663 (26.6)	<0.001	5731 (22.7)	19,609 (20.6)	<0.001
Direct to wards	28,051 (34.9)	11,863 (29.6)	<0.001	12,151 (48.1)	27,763 (29.2)	<0.001
Procedure area	15,517 (19.3)	10,785 (26.9)	<0.001	3363 (13.3)	22,939 (24.1)	<0.001
BMI, n (%)						
Underweight (<18.5 kg/m^2)	4755 (5.9)	2302 (5.8)	0.258	1908 (7.6)	5149 (5.4)	<0.001
Normal (18.5-25 kg/m^2)	19,226 (23.9)	10,020 (25.0)	<0.001	6830 (27.0)	22,416 (23.5)	<0.001
Overweight (25-30 kg/m^2)	20,463 (25.4)	10,389 (25.9)	0.058	6598 (26.1)	24,254 (25.5)	0.04
Obese (30-40 kg/m^2)	21,886 (27.2)	10,266 (25.6)	<0.001	6060 (24.0)	26,092 (27.4)	<0.001
Superobese (>40 kg/m^2)	9219 (11.5)	4505 (11.3)	0.279	2261 (8.9)	11,463 (12.0)	<0.001
Initial ward eCART score (median, IQR)	5 (3-10)	5 (3-10)	<0.001	5 (3-10)	5 (3-10)	<0.001
Elixhauser comorbidities						
Congestive heart failure	16,267 (20.2)	10,673 (26.7)	<0.001	6541 (25.9)	20,399 (21.4)	<0.001
Valvular disease	6715 (8.4)	3990 (10.0)	<0.001	2596 (10.3)	8109 (8.5)	<0.001
Pulmonary circulation disorder	5834 (7.3)	3328 (8.3)	<0.001	2181 (8.7)	6981 (7.3)	<0.001
Peripheral vascular disorder	8508 (10.6)	4288 (10.7)	0.485	3052 (12.1)	9744 (10.2)	<0.001
Hypertension, uncomplicated	38,666 (48.1)	20,206 (50.5)	<0.001	13,488 (55.4)	45,384 (47.7)	<0.001
Hypertension, complicated	16,544 (20.6)	10,100 (25.2)	<0.001	6300 (24.9)	20,344 (21.4)	<0.001
Paralysis	1883 (2.3)	1286 (3.2)	<0.001	847 (3.4)	2322 (2.4)	<0.001
Other neurological disorder	4045 (5.0)	3565 (8.9)	<0.001	1850 (7.3)	5760 (6.1)	<0.001
Chronic pulmonary disease	14,735 (18.3)	7620 (19.0)	0.003	4876 (19.3)	17,479 (18.4)	0.001
Diabetes, uncomplicated	19,455 (24.2)	10,886 (27.2)	<0.001	6936 (27.4)	23,405 (24.6)	<0.001
Diabetes, complicated	6957 (8.7)	3551 (8.9)	0.204	2458 (9.7)	8050 (8.5)	<0.001
Hypothyroidism	9724 (12.1)	4575 (11.4)	0.001	3759 (14.9)	10,540 (11.1)	<0.001
Renal failure	17,468 (21.7)	10,458 (26.1)	<0.001	6910 (27.3)	21,016 (22.1)	<0.001
Liver disease	6851 (8.5)	2689 (6.7)	<0.001	2879 (11.4)	6661 (7.0)	<0.001
Lymphoma	2364 (2.9)	1713 (4.3)	<0.001	1563 (6.2)	2514 (2.6)	<0.001
Metastatic cancer	14,612 (18.2)	4239 (10.6)	<0.001	6090 (24.1)	12,761 (13.4)	<0.001
Solid tumor, without metastasis	20,965 (26.1)	6137 (15.3)	<0.001	7968 (31.5)	19,134 (20.1)	<0.001
Collagen vascular disease	3927 (4.9)	1500 (3.7)	<0.001	1240 (4.9)	4187 (4.4)	0.001
Coagulopathy	13,855 (17.2)	6909 (17.3)	0.898	6561 (26.0)	14,203 (14.9)	<0.001
Obesity	13,010 (16.2)	5042 (12.6)	<0.001	3988 (15.8)	14,064 (14.8)	<0.001
Weight loss	13,115 (16.3)	4722 (11.8)	<0.001	6000 (23.7)	11,837 (12.4)	<0.001
Fluid and electrolyte disorder	34,444 (42.8)	17,493 (43.7)	0.004	14,668 (58.0)	37,269 (39.1)	<0.001
Blood loss anemia	7969 (9.9)	4,029 (10.1)	0.398	1832 (7.3)	10,166 (10.7)	<0.001
Deficiency anemia	904 (1.1)	459 (1.2)	0.729	398 (1.6)	965 (1.0)	<0.001
Alcohol abuse	4532 (5.6)	1950 (4.9)	<0.001	2138 (8.5)	4344 (4.6)	<0.001
Drug abuse	4919 (6.1)	1827 (4.6)	<0.001	1972 (7.8)	4774 (5.0)	<0.001
Psychoses	6709 (8.3)	2658 (6.6)	<0.001	3303 (13.1)	6064 (6.4)	<0.001
Depression	14,742 (18.3)	5113 (12.8)	<0.001	6861 (27.1)	12,994 (13.6)	<0.001
Obstructive sleep apnea	9518 (11.8)	4394 (11.0)	<0.001	3068 (12.1)	10,844 (11.4)	0.001

NOTE: Abbreviations: BMI, body mass index; eCART, Electronic Cardiac Arrest Risk Triage score; IQR, interquartile range.

morphine or lorazepam equivalents administered within each 6-hour window. We a priori presumed opioid doses greater than the 99th percentile (1200 mg) or benzodiazepine doses greater than 10 mg oral lorazepam equivalents within a 6-hour window to be erroneous entries, and replaced these outlier values with the median value for each medication category.

Outcomes

The primary outcome was the composite of ICU transfer or cardiac arrest (loss of pulse with attempted resuscitation) on the wards, with individual outcomes investigated secondarily. An ICU transfer (patient movement from a ward directly to the ICU) was identified using the hospital's admission-transfer-discharge database. Cardiac arrests were identified using a prospectively validated quality improvement database.[35]

Because deaths on the wards resulted either from cardiac arrest or from a comfort care scenario, mortality was not studied as an outcome.

Statistical Analysis

Patient characteristics were compared using Student t tests, Wilcoxon rank sum tests, and chi-squared statistics, as appropriate. Unadjusted and adjusted models were created using discrete-time survival analysis,[36-39] which involved dividing time into discrete 6-hour intervals and employing the predictor variables chronologically closest to the beginning of each time window to forecast whether the outcome occurred within each interval. Predictor variables in the adjusted model included patient characteristics (age, sex, BMI, and Elixhauser Agency for Healthcare Research and Quality-Web comorbidities[30] [a priori excluding comorbidities recorded for fewer than 1000 admissions from the model]), ward unit, surgical status, prior ICU admission during the hospitalization, cumulative opioid or benzodiazepine dose during the previous 24 hours, and severity of illness (measured by eCART score). The adjusted model for opioids also included the patient's pain score. Age, eCART score, and pain score were entered linearly while race, BMI (underweight, less than 18.5 kg/m^2; normal, 18.5-24.9 kg/m^2; overweight, 25.0-29.9 kg/m^2; obese, 30-39.9 kg/m^2; and severely obese, 40 mg/m^2 or greater), and ward unit were modeled as categorical variables.

Since repeat hospitalization could confound the results of our study, we performed a sensitivity analysis including only 1 randomly selected hospital admission per patient. We also performed a sensitivity analysis including receipt of both opioids and benzodiazepines, and an interaction term within each ward segment, as well as an analysis in which zolpidem—the most commonly administered nonbenzodiazepine hypnotic medication in our hospital—was included along with both opioids and benzodiazepines. Finally, we performed a sensitivity analysis replacing missing pain scores with imputed values ranging from 0 to the median ward pain score.

We also performed subgroup analyses of adjusted models across age quartiles and for each BMI category, as well as for surgical status, OSA status, gender, time of medication administration, and route of administration (intravenous vs. oral). We also performed an analysis across pain score severity[40] to determine whether these medications produce differential effects at various levels of pain.

All tests of significance used a 2-sided *P* value less than 0.05. Statistical analyses were completed using Stata version 14.1 (StataCorp, LLC, College Station, Texas).

RESULTS

Patient Characteristics

A total of 144,895 admissions, from 75,369 patients, had ward vital signs or laboratory values documented during the study period. Ward segments from 634 admissions were excluded due to comfort care status, which resulted in exclusion of 479 complete patient admissions. Additionally, 139 patients with tracheostomies were excluded. Furthermore, 2934 patient admissions with a sickle-cell diagnosis were excluded, of which 95% (n = 2791) received an opioid and 11% (n = 310) received a benzodiazepine. Another 14,029 admissions associated with seizures, 6134 admissions involving alcohol withdrawal, and 1332 with both were excluded, of which 66% (n = 14,174) received an opioid and 35% (n = 7504) received a benzodiazepine. After exclusions, 120,518 admissions were included in the final analysis, with 67% (n = 80,463) associated with at least 1 administration of an opioid and 21% (n = 25,279) associated with at least 1 benzodiazepine administration.

In total, there were 672,851 intervals when an opioid was administered during the study, with a median dose of 12 mg oral morphine equivalents (interquartile range, 8-30). Of these, 21,634 doses were replaced due to outlier status outside the 99th percentile. Patients receiving opioids were younger (median age 56 vs 61 years), less likely to be African American (48% vs 59%), more likely to have undergone surgery (18% vs 6%), and less likely to have most noncancer medical comorbidities than those who never received an opioid (all $P < 0.001$) (Table 1).

Additionally, there were a total of 98,286 6-hour intervals in which a benzodiazepine was administered in the study, with a median dose of 1 mg oral lorazepam (interquartile range, 0.5-1). A total of 790 doses of benzodiazepines (less than 1%) were replaced due to outlier status. Patients who received benzodiazepines were more likely to be male (49% vs. 41%), less likely to be African-American, less likely to be obese or morbidly obese (33% vs. 39%), and more likely to have medical comorbidities compared to patients who never received a benzodiazepine (all $P < 0.001$) (Table 1).

The eCART scores were similar between all patient groups. The frequency of missing variables differed by data type, with vital signs rarely missing (all less than 1.1% except AVPU [10%]), followed by hematology labs (8%-9%), electrolytes and renal function results (12%-15%), and hepatic function tests (40%-45%). In addition to imputed data for missing vital signs and laboratory values, our model omitted human immunodeficiency virus/acquired immune deficiency syndrome and peptic ulcer disease from the adjusted models on the basis of fewer than 1000 admissions with these diagnoses listed.

Patient Outcomes

The incidence of the composite outcome was higher in admissions with at least 1 opioid medication than those without an opioid (7% vs. 4%, $P < 0.001$), and in admissions with at least 1 dose of benzodiazepines compared to those without

TABLE 2. Unadjusted Ward Outcome Rates for Patient Admissions With and Without Opioid or Benzodiazepine Administration

	Opioids			Benzodiazepines		
Outcomes, n (%)	Received (n = 80,463)	Never received (n = 40,055)	*P* value	Received (n = 25,279)	Never received (n = 95,239)	*P* value
Composite	5230 (7)	1427 (4)	<0.001	2739 (11)	3918 (4)	<0.001
ICU transfer	5177 (6)	1399 (4)	<0.001	2708 (11)	3868 (4)	<0.001
Ward cardiac arrest	174 (0.2)	70 (0.2)	0.135	87 (0.3)	157 (0.2)	<0.001

NOTE: Abbreviation: ICU, intensive care unit.

TABLE 3. Adjusted Odds of Clinical Deterioration Outcomes Within Six Hours of Receiving an Opioid or Benzodiazepine[a]

	Opioids		Benzodiazepines	
Outcome	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Composite	1.019 (1.013-1.026)	<0.001	1.29 (1.16-1.45)	<0.001
ICU transfer	1.019 (1.013-1.026)	<0.001	1.29 (1.14-1.43)	<0.001
Ward cardiac arrest	1.020 (0.985-1.057)	0.26	2.36 (1.43-3.90)	0.001

[a]Adjustment includes patient characteristics, ward unit, surgical status, prior ICU admission, 24-hour cumulative opioid/benzodiazepine dose, and eCART score.

NOTE: Odds ratios reflect the change in odds associated with the equivalent of 15 mg oral morphine or 1 mg oral lorazepam. Abbreviations: eCART, Electronic Cardiac Arrest Risk Triage score; CI, confidence interval; ICU, intensive care unit; OR, odds ratio.

a benzodiazepine (11% vs. 4%, $P < 0.001$) (Table 2).

Within 6-hour segments, increasing doses of opioids were associated with an initial decrease in the frequency of the composite outcome followed by a dose-related increase in the frequency of the composite outcome with morphine equivalents greater than 45 mg. By contrast, the frequency of the composite outcome increased with additional benzodiazepine equivalents (Figure).

In the adjusted model, opioid administration was associated with increased risk for the composite outcome (Table 3) in a dose-dependent fashion, with each 15 mg oral morphine equivalent associated with a 1.9% increase in the odds of ICU transfer or cardiac arrest within the subsequent 6-hour time interval (odds ratio [OR], 1.019; 95% confidence interval [CI], 1.013-1.026; $P < 0.001$).

Similarly, benzodiazepine administration was also associated with increased adjusted risk for the composite outcome within 6 hours in a dose-dependent manner. Each 1 mg oral lorazepam equivalent was associated with a 29% increase in the odds of ward cardiac arrest or ICU transfer (OR, 1.29; 95% CI, 1.16-1.44; $P < 0.001$) (Table 3).

Sensitivity Analyses

A sensitivity analysis including 1 randomly selected hospitalization per patient involved 67,097 admissions and found results similar to the primary analysis, with each 15 mg oral morphine equivalent associated with a 1.9% increase in the odds of the composite outcome (OR, 1.019; 95% CI, 1.011-1.028; $P < 0.001$) and each 1 mg oral lorazepam equivalent associated with a 41% increase in the odds of the composite outcome (OR, 1.41; 95% CI, 1.21-1.65; $P < 0.001$). Inclusion of both opioids and benzodiazepines in the adjusted model again yielded results similar to the main analysis for both opioids (OR, 1.020; 95% CI, 1.013-1.026; $P < 0.001$) and benzodiazepines (OR, 1.35; 95% CI, 1.18-1.54; $P < 0.001$), without a significant interaction detected ($P = 0.09$). These results were unchanged with the addition of zolpidem to the model as an additional potential confounder, and zolpidem did not increase the risk of the study outcomes ($P = 0.2$).

A final sensitivity analysis for the opioid model involved replacing missing pain scores with imputed values ranging from 0 to the median ward score, which was 5. The results of these analyses did not differ from the primary model and were consistent regardless of imputation value (OR, 1.018; 95% CI, 1.012-1.023; $P < 0.001$).

Subgroup Analyses

Analyses of opioid administration by subgroup (sex, age quartiles, BMI categories, OSA diagnosis, surgical status, daytime/nighttime medication administration, IV/PO administration, and pain severity) yielded similar results to the overall analysis (Supplemental Figure 2). Subgroup analysis of patients receiving benzodiazepines revealed similarly increased adjusted odds of the composite outcome across strata of gender, BMI, surgical status, and medication administration time (Supplemental Figure 3). Notably, patients older than 70 years who received a benzodiazepine were at 64% increased odds of the composite outcome (OR, 1.64; 95% CI, 1.30-2.08), compared to 2% to 38% increased risk for patients under 70 years. Finally, IV doses of benzodiazepines were associated with 48% increased odds for deterioration (OR, 1.48; 95% CI, 1.18-1.84; $P = 0.001$), compared to a nonsignificant 14% increase in the odds for PO doses (OR, 1.14; 95% CI, 0.99-1.31; $P = 0.066$).

DISCUSSION

In a large, single-center, observational study of ward inpatients, we found that opioid use was associated with a small but significant increased risk for clinical deterioration on the wards, with every 15 mg oral morphine equivalent increasing the odds of ICU transfer or cardiac arrest in the next 6 hours by 1.9%. Benzodiazepines were associated with a much higher risk: each equivalent of 1 mg of oral lorazepam increased the odds of ICU transfer or cardiac arrest by almost 30%. These results have important implications for care at the bedside of hospitalized ward patients and suggest the need for closer monitoring after receipt of these medications, particularly benzodiazepines.

Previous work has described negative effects of opioid medications among select inpatient populations. In surgical patients, opioids have been associated with hospital readmission, increased length of stay, and hospital mortality.[26,28] More recently, Herzig et al.[15] found more adverse events in nonsurgical ward patients within the hospitals prescribing opioids the most frequently. These studies may have been limited by the populations studied and the inability to control for confounders such as severity of illness and pain score. Our study expands these findings to a more generalizable population and shows that even after adjustment for potential confounders, such as severity of illness, pain score, and medication dose, opioids are associated with increased short-term risk of clinical deterioration.

By contrast, few studies have characterized the risks associated with benzodiazepine use among ward inpatients. Recently, Overdyk et al.[27] found that inpatient use of opioids and sedatives was associated with increased risk for cardiac arrest and hospital death. However, this study included ICU patients, which may confound the results, as ICU patients often receive high doses of opioids or benzodiazepines to facilitate mechanical ventilation or other invasive procedures, while also having a particularly high risk of adverse outcomes like cardiac arrest and inhospital death.

Several mechanisms may explain the magnitude of effect seen with regard to benzodiazepines. First, benzodiazepines may directly produce clinical deterioration by decreased respiratory drive, diminished airway tone, or hemodynamic decompensation. It is possible that the broad spectrum of cardiorespiratory side effects of benzodiazepines—and potential unpredictability of these effects—increases the difficulty of observation and management for patients receiving them. This difficulty may be compounded with intravenous administration of benzodiazepines, which was associated with a higher risk for deterioration than oral doses in our cohort. Alternatively, benzodiazepines may contribute to clinical decompensation by masking signs of deterioration such as encephalopathy or vital sign instability like tachycardia or tachypnea that may be mistaken as anxiety. Notably, while our hospital has a nursing-driven protocol for monitoring patients receiving opioids (in which pain is serially assessed, leading to additional bedside observation), we do not have protocols for ward patients receiving benzodiazepines. Finally, although we found that orders for opioids and benzodiazepines were more common in white patients than African American patients, this finding may be due to differences in the types or number of medical comorbidities experienced by these patients.

Our study has several strengths, including the large number of admissions we included. Additionally, we included a broad range of medical and surgical ward admissions, which should increase the generalizability of our results. Further, our rates of ICU transfer are in line with data reported from other groups,[41,42] which again may add to the generalizability of our findings. We also addressed many potential confounders by including patient characteristics, individual ward units, and (for opioids) pain score in our model, and by controlling for severity of illness with the eCART score, an accurate predictor of ICU transfer and ward cardiac arrest within our population.[32,37] Finally, our robust methodology allowed us to include acute and cumulative medication doses, as well as time, in the model. By performing a discrete-time survival analysis, we were able to evaluate receipt of opioids and benzodiazepines—as well as risk for clinical deterioration—longitudinally, lending strength to our results.

Limitations of our study include its single-center cohort, which may reduce generalizability to other populations. Additionally, because we could not validate the accuracy of—or adherence to—outpatient medication lists, we were unable to identify chronic opioid or benzodiazepine users by these lists. However, patients chronically taking opioids or benzodiazepines would likely receive doses each hospital day; by including 24-hour cumulative doses in our model, we attempted to adjust for some portion of their chronic use. Also, because evaluation of delirium was not objectively recorded in our dataset, we were unable to evaluate the relationship between receipt of these medications and development of delirium, which is an important outcome for hospitalized patients. Finally, neither the diagnoses for which these medications were prescribed, nor the reason for ICU transfer, were present in our dataset, which leaves open the possibility of unmeasured confounding.

CONCLUSION

After adjustment for important confounders including severity of illness, medication dose, and time, opioids were associated with a slight increase in clinical deterioration on the wards, while benzodiazepines were associated with a much larger risk for deterioration. This finding raises concern about the safety of benzodiazepine use among ward patients and suggests that increased monitoring of patients receiving these medications may be warranted.

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Rates, Predictors and Variability of Interhospital Transfers: A National Evaluation

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IMPORTANCE: Interhospital transfer (IHT) remains a largely unstudied process of care.

OBJECTIVE: To determine the nationwide frequency of, patient and hospital-level predictors of, and hospital variability in IHT.

DESIGN: Cross-sectional study.

SETTING: Centers for Medicare and Medicaid 2013 100% Master Beneficiary Summary and Inpatient claims files merged with 2013 American Hospital Association data.

PATIENTS: Beneficiaries ≥65 years and older enrolled in Medicare A and B, with an acute care hospitalization claim in 2013.

EXPOSURES: Patient and hospital characteristics of transferred and nontransferred patients.

MEASUREMENTS: Frequency of interhospital transfers (IHT); adjusted odds of transfer of each patient and each hospital characteristic; and variability in hospital transfer rates.

RESULTS: Of 6.6 million eligible beneficiaries with an acute care hospitalization, 101,507 (1.5%) underwent IHT. Selected characteristics associated with greater adjusted odds of transfer included: patient age 74-85 years (odds ratio [OR], 2.38 compared with 65-74 years; 95% confidence intervals [CI], 2.33-2.43); nonblack race (OR, 1.17; 95% CI, 1.13-1.20); higher comorbidity (OR, 1.37; 95% CI, 1.36-1.37); lower diagnosis-related group–weight (OR, 2.02; 95% CI, 1.95-2.09); fewer recent hospitalizations (OR, 1.87; 95% CI, 1.79-1.95); and hospitalization in the Northeast (OR, 1.40; 95% CI, 1.27-1.55). Higher case mix index of the hospital was associated with a lower adjusted odds of transfer (OR, 0.36; 95% CI, 0.30-0.45). Variability in hospital transfer rates remained significant after adjustment for patient and hospital characteristics (variance 0.28, $P = 0.01$).

CONCLUSIONS: In this nationally representative evaluation, we found that a sizable number of patients undergo IHT. We identified both expected and unexpected patient and hospital-level predictors of IHT, as well as unexplained variability in hospital transfer rates, suggesting lack of standardization of this complex care transition. Our study highlights further investigative avenues to help guide best practices in IHT. *Journal of Hospital Medicine* 2017;12:435-442. © 2017 Society of Hospital Medicine

Interhospital transfer (IHT) is defined as the transfer of hospitalized patients between acute care hospitals. Although cited reasons for transfer include providing patients access to unique specialty services,[1] patterns and practices of IHT remain largely unstudied. Interhospital transfer is known to be common in certain patient populations, including selected patients presenting to the intensive care unit[2] and those with acute myocardial infarction (AMI),[3-5] but no recent studies have looked at frequency of IHT among a broader group of hospitalized patients nationally. Little is known about which patients are selected for transfer and why.[6] Limited evidence suggests poor concordance between cited reason for transfer among patients, transferring physicians, and receiving physicians,[7] indicating ambiguity in this care process.

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Interhospital transfer exposes patients to the potential risks associated with discontinuity of care. Communication is particularly vulnerable to error during times of transition.[8-10] Patients transferred between acute care hospitals are especially vulnerable, given the severity of illness in this patient population,[11] and the absence of other factors to fill in gaps in communication, such as common electronic health records. Limited existing literature suggests transferred patients use more resources [12-13] and experience worse outcomes compared to nontransferred patients,[11] although these data involved limited patient populations, and adjustment for illness severity and other factors was variably addressed.[14-16]

To improve the quality and safety of IHT, therefore, it is necessary to understand which patients benefit from IHT and identify best practices in the IHT process.[17] A fundamental first step is to study patterns and practices of IHT, in particular with an eye towards identifying unwarranted variation.[18] This is important to understand the prevalence of the issue, provide possible evidence of lack of standardization, and natural experiments with which to identify best practices.

To address this, we conducted a foundational study examining a national sample of Medicare patients to determine the nationwide frequency of IHT among elderly patients,

patient and hospital-level predictors of transfer, and hospital variability in IHT practices.

METHODS

We performed a cross-sectional analysis using 2 nationally representative datasets: (1) Center for Medicare and Medicaid Services (CMS) 2013 100% Master Beneficiary Summary and Inpatient claims files, which contains data on all fee-for-service program Medicare enrollees' demographic information, date of death, and hospitalization claims, including ICD-9 codes for diagnoses, diagnosis-related group (DRG), and dates of service; merged with (2) 2013 American Hospital Association (AHA) data,[19] which contains hospital-level characteristics for all acute care hospitals in the U.S. Our study protocol was approved by the Partners Healthcare Human Subjects Review Committee.

Beneficiaries were eligible for inclusion if they were 65 years or older, continuously enrolled in Medicare A and B, with an acute care hospitalization claim in 2013, excluding Medicare managed care and end-stage renal disease (ESRD) beneficiaries. We additionally excluded beneficiaries hospitalized at federal or nonacute care hospitals, or critical access hospitals given their mission to stabilize and transfer patients to referral hospitals.[20]

Transferred patients were defined as: (1) beneficiaries with a "transfer out" claim and a corresponding "transfer in" claim at a different hospital; as well as (2) beneficiaries with a "transfer out" claim and a corresponding date of admission to another hospital within 1 day following the date of claim; and (3) beneficiaries with a "transfer in" claim and a corresponding date of discharge from another hospital within 1 day preceding the date of claim. Beneficiaries transferred to the same hospital, or cared for at hospitals with "outlier" transfer in rates equal to 100% or transfer out rates greater than 35%, were excluded from analysis given the suggestion of nonstandard claims practices. Beneficiaries with greater than 1 transfer within the same hospitalization were additionally excluded.

Patient Characteristics

Patient characteristics were obtained from the CMS data files and included: demographics (age, sex, race); DRG-weight, categorized into quartiles; primary diagnosis for the index hospitalization using ICD-9 codes; patient comorbidity using ICD-9 codes compiled into a CMS-Hierarchical Condition Category (HCC) risk score;[21] presence of Medicaid co-insurance; number of hospitalizations in the past 12 months, categorized into 0, 1, 2-3, and 4 or more; season, defined as calendar quarters; and median income per household by census tract. These characteristics were chosen a priori given expert opinion in combination with prior research demonstrating association with IHT.[11,22]

Hospital Characteristics

Hospital characteristics were obtained from AHA data files and included hospitals' size, categorized into small, medium, and large (less than 100, 100 to 399, 400 or more beds); geographic location; ownership; teaching status; setting (urban vs. rural); case mix index (CMI) for all patients cared for at the hospital; and presence of selected specialty services, including certified trauma center, medical intensive care unit, cardiac intensive care unit, cardiac surgery services, adult interventional cardiac catheterization, adult cardiac electrophysiology, and composite score of presence of 55 other specialty services (complete list in Appendix A). All characteristics were chosen *a priori* given expert opinion or relationship of characteristics with IHT, and prior research utilizing AHA data.[23-24]

Analysis

Descriptive statistics were used to evaluate the frequency of IHT, characteristics of transferred patients, and number of days to transfer. Patient and hospital characteristics of transferred vs. nontransferred patients were compared using chi-square analyses.

To analyze the effects of each patient and hospital characteristic on the odds of transfer, we used logistic regression models incorporating all patient and hospital characteristics, accounting for fixed effects for diagnosis, and utilizing generalized estimating equations (the GENMOD procedure in SAS statistical software, v 9.4; SAS Institute Inc., Cary, North Carolina) to account for the clustering of patients within hospitals.[25] Indicator variables were created for missing covariate data and included in analyses when missing data accounted for greater than 10% of the total cohort.

To measure the variability in transfer rates between hospitals, we used a sequence of random effects logistic regression models. We first ran a model with no covariates, representing the unadjusted differences in transfer rates between hospitals. We then added patient characteristics to see if the unadjusted differences in IHT rates were explained by differences in patient characteristics between hospitals. Lastly, we added hospital characteristics to determine if these explained the remaining differences in transfer rates. Each of the 3 models provided a measure of between-hospital variability, reflecting the degree to which IHT rates differed between hospitals. Additionally, we used the intercept from the unadjusted model and the measure of between-hospital variability from each model to calculate the 95% confidence intervals, illustrating the range of IHT rates spanning 95% of all hospitals. We used those same numbers to calculate the 25th and 75th percentiles, illustrating the range of IHT rates for the middle half of hospitals.

RESULTS

Among 28 million eligible beneficiaries, 6.6 million had an acute care hospitalization to nonfederal, noncritical access hospitals, and 107,741 met our defined criteria for IHT. An additional 3790 beneficiaries were excluded for being transferred to the same facility, 416 beneficiaries (115 transferred, 301 nontransferred) were excluded as they were cared for at 1 of the 11 hospitals with "outlier" transfer in/out rates, and

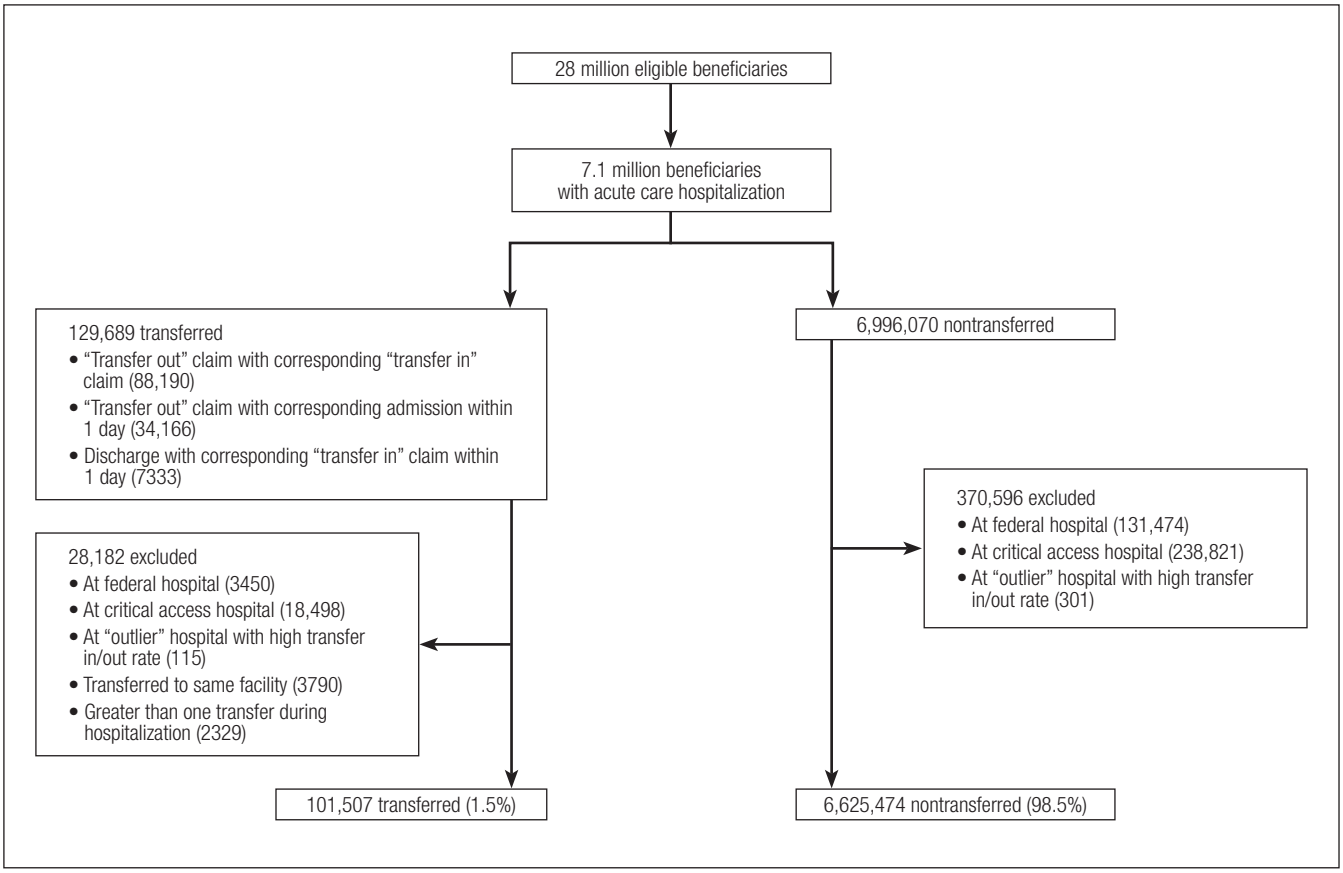

FIG. 1. Cohort selection.[a]

[a]Centers for Medicare and Medicaid Services 2013 100% Master Beneficiary Summary and Inpatient claims files.

2329 were excluded because they had more than 1 transfer during hospitalization. Thus, the final cohort consisted of 101,507 transferred (1.5%) and 6,625,474 nontransferred beneficiaries (Figure 1). Of the 101,507 transferred beneficiaries, 2799 (2.8%) were included more than once (ie, experienced more than 1 IHT on separate hospitalizations throughout the study period; the vast majority of these had 2 separate hospitalizations resulting in IHT). Characteristics of transferred and nontransferred beneficiaries are shown (Table 1).

Among transferred patients, the top 5 primary diagnoses at time of transfer included AMI (12.2%), congestive heart failure (CHF) (7.2%), sepsis (6.6%), arrhythmia (6.6%), and pneumonia (3.4%). Comorbid conditions most commonly present in transferred patients included CHF (52.6%), renal failure (51.8%), arrhythmia (49.8%), and chronic obstructive pulmonary disease (COPD; 37.0%). The most common day of transfer was day after admission (hospital day 2, 24.7%), with 75% of transferred patients transferred before hospital day 6 (Appendix B).

After adjusting for all other patient and hospital characteristics and clustering by hospital, the following variables were associated with greater odds of transfer: older age, male sex, nonblack race, non-Medicaid co-insurance, higher comorbidity (HCC score), lower DRG-weight, and fewer hospitalizations in the prior 12 months. Beneficiaries also had greater odds of transfer if initially hospitalized at smaller hospitals, nonteaching hospitals, public hospitals, at hospitals in the Northeast, those with fewer specialty services, and

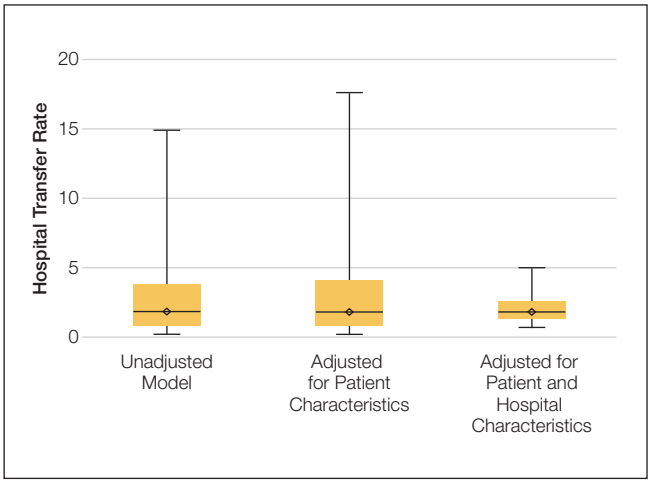

FIG. 2. Distribution of transfer rates across hospitals.

NOTE: All models are centered at the median transfer rate of 1.79%. Shaded boxes encompass transfer rates from the 25th percentile (Q3) for each model. Whiskers encompass transfer rates from the 2.5th percentile to the 97.5th percentile. For example, the null model demonstrates that half of all hospitals have transfer rates between Q1 = 0.83% and Q3 = 3.80%; after equalizing the patient characteristics, the interquartile ranges expands to Q1 = 0.78% to Q3 = 4.06%; however, measured hospital characteristics explain most of this variability, reducing the interquartile range to Q1 = 1.26% to Q3 = 2.54%.

TABLE 1. Baseline Characteristics of Transferred vs. Nontransferred Beneficiaries

Characteristic	Transferred (n = 101,507)	Nontransferred (n = 6,625,474)	*P* value
Patient Characteristics			
Age, n (%)			
65-74	42,245(41.6)	2,328,830(35.1)	<0.001
75-84	40,630(40.0)	2,419,802(36.5)	
≥85	18,632(18.4)	1,876,842(28.3)	
Male, n (%)	49,830(49.1)	2,800,503(42.3)	<0.001
Race, n (%)			
White	88,873(87.6)	5,711,376(86.2)	
Black	8,381(8.3)	596,347(9.0)	<0.001
Hispanic	1,273(1.3)	112,580(1.7)	
Other	2,980(2.9)	205,171(3.1)	
DRG-weight quartile, n (%)			
Lowest quartile	29,883(29.4)	1,669,620 (25.2)	
2nd quartile	28,007(27.6)	1,629,864(24.6)	<0.001
3rd quartile	28,992(28.6)	1,696,125(25.6)	
Highest quartile	14,625(14.4)	1,629,865(24.6)	
Primary diagnosis on admission, n (%)			
AMI	12,395(12.2)	172,845(2.6)	
CHF	7,341 (7.2)	379,372(5.7)	
Sepsis	6,682(6.6)	419,110(6.4)	
Arrhythmia	6,687(6.6)	300,126(4.6)	
Stroke	3,640(3.6)	211,593(3.1)	
Pneumonia	3,461(3.4)	300,804(4.6)	
GI bleed	3,089(3.0)	178,606(2.7)	
Renal failure	2,085(2.1)	188,021(2.8)	<0.001
Esophageal	1,948(1.9)	230,289(3.4)	
COPD	1,809(1.8)	258,984(3.8)	
Hip fracture/dislocation	1,690(1.7)	158,915(2.4)	
Chest pain	896(0.9)	66,288(1.0)	
UTI	924(0.9)	414,999(6.3)	
Respiratory disease	799(0.8)	84,180(1.3)	
Metabolic	845(0.8)	121,321(1.8)	
Other	47,216(46.5)	3,140,021(47.5)	
HCC risk score, mean (SD)[a]	3.5(2.0)	2.6(1.8)	<0.001
Top comorbid conditions, n (%)			
CHF	53,397(52.6)	2,383,413(36.0)	
Renal failure	52,542(51.8)	2,599,411(39.2)	<0.001
Arrhythmia	50,577(49.8)	2,363,757(35.7)	
COPD	37,511(37.0)	2,014,789(30.4)	
Medicaid co-insurance, n (%)	19,326(19.0)	1,337,310(20.2)	<0.001
Number of hospitalizations in the past 12 months, n (%)			
0	67,944(66.9)	4,296,542(64.8)	
1	18,748(18.5)	1,336,788(20.2)	<0.001
2-3	12,382(12.2)	843,101(12.7)	
≥4	2,433(2.4)	149,043(2.3)	
Season of hospital admission[b]			
Q1	27,148(26.7)	1,797,723(27.1)	
Q2	26,153(25.8)	1,658,024(25.0)	<0.001
Q3	25,317(24.9)	1,581,828(23.9)	
Q4	22,889(22.5)	1,587,899(24.0)	
Median income per household by census tract, mean (SD)	52,818.5(21,932)	53,241.3(23,272)	<0.001
Index Hospital Characteristics[c]			
Size, n (%)			
Small (<99 beds)	27,422(27.0)	561,838(8.5)	
Medium (100-399 beds)	62,307(61.4)	3,743,514(56.5)	<0.001
Large (≥400 beds)	11,778(11.6)	2,320,122(35.0)	

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those with a low CMI (Table 2).

In examining the between-hospital variability in IHT, our unadjusted model estimated an average transfer rate of 1.79%, and showed a variance estimate of 1.33 (P = 0.009), demonstrating that 95% of hospitals have transfer rates between 0.83% and 3.80%. The variance estimate increased by 19% to 1.58 (P = 0.009) when adjusting for patient characteristics. After adjusting for hospital characteristics, variance decreased by 83% to 0.28 (P = 0.01), showing 95% of hospitals have transfer rates between 1.26% and 2.54% (Figure 2).

DISCUSSION

In this nationally representative study of 6.6 million Medicare beneficiaries, we found that 1.5% of patients were transferred between acute care facilities and were most often transferred prior to hospital day 6. Older age, male sex, nonblack race, higher medical comorbidity, lower DRG weight, and fewer recent hospitalizations were associated with greater odds of transfer. Initial hospitalization at smaller, nonteaching, public hospitals, with fewer specialty services were associated with greater odds of transfer, while higher CMI was associated with a lower odds of transfer. The most common comorbid conditions among transferred patients included CHF, renal failure, arrhythmia, and COPD; particularly notable was the very high prevalence of these conditions among transferred as compared with nontransferred patients. Importantly, we found significant variation in IHT by region and a large variation in transfer practices by hospital, with significant variability in transfer rates even after accounting for known patient and hospital characteristics.

Among our examined population, we found that a sizable number of patients undergo IHT—more than 100,000 per year. Primary diagnoses at time of transfer consist of common inpatient conditions, including AMI, CHF, sepsis, arrhythmia, and pneumonia. Limited prior data support our findings, with up to 50% of AMI patients reportedly undergoing IHT,[3-5] and severe sepsis and respiratory illness reported as common diagnoses at transfer.[11] Although knowledge of these primary diagnoses does not directly confer an understanding of reason for transfer, one can speculate based on our findings. For example, research demonstrates the majority of AMI patients who undergo IHT had further intervention, including stress testing, cardiac catheterization, and/or coronary artery bypass graft surgery.[5,26] Thus, it is reasonable to presume that many of the beneficiaries transferred with AMI were transferred to receive this more specialized cardiac care. We further found the majority of patients are transferred

prior to hospital day 6 with the highest prevalence on day 2, supporting the hypothesis that these patients may be transferred for receipt of specialty services for their admission diagnosis. However, we cannot prove this presumption, and for other conditions, such as pneumonia, the plan after IHT is less obvious. There are numerous possible reasons for transfer,[1] including patient preference and prior affiliation with receiving hospital. Further research is required to more fully define these reasons in greater detail.

We additionally found that certain patient characteristics were associated with greater odds of transfer. Research suggests that transferred patients are "sicker" than nontransferred patients.[1,11] Although our findings in part confirm these data, we paradoxically found that higher DRG-weight and 4 or more hospitalizations in the past year were actually associated with lower odds of transfer. In addition, the oldest patients in our cohort (85 years or older) were actually less likely to be transferred than their slightly younger counterparts (75 to 84 years). These variables may reflect extreme illness or frailty,[27] and providers consciously (or subconsciously) may factor this in to their decision to transfer, considering a threshold past which transfer would confer more risk than benefit (eg, a patient may be "too sick" for transfer). Indeed, in a secondary analysis without hospital characteristics or comorbidities, and with fixed effects by hospital, we found the highest rates of IHT in patients in the middle 2 quartiles of DRG-weight, supporting this threshold hypothesis. It is also possible that patients with numerous hospitalizations may be less likely to be transferred because of familiarity and a strong sense of responsibility to continue to care for those patients (although we cannot confirm that those prior hospitalizations were all with the same index hospital).

TABLE 1. Baseline Characteristics of Transferred vs. Nontransferred Beneficiaries (continued)

Characteristic	Transferred (n = 101,507)	Nontransferred (n = 6,625,474)	*P* value
Index Hospital Characteristics[c]			
Geographic location, n (%)			
Northeast	24,471(24.1)	1,298,613(19.6)	<0.001
Midwest	22,989(22.6)	1,577,640(23.8)	
South	42,902(42.3)	2,745,777(41.4)	
West	11,145(11.0)	1,003,444(15.1)	
Ownership, n (%)			
For-profit	17,030(16.8)	993,766(15.0)	<0.001
Not-for-profit	71,167(70.1)	4,948,187(74.7)	
Public	13,310(13.1)	683,521(10.3)	
Teaching status, n (%)			
Major	5,554(5.5)	1,203,923(18.2)	<0.001
Minor	25,548(25.2)	2,267,028(34.2)	
Nonteaching	70,405(69.4)	3,154,523(47.6)	
Urban location, n (%)	92,048(91.0)	6,479,938(97.8)	<0.001
CMI, mean (SD)	1.4(0.3)	1.6(0.3)	<0.001
Presence of a certified trauma center, n (%)	33,812(33.3)	3,275,068(49.4)	<0.001
Presence of medical intensive care unit, n(%)	82,428(81.2)	5,796,508(87.5)	<0.001
Presence of cardiac intensive care unit, n(%)	35,416(34.9)	3,980,271(60.1)	<0.001
Presence of cardiac surgery services, n (%)	25,041(24.7)	4,045,224(61.1)	<0.001
Presence of adult interventional cardiac catheterization, n (%)	44,304(43.6)	4,865,738(73.4)	<0.001
Presence of adult cardiac electrophysiology, n (%)	35,829(35.3)	4,278,655(64.6)	<0.001
Composite score of other hospital specialty services, mean (SD)[d]	21.1(11.8)	27.7(12.9)	<0.001

[a]CMS HCC risk score.[20]

[b]Q=Calendar quarters.

[c]Presented hospital characteristics for the transferred beneficiaries are characteristics of index hospital.

[d]Score ranged from 0-55 with complete list of other hospital specialty services included in composite score listed in Appendix A.

NOTE: Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure; CMI, case mix index; CMS, Centers for Medicare and Medicaid Services; COPD, chronic obstructive pulmonary disease; DRG, diagnosis-related group; GI, gastrointestinal; HCC, Hierarchical Condition Category; SD, standard deviation; UTI, urinary tract infection.

It is also notable that odds of transfer differed by race, with black patients 17% less likely to undergo transfer compared to whites, similar to findings in other IHT studies.[11] This finding, in combination with our demonstration that Medicaid patients also have lower odds of transfer, warrants further investigation to ensure the process of IHT does not bias against these populations, as with other well-documented health disparities.[28-30]

The hospital predictors of transfer were largely expected. However, interestingly, when we controlled for all other patient and hospital characteristics, regional variation persisted, with highest odds of transfer with hospitalization in the Northeast, indicating variability by region not explained by other factors, and findings supported by other limited data.[31] This variability was further elucidated in our examination of change in variance estimates accounting for patient, then hospital, characteristics. Although we expected and found marked variability in hospital transfer rates in our null model (without accounting for any patient or hospital characteristics), we interestingly found that variability *increased* upon adjusting for patient characteristics. This result is presumably due to the fact that patients who are more likely to be transferred (ie, "sick" patients) are more often already at hospitals less likely to transfer patients, supported by our findings that hospital CMI is inversely associated with odds of transfer (in other words, hospitals that care for a less sick patient population are *more* likely to transfer their patients, and hospitals that care for a sicker patient population [higher CMI] are *less* likely to transfer). Adjusting solely for patient characteristics effectively equalizes these patients across hospitals, which would lead to even increased variability in transfer rates. Conversely, when we then adjusted for hospital characteristics, variability in hospital transfer rates decreased by 83% (in other words, hospital characteristics, rather than patient characteristics, explained much of the variability in transfer rates), although significant unexplained variability remained. We should note that although the observed reduction in variability was explained by the patient and hospital characteristics included in the model, these character-

TABLE 2. Patient and Hospital Predictors of Transfer

Characteristic	Adjusted Odds of Transfer (95% CI)[a]	*P* value
Patient Characteristics		
Age, y		
65-74 (referent)	--	
75-84	2.38(2.33, 2.43)	<0.001
≥85	1.89(1.85, 1.93)	<0.001
Sex		
Male	1.11(1.09, 1.12)	<0.001
Female (referent)	--	--
Race		
White	1.17(1.13, 1.20)	<0.001
Black (referent)	--	--
Hispanic	1.16(1.09, 1.24)	<0.001
Other	1.34(1.28, 1.41)	<0.001
DRG-weight quartile		
Lowest quartile	2.02(1.95, 2.09)	<0.001
2nd quartile	1.85(1.75, 1.91)	<0.001
3rd quartile	1.51(1.46, 1.55)	<0.001
Highest quartile (referent)	--	--
Primary diagnosis on admission		
AMI	25.1(23.2, 27.2)	<0.001
CHF	3.76 (3.51, 4.02)	<0.001
Sepsis	2.58(2.41, 2.76)	<0.001
Arrhythmia	6.18(5.77, 6.63)	<0.001
Stroke	4.84(4.46, 5.26)	<0.001
Pneumonia	1.90(1.78, 2.04)	<0.001
GI bleed	3.84(3.58, 4.13)	<0.001
Renal failure	2.31(2.15, 2.48)	<0.001
Esophageal	1.99(1.86, 2.14)	<0.001
COPD	1.91(1.74, 2.09)	<0.001
Hip fracture/dislocation	4.37(4.03, 4.75)	<0.001
Chest pain	3.53(3.21, 3.87)	<0.001
UTI (referent)	--	--
Respiratory disease	1.16(1.08, 1.25)	<0.001
Metabolic	1.30(1.20, 1.41)	<0.001
Other	3.89(3.65, 4.13)	<0.001
HCC risk score[b]	1.37(1.36, 1.37)	<0.001
Medicaid co-insurance		
Yes (referent)	--	--
No	1.50(1.47, 1.53)	<0.001
Number of hospitalizations in the past 12 months		
0	1.87(1.79, 1.95)	<0.001
1	1.49(1.42, 1.55)	<0.001
2-3	1.30(1.24, 1.36)	<0.001
≥4 (referent)	--	--
Season of hospital admission[c]		
Q1	1.04(1.03, 1.06)	<0.001
Q2	1.05(1.03, 1.07)	<0.001
Q3	1.07(1.05, 1.09)	<0.001
Q4 (referent)	--	--
Median income per household by census tract, per $1000	1.00(1.00, 1.00)	0.58
Index Hospital Characteristics[d]		
Size		
Small (<99 beds)	2.30(1.95, 2.72)	<0.001
Medium (100-399 beds)	1.67(1.44, 1.95)	<0.001
Large (>400 beds)(referent)	--	--

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istics do not necessarily justify the variability they accounted for; although patients' race or hospitals' location may explain some of the observed variability, this does not reasonably justify it.

This observed variability in transfer practices is not surprising given the absence of standardization and clear guidelines to direct clinical IHT practice.[17] Selection of patients that may benefit from transfer is often ambiguous and subjective.[6] The Emergency Medical Treatment and Active Labor Act laws dictate that hospitals transfer patients requiring a more specialized service, or when "medical benefits ... outweigh the increased risks to the individual...," although in practice this provides little guidance to practitioners.[1] Thus, clearer guidelines may be necessary to achieve less variable practices.

Our study is subject to several limitations. First, although nationally representative, the Medicare population is not reflective of all hospitalized patients nationwide. Additionally, we excluded patients transferred from the emergency room. Thus, the total number of patients who undergo IHT nationally is expected to be much higher than reflected in our analysis. We also excluded patients who were transferred more than once during a given hospitalization. This enabled us to focus on the initial transfer decision but does not allow us to look at patients who are transferred to a referral center and then transferred back. Second, given the criteria we used to define transfer, it is possible that we included nontransferred patients within our transferred cohort if they were discharged from one hospital and admitted to a different hospital within 1 day. However, on quality assurance analyses where we limited our cohort to only those beneficiaries with corresponding "transfer in" and "transfer out" claims (87% of the total cohort), we found no marked differences in our results. Additionally, although we assume that patient transfer status was coded correctly within the Medicare dataset, we could not confirm by individually examining each patient we defined as "transferred." However, on additional quality assurance analyses where we examined randomly selected excluded patients with greater than 1 transfer during hospitalization, we found differing provider numbers with each transfer, suggesting validity of the coding. Third, because there are likely many unmeasured patient confounders, we cannot be sure how much of the between-hospital variation is due to incomplete adjustment for patient characteristics. However, since adjusting for patient characteristics actually *increased* variability in hospital transfer rates, it is unlikely that residual patient confounders fully explain our observed results. Despite this, other variables that are not available within the CMS or AHA datasets may further eluci-

date hospital transfer practices, including variables reflective of the transfer process (eg, time of day of patient transfer, time delay between initiation of transfer and patient arrival at accepting hospital, accepting service on transfer, etc.); other markers of illness severity (eg, clinical service at the time of index admission, acute physiology score, utilization of critical care services on arrival at receiving hospital); and other hospital system variables (ie, membership in an accountable care organization and/or regional care network, the density of nearby tertiary referral centers (indicating possible supply-induced demand), other variables reflective of the "transfer culture" (such as the transfer rate at the hospital or region where the attending physician trained, etc.). Lastly, though our examination provides important foundational information regarding IHT nationally, this study did not examine patient outcomes in transferred and nontransferred patients, which may help to determine which patients benefit (or do not benefit) from transfer and why. Further investigation is needed to study these outcomes.

TABLE 2. Patient and Hospital Predictors of Transfer (continued)

Characteristic	Adjusted Odds of Transfer (95% CI)[a]	*P* value
Index Hospital Characteristics[d]		
Geographic location		
Northeast	1.40(1.27, 1.55)	<0.001
Midwest	1.27(1.17, 1.39)	<0.001
South	1.10(1.02,1.19)	0.02
West (referent)	--	--
Ownership		
For-profit (referent)	--	--
Not-for-profit	1.09(1.02, 1.18)	0.017
Public	1.27(1.17, 1.38)	<0.001
Teaching status		
Major (referent)	--	--
Minor	1.53(1.22, 1.92)	<0.001
Nonteaching	1.79(1.42, 2.26)	<0.001
Location		
Urban (referent)	--	--
Rural	1.24(1.15, 1.34)	<0.001
CMI	0.36(0.30, 0.45)	<0.001
Absence of certified trauma center	1.04(0.98, 1.10)	0.179
Absence of medical intensive care unit	1.11(1.00, 1.22)	0.022
Absence of cardiac intensive care unit	1.07(1.00, 1.14)	0.056
Absence of cardiac surgery services	2.52(2.28, 2.79)	<0.001
Absence of adult interventional cardiac catheterization	1.21(1.11, 1.30)	<0.001
Absence of adult cardiac electrophysiology	1.17(1.09,1.27)	<0.001
Composite score of other hospital specialty services	0.99(0.98, 1.00)	0.0009

[a]Adjusted for all patient and hospital characteristics, accounting for fixed effects for diagnosis and for the clustering of patients within hospitals.
[b]CMS HCC risk score.
[c]Q=Calendar quarters.
[d]Presented hospital characteristics for the transferred beneficiaries are characteristics of index hospital.
NOTE: Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure; CI, confidence interval; CMI, case mix index; CMS, Centers for Medicare and Medicaid Services; COPD, chronic obstructive pulmonary disease; DRG, diagnosis-related group; GI, gastrointestinal; HCC, Hierarchical Condition Category; SD, standard deviation; UTI, urinary tract infection.

CONCLUSION

In this national study of IHT, we found that a sizable number of patients admitted to the hospital undergo transfer to another acute care facility. Patients are transferred with common medical conditions, including those requiring specialized care such as AMI, and a high rate of comorbid clinical conditions, and certain patient and hospital characteristics are associated with greater odds of transfer. Although many of the observed associations between characteristics and odds of transfer were expected based on limited existing literature, we found several unexpected findings, eg, suggesting the possibility of a threshold beyond which sicker patients are not transferred. Additionally, we found that black and Medicaid patients had lower odds of transfer, which warrants further investigation for potential health care disparity. Importantly, we found much variability in the practice of IHT, as evidenced by the inexplicable differences in transfer by hospital region, and by residual unexplained variability in hospital transfer rates after accounting for patient and hospital characteristics, which may be due to lack of standard guidelines to direct IHT practices. In conclusion, this study of hospitalized Medicare patients provides important foundational information regarding rates and predictors of IHT nationally, as well as unexplained variability that exists within this complex care transition. Further investigation will be essential to understand reasons for, processes related to, and outcomes of transferred patients, to help guide standardization in best practices in care.

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The Shifting Landscape in Utilization of Inpatient, Observation, and Emergency Department Services Across Payers

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Recent policies by public and private payers have increased incentives to reduce hospital admissions. Using data from four states from the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project, this study compared the payer-specific population-based rates of adults using inpatient, observation, and emergency department (ED) services for 10 common medical conditions in 2009 and in 2013. Patients had an expected primary payer of private insurance, Medicare, Medicaid, or no insurance. Across all four payer populations, inpatient admissions declined, and care shifted toward treat-and-release observation stays and ED visits. The percentage of hospitalizations that began with an observation stay increased. Implications for quality of care and costs to patients warrant further examination. *Journal of Hospital Medicine* 2017;12:443-446.

For over a decade, private and public payers have implemented policies aimed at reducing rates of inpatient hospitalization. One approach for doing so is to improve ambulatory care, which can reduce the need for hospital-based acute care. Another approach is to stabilize acutely ill patients and discharge them from the emergency department (ED) or following a period of observation.[1] Private payers are entering into value-based contracting arrangements with hospitals and health systems to improve the quality of ambulatory care and lower healthcare expenditures.[2] Enrollment in managed care programs has grown among Medicaid recipients for similar reasons.[3] Policies of the Centers for Medicare & Medicaid Services (CMS) encourage improvements in ambulatory care as well as observation of Medicare beneficiaries instead of inpatient admission in certain situations.[4]

Recent studies have documented declines in inpatient admissions and increases in treat-and-release observation stays and ED visits among Medicare beneficiaries.[4-7] However, almost half of all hospitalizations unrelated to childbirth occur among patients with private insurance, Medicaid, or no insurance.[8] Less is known about shifts in the nature of hospital-based acute care among these populations. Such shifts would have implications for quality of care, patient outcomes, and costs. Therefore, further investigation is warranted.

Our objective was to investigate recent trends in payer-specific population-based rates of adults using inpatient, observation, and ED services. We focused on 10 medical conditions that are common reasons for hospital-based acute care: heart failure, bacterial pneumonia, chronic obstructive pulmonary disease, asthma, dehydration, urinary tract infection, uncontrolled diabetes, diabetes with long-term complications, diabetes with short-term complications, and hypertension. These conditions constitute more than 20% of inpatient stays in the general medical service line, can be affected by improvements in ambulatory care, and provided a consistent set of diagnoses to track trends over time.[9] We used 2009 and 2013 data from four states to examine trends among individuals with private insurance, Medicare, Medicaid, and no insurance.

METHODS

We obtained encounter-level data for Georgia, Nebraska, South Carolina, and Tennessee from the Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP).[10] Using encrypted patient identifiers, we linked inpatient admissions from the 2009 and 2013 State Inpatient Databases, observation stays from the State Ambulatory Surgery and Services Databases, and ED visits from State Emergency Department Databases.

We defined the 10 medical conditions using numerator specifications from the ICD-9-CM v 5.0 AHRQ Prevention Quality Indicators (see Appendix). At most, 1 inpatient admission, 1 observation stay, and 1 ED visit for a study condition was counted for each adult in each year. Limiting the number of visits minimized the skew caused by multiple uses of the same service.

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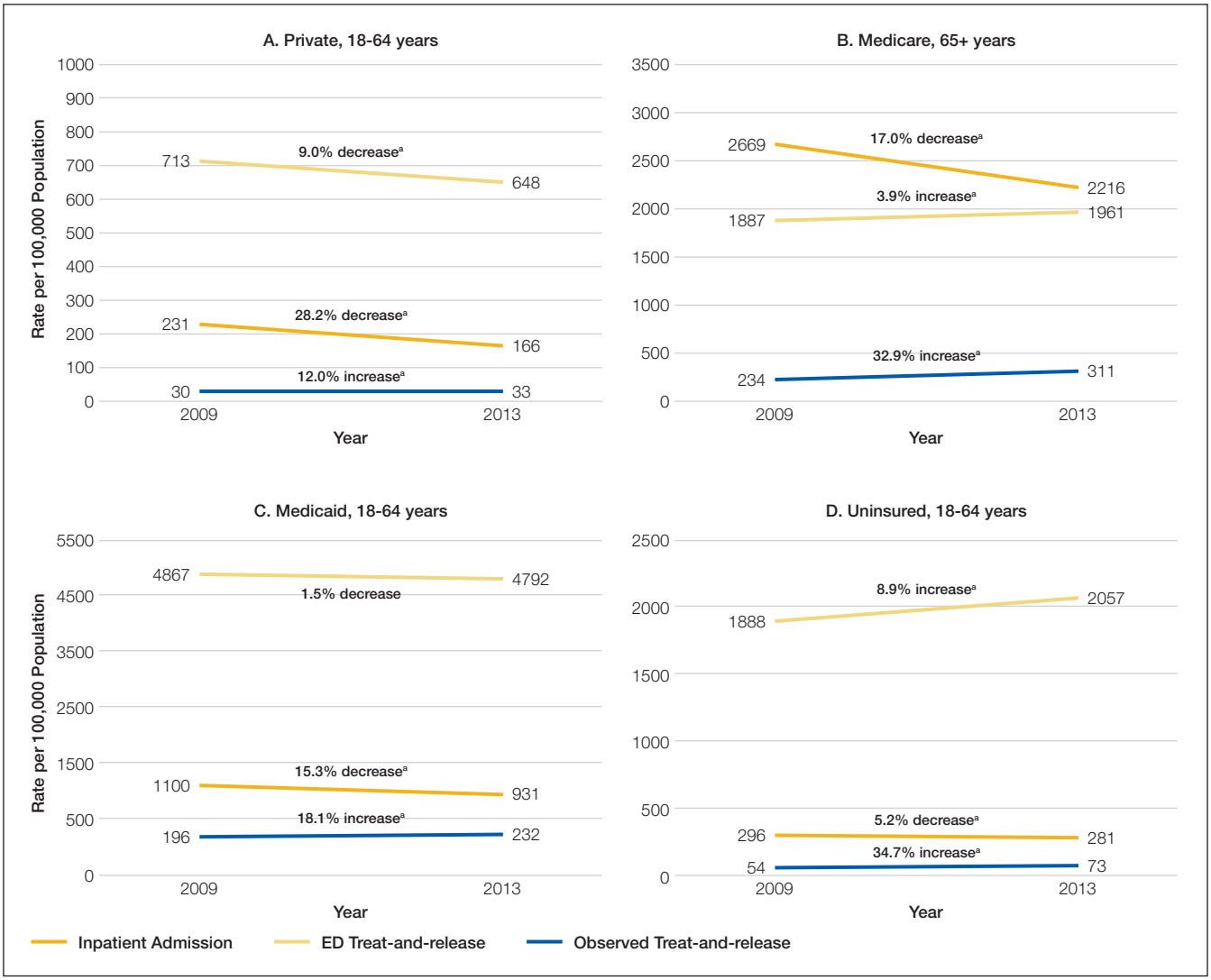

FIG. 1. Trends in the rate of adults (per 100,000 population) with treat-and-release observation stays and ED visits relative to inpatient admissions for ambulatory care sensitive conditions, 2009–2013.

[a]$P < 0.05$. Sources: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, state databases and U.S. Census Bureau, American Community Survey, Georgia, Nebraska, South Carolina, and Tennessee, 2009 and 2013.

NOTE: Abbreviation: ED, emergency department.

Using the American Community Survey, we calculated utilization rates for each type of service per 100,000 population in four payer and age groups: privately insured adults, Medicaid recipients, and uninsured adults 18 to 64 years, as well as Medicare beneficiaries 65 years and older. For each group, we also examined the origin of inpatient admissions—those who were directly admitted without evaluation in the ED, those admitted from the ED, and ED visits leading to observation stays and then inpatient admission.

RESULTS

Comparing 2009 and 2013, population-based rates of adults with 1 or more inpatient admissions for 10 common medical conditions declined, whereas rates of adults with treat-and-release observation stays rose. Changes in rates of treat-and-release ED visits varied across payers but were small relative to the substantial declines in inpatient admissions (Figure 1). In addition, a growing percentage of inpatient admissions began as observation stays and fewer adults were admitted directly, except among uninsured individuals (Figure 2).

Private Payers, 18 to 64 Years

The rate of adults with treat-and-release observation stays rose (+12.0%, 30 to 33 per 100,000 private payer population, $P < 0.001$). The rate of adults with treat-and-release ED visits declined (–9.0%, 713 to 648 per 100,000 population, $P < 0.001$), but by less than for inpatient admissions (–28.2%, 231 to 166 per 100,000 population, $P < 0.001$; Figure 1A). The percentage of inpatient admissions that began as observation stays rose (from 4.1% to 5.4%, $P = 0.041$), as did the percentage of admissions originating in the ED (from 66.4% to 71.5%, $P \leq 0.001$; Figure 2).

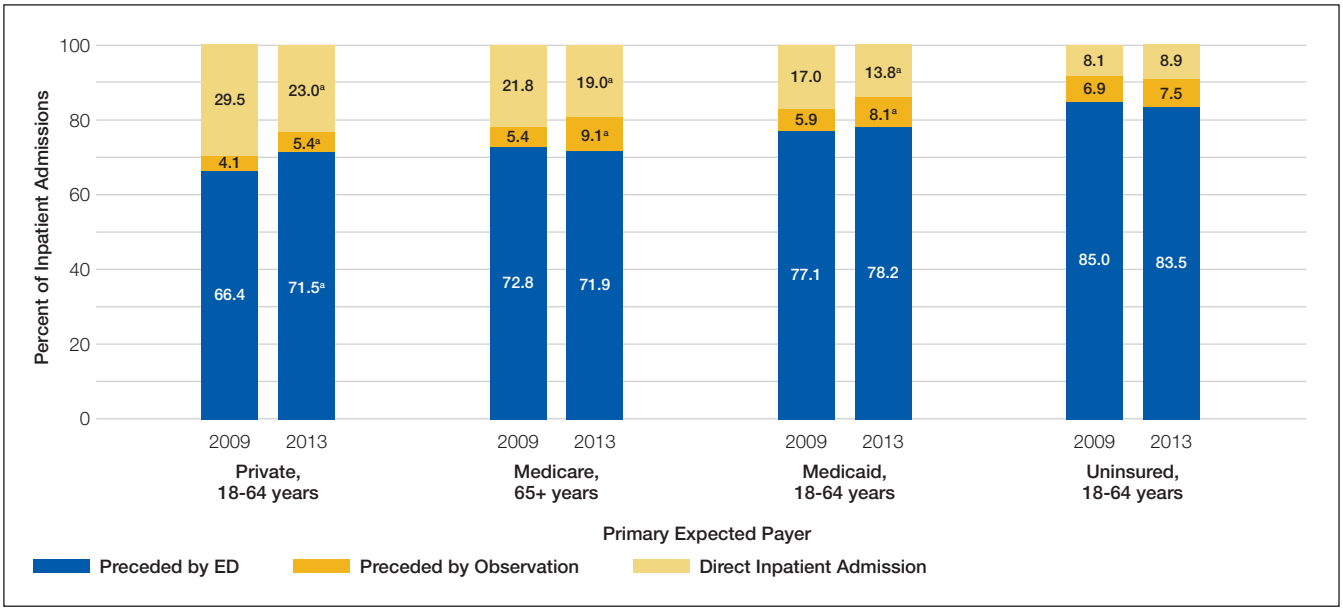

FIG. 2. Trends in the proportion of inpatient admissions for ambulatory care sensitive conditions that were preceded by observation or ED care.

[a]$P < 0.05$. Sources: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, Georgia, Nebraska, South Carolina, and Tennessee, 2009 and 2013.
NOTE: Abbreviation: ED, emergency department.

Medicare, 65 Years and Older

The rate of adults with inpatient admissions declined (–17.0%, 2669 to 2216 per 100,000 Medicare population, $P < 0.001$). Rates rose for adults with treat-and-release ED visits (+3.9%, 1887 to 1961 per 100,000 population, $P < 0.001$) and treat-and-release observation stays (+32.9%, 234 to 311 per 100,000 population, $P < 0.001$; Figure 1B). The percentage of inpatient admissions that began as observation stays also rose (5.4% to 9.1%, $P < 0.001$; Figure 2).

Medicaid, 18 to 64 Years

The rate of adults with inpatient admissions declined (–15.3%, 1100 to 931 per 100,000 Medicaid population, $P < 0.001$), whereas treat-and-release ED visits remained flat (–1.5%, 4867 to 4792 per 100,000 population, $P = 0.413$) and treat-and-release observation stays rose (+18.1%, 196 to 232 per 100,000 population, $P < 0.001$; Figure 1C). The percentage of inpatient admissions that began as observation stays rose (5.9% to 8.1%, $P = 0.022$; Figure 2).

Uninsured, 18 to 64 Years

The rate of adults with inpatient admissions declined (–5.2%, 296 to 281 per 100,000 uninsured population, $P = 0.003$), whereas rates rose for treat-and-release ED visits (+8.9%, 1888 to 2057 per 100,000 population, $P < 0.001$) and treat-and-release observation stays (34.7%, 54 to 73 per 100,000 population, $P < 0.001$; Figure 1D). The source of inpatient admissions remained stable (Figure 2).

DISCUSSION

Data on hospital encounters from four states show that both ED visits and observation stays are playing an increasing role in hospital-based acute care for 10 common conditions among populations insured by private payers, Medicare, and Medicaid, as well as those without insurance. Compared with 2009, in 2013 substantially fewer individuals had inpatient admissions, and patients were more likely to be discharged from the ED or discharged following observation without receiving inpatient care. Additionally, an increasing percentage of inpatient admissions followed observation stays, whereas direct admissions declined.

Previous authors also have reported declines in inpatient stays for these same conditions.[11] Others have reported increases in the use of observation stays for diverse conditions among patients with private insurance, Medicare beneficiaries, and veterans.[4,12,13] The unique attributes of HCUP databases from these four states (eg, all-payer data including patient linkage numbers across inpatient, observation, and ED care) enabled us to assess concurrent shifts in hospital-based acute care from inpatient to outpatient care among multiple payer populations. A recent analysis reported declines in readmissions and increases in observation visits occurring within 30 days after hospitalization among Medicare beneficiaries with heart failure, acute myocardial infarction, or pneumonia.[14] Future research should examine trends in readmissions and observation visits following hospitalization among multiple payer populations.

These shifts raise two important questions. The first pertains to quality of care, including outcomes. Although dedicated observation units with condition-specific care pathways can be associated with shorter stays and fewer admissions, many patients placed under observation are neither in dedicated units nor subject to care pathways.[15,16] Systems for monitoring quality of care are less developed for

observation care. The CMS publicly reports hospital-level data on quality of ED and inpatient care, including for several of the conditions we studied, but no measures apply to observation stays.[17] Little is known about whether shifts from inpatient care to observation status or discharge from the ED are associated with different health outcomes.

The second issue is patients' out-of-pocket costs. Although shifts from inpatient admissions to observation stays can reduce costs to payers,[15] effects on patient out-of-pocket costs are uncertain and may vary. For privately insured patients, out-of-pocket costs may be up to four times higher for observation than for inpatient care.[18] For Medicare beneficiaries, out-of-pocket costs can be higher for observation than for inpatient stays, particularly when patients receive costly medications or are discharged to skilled nursing facilities;[19,20] however, having secondary insurance dramatically reduces out-of-pocket costs.[21] We are not aware of data on Medicaid recipients or uninsured individuals.

This study has limitations. Only four states had data needed for these analyses, so generalization to other states is limited. Our analysis was descriptive and did not control for case mix, evaluate specific policies by any payer, or assess the full volume of visits among high utilizers. Movement of healthier or sicker individuals across payers could have contributed to temporal trends, but findings were similar across payers.

In conclusion, among 10 common medical conditions and three major payer populations and uninsured individuals in four states, inpatient admissions declined, and care shifted toward treat-and-release ED visits and observation stays. The number of inpatient admissions that began as observation stays also increased. Given these trends and the possibility that such shifts may be widespread and continue beyond 2013, quality of care, outcomes, and costs to patients warrant further evaluation.

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Telemetry Monitor Watchers Reduce Bedside Nurses' Exposure to Alarms by Intercepting a High Number of Nonactionable Alarms

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Cardiac telemetry, designed to monitor hospitalized patients with active cardiac conditions, is highly utilized outside the intensive care unit but is also resource-intensive and produces many nonactionable alarms. In a hospital setting in which dedicated monitor watchers are set up to be the first responders to system-generated alerts, we conducted a retrospective study of the alerts produced over a continuous 2-month period to evaluate how many were intercepted before nurse notification for being nonactionable, and how many resulted in code team activations. Over the 2-month period, the system generated 20,775 alerts (5.1/patient-day, on average), of which 87% were intercepted by monitor watchers. None of the alerts for asystole, ventricular fibrillation, or ventricular tachycardia resulted in a code team activation. Our results highlight the high burden of alerts, the large majority of which are nonactionable, as well as the role of monitor watchers in decreasing the alarm burden on nurses. Measures are needed to decrease telemetry-related alerts in order to reduce alarm-related harms, such as alarm fatigue. *Journal of Hospital Medicine* 2017;12:447-449. © 2017 Society of Hospital Medicine

Cardiac telemetry, designed to monitor hospitalized patients with active cardiac conditions, is highly utilized outside the intensive care unit (ICU) and generates a large number of automated alarms. Telemetry is also costly and requires substantial time and attention commitments from nursing and technician staff, who place and maintain the recording devices and address monitoring results.[1,2] The staff address and dismiss invalid alarms caused by telemetry artifacts,[2] such as the misreporting of patient movement as ventricular tachycardia/fibrillation (VT/VF) or the mimicking of asystole by a lead disconnection.

One strategy for addressing telemetry alarms is to have dedicated staff observe telemetry monitors and notify nurses with any events or findings. Studies conducted in the 1990s showed that dedicated monitor watchers, compared with automatically generated alarms alone, did not affect most outcomes[3] but can improve accuracy of arrhythmia detection.[4] Since then, given the advances in telemetry detection software, the effect of monitor watchers has not been evaluated. Mindful of the perceived burden of nonactionable telemetry alerts, we wanted to quantify the frequency of automated telemetry alerts in the wards and analyze the proportion of alerts deemed nonactionable by monitor watchers.

METHODS

We conducted this retrospective study at a 545-bed urban academic hospital in the United States. We reviewed the cases of all non-ICU patients with telemetry monitoring ordered. The telemetry order requires providers specify the indication for monitoring and adjust alert parameters for variables such as heart rate (preset to 60 and 100 beats per minute) and baseline rhythm (preset to normal sinus). Once a telemetry order is received, 5 leads are attached to the patient, and electrocardiographic data begin transmitting to a portable wireless telemetry monitor, or telemeter (Philips Intellispace Telemetry System), which in turn transmits to a central monitoring station in the progressive care unit (PCU; cardiac/pulmonary unit). The majority of patients on telemetry are in the PCU. Telemeters are also located in the general medicine, surgical, and neurologic non-ICU units. Data from a maximum of 96 telemeters in the hospital are simultaneously displayed in the central monitoring station.

At all times, two dedicated monitor watchers oversee the central monitoring station. Watchers are certified medical assistants with extra telemetry-specific training. Each receives a salary of $17 per hour (no benefits), or about $800 per 24-hour day for two watchers. Their role is to respond to audiovisual alerts triggered by the monitoring system—they either contact the bedside nurse or intercept the alert if deemed nonactionable. Consistent with the literature,[5] *nonactionable* alerts and alarms were defined as either "invalid" or "nuisance." Invalid alerts and alarms misrepresent patient status (eg, patient motion is electronically interpreted as VT/VF), and nuisance alerts and alarms do not require clinical intervention (eg, persistent sinus tachycardia has already been communicated to the nurse or provider). Monitor watchers must intercept the alert within a limited amount of time: 15 seconds for suspected lethal alerts (asystole, VT/VF), 30 seconds for extreme tachycardia/bradycardia, and 60 seconds for lead displacement or low battery.

If a watcher does not intercept an alert—either intention-

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ally or because time ran out—the alert generates an alarm, which automatically sends a text message to the patient's nurse's wireless phone. The nurse acknowledges the alarm and decides on further action. If the bedside nurse does not acknowledge the alarm within the same time frames as mentioned, the alarm is escalated, first to the unit charge nurse and then to the monitoring station charge nurse (Figure). All alerts are available for provider review at the central monitoring station for the duration of the telemetry order, and select telemetry strips are printed and filed in the patient's paper chart.

For this study, we analyzed telemetry system data for all monitored non-ICU ward patients from August 1 through September 30, 2014. We focused on the rate and relevance of alerts (system-generated) and alarms (text message to nurse). As cardiac arrhythmias leading to cardiopulmonary arrest can potentially be detected by telemetry, we also reviewed all code team activations, which are recorded in a separate database that details time of code team activation, to evaluate for correlation with telemetry alerts.

RESULTS

Within the 2-month study period, there were 1917 admissions to, and 1370 transfers to, non-ICU floors, for a total of 3287 unique patient-admissions and 9704 total patient-days. There were 1199 patient admissions with telemetry orders (36.5% of all admissions), 4044 total patient-days of telemetry, and an average of 66.3 patients monitored per day. In addition, the system generated 20,775 alerts, an average of 341 per day, 5.1 per patient-day, 1 every 4 minutes. Overall, 18,051 alerts (87%) were intercepted by monitor watchers, preventing nurse text-alarms. Of all alerts, 91% were from patients on medicine services, including pulmonary and cardiology; 6% were from patients on the neurology floor; and 3% were from patients on the surgery floor.

Forty percent of all alerts were for heart rates deviating outside the ranges set by the provider; of these, the overwhelming majority were intercepted as nuisance alerts (Table). In addition, 26% of all alerts were for maintenance reasons, including issues with batteries or leads. Finally, 34% (6954) were suspected lethal alerts (asystole, VT/VF); of these, 74% (5170) were intercepted by monitor watchers, suggesting they were deemed invalid. None of the suspected lethal alerts triggered a code team activation, indicating there were no telemetry-documented asystole or VT/VF episodes prompting resuscitative efforts. During the study period, there were 7 code team activations. Of the 7 patients, 2 were on telemetry, and their code team activation was for hypoxia detected by pulse oximetry; the other 5 patients, not on telemetry, were found unresponsive or apneic, and 4 of them had confirmed pulseless electrical activity.

TABLE. Frequency of Alerts by Type and Proportion Being Intercepted by Monitor Watchers

	Alerts		Intercepted Alerts	
Alert Type	n	%	n	%
Asystole	2818	14	1945	76
Ventricular tachycardia	3638	18	2849	78
Ventricular fibrillation	498	2	376	77
Tachycardia	7477	36	7215	90
Bradycardia	898	4	881	92
Leads off	5032	24	4537	79
Battery	414	2	248	40
Total	20,775	100	18,051	87

DISCUSSION

In small studies, other investigators have directly observed nurses for hours at a time and assessed their response to telemetry-related alarms.[1,2] In the present study, we found a very large number of telemetry-detected alerts over a continuous 2-month period. The large majority (87%) of alerts were manually intercepted by monitor watchers before being communicated to a nurse or provider, indicating these alerts did not affect clinical management and likely were either false positives or nonactionable. It is possible that repeat nonactionable alerts, like continued sinus tachycardia or bradycardia, affect decision making, but this may be outside the role of continuous cardiac telemetry. In addition, it is likely that all the lethal alarms (asystole, VT/VF) forwarded to the nurses were invalid, as none resulted in code team activations.

Addressing these alerts is a major issue, as frequent telemetry alarms can lead to alarm fatigue, a widely acknowledged

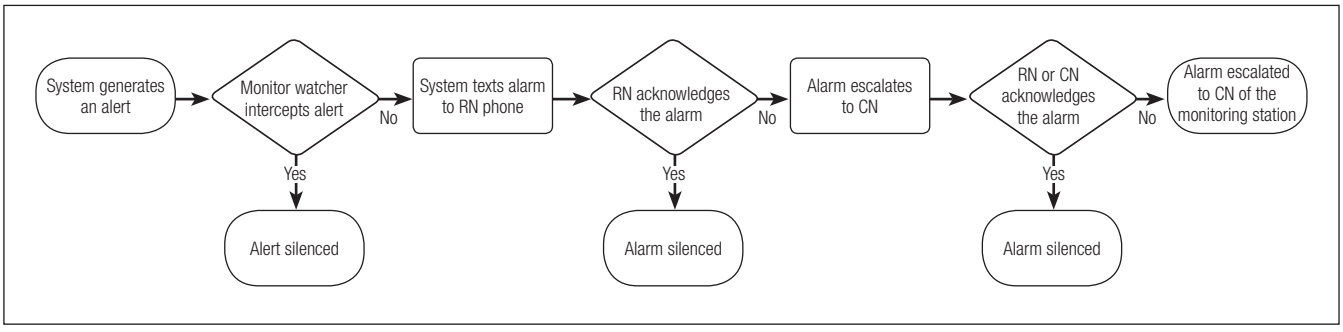

FIG. Escalation protocol of telemetry alerts and alarms.

NOTE: Alert or alarm must be intercepted or acknowledged within described time limits to prevent escalation. Abbreviations: CN, charge registered nurse; RN, registered nurse.

safety concern.[6] Furthermore, nonactionable alarms are a time sink, diverting nursing attention from other patient care needs. Finally, nonactionable alarms, especially invalid alarms, can lead to adverse patient outcomes. Although we did not specifically evaluate for harm, an earlier case series found a potential for unnecessary interventions and device implantation as a result of reporting artifactual arrhythmias.[7]

Our results also highlight the role of monitor watchers in intercepting nonactionable alarms and reducing the alarm burden on nurses. Other investigators have reported on computerized paging systems that directly alert only nurses,[8] or on escalated alarm paging systems that let noncrisis alarms self-resolve.[9] In contrast, our study used a hybrid 2-step telemetry-monitoring system—an escalated paging system designed to be sensitive and less likely than human monitoring to overlook events, followed by dedicated monitor watchers who are first-responders for a large number of alarms and who increase the specificity of alarms by screening for nonactionable alarms, thereby reducing the number of alarms transmitted to nurses. We think that, for most hospitals, monitor watchers are cost-effective, as their hourly wage is lower than that of registered nurses. Furthermore, monitor watchers can screen alerts faster because they are always at the monitoring station. Their presence reduces the amount of time that nurses need to divert from other clinical tasks in order to walk to the monitoring station to evaluate alerts.

Nonetheless, there remains a large number of nonactionable alerts forwarded as alarms to nurses, likely because of monitor watchers' inability to address the multitude of alerts, and perhaps because of alarm fatigue. Although this study showed the utility of monitor watchers in decreasing telemetry alarms to nurses, other steps can be taken to reduce telemetry alarm fatigue. A systematic review of alarm frequency interventions[5] noted that detection algorithms can be improved to decrease telemetry alert false positives. Another solution, likely easier to implement, is to encourage appropriate alterations in telemetry alarm parameters, which can decrease the alarm proportion.[10] An essential step is to decrease inappropriate telemetry use regarding the indication for and duration of monitoring, as emphasized by the Choosing Wisely campaign championing American Heart Association (AHA) guidelines for appropriate telemetry use.[11] At our institution, 20.2% of telemetry orders were for indications outside AHA guidelines, and that percentage likely is an underestimate, as this was required self-reporting on ordering.[12] Telemetry may not frequently result in changes in management in the non-ICU setting,[13] and may lead to other harms such as worsening delirium,[14] so it needs to be evaluated for harm versus benefit per patient before order.

Cardiac telemetry in the non-ICU setting produces a large number of alerts and alarms. The vast majority are not seen or addressed by nurses or physicians, leading to a negligible impact on patient care decisions. Monitor watchers reduce the nursing burden in dealing with telemetry alerts, but we emphasize the need to take additional measures to reduce telemetry-related alerts and thereby reduce alarm-related harms and alarm fatigue.

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Perceptions of Hospital-Dependent Patients on Their Needs for Hospitalization

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In the United States, older adults account for a significant proportion of hospitalizations, and a subset become hospital-dependent, for reasons that are unclear. We conducted a qualitative study to explore these individuals' perspectives on their need for hospitalizations. Twenty patients hospitalized at an academic medical center underwent semistructured qualitative interviews. Criteria for selection included age 65 and older, at least three hospitalizations over six months, admission to the medical service at the time of the study, did not meet criteria for chronic critical illness, was not comfort measures only, and did not have a conservator. Interviews were audiotaped, transcribed, and inductively analyzed. The major themes derived were the necessity and inevitability of hospitalizations ("You have to bring me in here"), feeling safe in the hospital ("It makes me feel more secure"), patients hospitalized despite having outside medical and social support ("I have everything"), and inadequate goals-of-care discussions ("It just doesn't occur to me"). Results suggested that candid discussions about health trajectories are needed to ensure hospitalization is consistent with the patient's realistic health priorities. *Journal of Hospital Medicine* 2017;12:450-453. © 2017 Society of Hospital Medicine

In the United States, patients 65 years old or older accounted for more than one third of inpatient stays and 42% of inpatient care spending in 2012.[1] Despite the identification of risk factors, the implementation of an array of interventions, and the institution of penalties on hospitals, a subset of older adults continues to spend significant time in the hospital.[2,3]

Hospital dependency is a concept that was only recently described. It identifies patients who improve while in the hospital but quickly deteriorate after leaving the hospital, resulting in recurring hospitalizations.[4] Although little is known about hospital-dependent patients, studies have explored patients' perspectives on readmissions.[5,6] Nevertheless, it remains unclear whether there are individuals for whom frequent and prolonged hospitalizations are appropriate, and whether there are undisclosed factors that, if addressed, could decrease their hospital dependency. We conducted an exploratory study to ascertain hospital-dependent patients' perspectives on their needs for hospitalizations.

METHODS

Study Design

This study was approved by the Yale University Institutional Review Board. From March 2015 to September 2015, Dr. Liu conducted semistructured explorative interviews with patients on the medical units of an academic medical center. Dr. Liu was not directly involved in the care of these patients. An interview guide that includes open-ended questions was created to elicit patients' perspectives on their need for hospitalizations, health status, and outside-hospital support. This guide was pilot-tested with 6 patients, whose transcripts were not included in the final analysis, to assess for ease of understanding. After the pilot interviews, the questions were revised, and the final guide consists of 12 questions (Supplemental Table).

Recruitment

We used predetermined criteria and a purposeful sampling strategy to select potential study participants. We identified participants by periodically (~once a week) reviewing the electronic medical records of all patients admitted to the medicine service during the study period. Eligible patients were 65 years old or older and had at least 3 hospitalizations over the preceding 6 months. Patients were excluded if they met our chronic critical illness criteria: mechanical ventilation for more than 21 days, history of tracheotomy for failed weaning from mechanical ventilation,[7] presence of a conservator, or admission only for comfort measures. Participants were recruited until no new themes emerged.

Data Collection

Twenty-nine patients were eligible. We obtained permission from their inpatient providers to approach them about the study. Of the 29 patients, 26 agreed to be interviewed, and 3 declined. Of the 26 participants, 6 underwent pilot interviews, and 20 underwent formal interviews with use of the finalized interview guide. The interviews, conducted in the hospital while the participants were hospitalized, lasted 17 minutes on average. The interviews were transcribed and iteratively

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analyzed. The themes that emerged from the initial interviews were further explored and validated in subsequent interviews. Interviews were conducted until theoretical saturation was reached and no new themes were derived from them. Demographic information, including age, sex, ethnicity, and marital status, was also collected.

Analysis

Interviews were digitally recorded and transcribed. Independently, two investigators used Atlas Ti software to analyze and code the interview transcriptions. An inductive approach was used to identify new codes from the data.[8] The coders then met to discuss repeating ideas based on the codes. When a code was identified by one coder but not the other, or when there was disagreement about interpretation of a code, the coders returned to the relevant text to reach consensus and to determine whether to include or discard the code.[9] We then organized and reorganized repeating ideas based on their conceptual similarities to determine the themes and subthemes.[9]

RESULTS

Twenty patients participated in the formal interviews. Participants' baseline characteristics are listed in Table 1, and four dominant themes, and their subthemes and exemplary quotations, are listed in Table 2.

Perspectives on Hospital Care

Participants perceived their hospitalizations as inevitable and necessary for survival: "I think if I haven't come to the hospital, I probably would have died." Furthermore, participants thought only the hospital had the resources to help them ("The medications they were giving me … you can get that in the hospital but not outside the hospital") and sustain them ("You are like an old car, and it breaks down little by little, so you have to go in periodically and get the problem fixed, so you will drive it around for a while").

Feeling Safe in Hospital. Asked how being in the hospital makes them feel, participants attributed their feelings of safety to the constant observation, the availability of providers and nurses, and the idea that hospital care is helping. As one participant stated, "Makes me feel safer in case you go into something like cardiac arrest. You are right here where they can help you."

Outside-Hospital Support. Despite multiple hospitalizations, most participants reported having social support ("I have the aide. I got the nurses come in. I have my daughter …"), physical support, and medical support ("I have all the doctors") outside the hospital. A minority of participants questioned the usefulness of the services. One participant described declining the help of visiting nurses because she wanted to be independent and thought that, despite recurrent hospitalizations for physical symptoms, she still had the ability to manage her own medications.

Goals-of-Care Discussion. Some participants reported inadequate discussions about goals of care, health priorities, and health trajectories. In their reports, this inadequacy included not thinking about their goals, despite continued health decline. One participant stated, "Oh, God, I don't know if I had any conversation like that. … I think until it is really brought to the front, you don't make a decision really if you don't have to." Citing the value of a more established relationship and deeper trust, participants preferred having these serious and personal discussions with their ambulatory care clinicians: "Because I know my doctor much closer. I have been with him for a number of years. The doctors in the hospital seem to be nice and competent, but I don't know them."

TABLE 1. Characteristics of Participants (n = 20)

Characteristic	n (%)[a]
Age, y	
Mean (SD)	81 (6)
65-74	2 (10)
75-84	10 (50)
≥85	8 (40)
Women	12 (60)
Race/ethnicity	
White	17 (85)
Black	3 (15)
Marital status	
Married	10 (50)
Widowed	9 (45)
Single	1 (5)
Mean (SD) medications, n	16 (6)
Residence before admission	
Home	16 (80)
Skilled nursing facility	3 (15)
Assisted living facility	1 (5)
Location after hospital discharge	
Home	12 (60)
Skilled nursing facility	8 (40)
Mean (SD) length of stay per admission, d	7.1 (6)
Mean (SD) hospitalizations in past 12 months, n	6 (4)
Principal diagnosis for current admission	
COPD/asthma exacerbation	5 (25)
CHF exacerbation	4 (20)
Urinary traction infection	3 (15)
Pneumonia	2 (10)
Other	6 (30)
Chronic condition	
CAD/CHF/cardiomyopathy	14 (70)
Atrial fibrillation	10 (50)
Hypertension	15 (75)
Diabetes	13 (65)
Chronic kidney disease	11 (55)
COPD	9 (45)
Depression	5 (25)
Stroke/transient ischemic attack	3 (15)
Cancer except nonmelanoma skin cancers	3 (15)

[a]Except where indicated otherwise.

NOTE: Abbreviations: CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; SD: standard deviation.

TABLE 2. Older Adults' Perspectives on Their Need for Hospitalizations

	Theme 1. Perspectives about hospital care
Subthemes	*Participants express their hospital care needs and their reasons for seeking hospital care and for experiencing multiple hospitalizations*
Subtheme 1. Need for hospital care	"I think if I haven't come to the hospital, I probably would have died"—A1, 85-year-old Caucasian man
	"If I break down and can't breathe, then you have to bring me in here, and they got to do all these stuff when I come in to the hospital"—A3, 86-year-old African American woman
Subtheme 2. Why hospital care	"When I am sick at home, I feel like I don't want to go to the hospital, but if I have to go to the hospital I have to go because I want to get over this feeling … so I know I have no choice ... they give me something over there to fix me up a little"—A17, 85-year-old Caucasian man
	"The medications they were giving me to see if they were working, you can get that in the hospital but not outside the hospital—that's why my doctors outside tell me to get into the emergency room"—A15, 78-year-old Caucasian man
	"They have all things in the hospital that I don't have at home, you know, so I can't take no x-ray at home, I have to come into the hospital and do it, you know—all the doctors come in here to see me, they can't come in my house, so they see me in hospital"—A3, 86-year-old African American woman
Subtheme 3. Why multiple hospitalizations	"Well, it gets better when I come to the hospital … say I go home and stay about a month, and the same thing happens to me again, and then I come back to the hospital again and they put me on the medication again. And then it holds me up for about a month again, then I would be back in"—A3, 86-year-old African American woman
	"Well, I have a lot of chronic problems, they are probably related to my age, like the heart and the kidney … and so you are like an old car, and it breaks down little by little, so you have to go in periodically and get the problem fixed, so you will drive it around for a while and something else would break down, and you go and get it fixed"—A8, 85-year-old Caucasian woman
	Theme 2. Feeling safe in hospital
No Subthemes	*Participants describe their feelings about hospital safety*
	"Just being around them makes you feel safer, makes me feel safer in case you go into something like cardiac arrest. You are right here where they can help you"—A18, 75-year-old African American woman
	"It makes me more secure knowing that there are people who can help cure me"—A6, 84-year-old Caucasian man
	"It makes me feel more secure. Well, I feel that I am in good hands, that they can take care of me and do things that I can't do"—A7, 78-year-old Caucasian woman
	Theme 3. Recurrent hospitalizations despite having support outside hospital
Subthemes	*Participants describe their perspectives on their out-of-hospital experiences—the social and physical support they may or may not receive, their medical care, and why they decline home support*
Subtheme 1. Home social and physical support	"My youngest daughter carries me through this whole thing … she knows all the medications, all the illnesses, all the doctors. She makes all my appointments, she does all that stuff. She goes with me to all the appointments"—A15, 78-year-old Caucasian man
	"I have everything. I have the aide. I got the nurses come in. I have my daughter and my daughter-in-law"—A4, 89-year-old Caucasian woman
Subtheme 2. Ambulatory medical care	"I have a heart doctor, I have an eye doctor, I have a chest doctor whatever you call it, I have all the doctors"—A3, 86-year-old African American woman
	"I have a nurse who comes usually at least once a week … I will continue to see her until I am well enough that I won't need her … I have seen her many times, so she understands my case"—A7, 78-year-old Caucasian woman
	"I have a good doctor and if one is not available for whatever reason, there is always someone taking over for him. I have been with the same doctor for 25 years, and I have had the same cardiologist for about 20 years, so that makes a difference, and both are very caring"—A8, 85-year-old Caucasian woman
Subtheme 3. Feels home care is declining or services are not helping	"They told me that I could have the visiting nurse come in and put my pills out because I take about 16 pills a day. And I refuse. I said I know just where everything is … and I said the visiting nurse would just upset me because they don't know where things are"—A9, 89-year-old Caucasian woman
	"I saw one, and that was the only one that came in every other day that wrap my leg. And to me, that was ridiculous because, as I said, they didn't wrap it the way it should have been wrapped anyway. So you get discouraged, so why are you doing this. All you are doing is giving government money"—A12, 80-year-old Caucasian woman
	Theme 4. Goals-of-care discussions
Subthemes	*Participants express reasons for not having conversations about goals of care and identify the clinicians with whom they would prefer to have such conversations*
Subtheme 1. Reasons for not having healthcare goals	"Can I tell why I don't want to talk to them, because usually it just doesn't occur to me"—A11, 87-year-old Caucasian man
	"I noticed that our intern has been hitting my wife with those questions a little bit, hasn't been particularly at me directly. Usually we have too much other stuff to worry about"—A16, 77-year-old Caucasian man
	"Oh, God, I don't know if I had any conversation like that. I don't know, I think until it is really brought to the front, you don't make a decision really if you don't have to"—A19, 75-year-old Caucasian woman
Subtheme 2. With whom to have conversations about healthcare goals	"Because I know my doctor much closer. I have been with him for a number of years. The doctors in the hospital seem to be nice and competent, but I don't know them"—A1, 85-year-old Caucasian man
	"Well, I have a primary doctor. He knows mostly about me, and that's who I would talk to … because you don't have any relationship with [providers in the hospital]. When you see [a primary care provider] for 20 years, you have a relationship"—A7, 78-year-old Caucasian woman
	"Yeah, my primary doctor, I don't do nothing without consulting him first. I trust [providers in the hospital], don't get me wrong, but I will tell my primary doctor things that I won't tell the new ones"—A4, 89-year-old Caucasian woman

DISCUSSION

Participants considered their hospitalizations a necessity and reported feeling safe in the hospital. Given that most already had support outside the hospital, increasing community services may be inadequate to alter participants' perceived hospital care needs. On the other hand, a few participants reported declining services that might have prevented hospitalizations. Although there has been a study of treatment refusal among older adults with advanced illnesses,[10] not much is known about refusal of services among this population. Investigators should examine the reasons for refusing services and the effect that refusal has on hospitalizations. Furthermore, although it would have been informative to ascertain clinician perspectives as well, we focused on patient perspec-

tives because less is known on this topic.

Some participants noted their lack of discussion with their clinicians about healthcare goals and probable health trajectories. Barriers to goals-of-care discussion among this highly vulnerable population have been researched from the perspectives of clinicians and other health professionals but not patients themselves.[11,12] Of particular concern in our study is the participant-noted lack of discussion about health trajectories and health priorities, given the decline that occurs in this population and even in those with good care. This inadequacy in discussion suggests continued hospital care may not always be consistent with a patient's goals. Patients' desire to have this discussion with their clinicians, with whom they have a relationship, supports the need to involve ambulatory care clinicians, or ensure these patients are cared for by the same clinicians, across healthcare settings.[13,14] Whoever provides the care, the clinician must align treatment with the patient's goal, whether it is to continue hospital-level care or to transition to palliative care. Such an approach also reflects the core elements of person-centered care.[15]

Study Limitations

Participants were recruited from the medicine service at a single large academic center, limiting the study's generalizability to patients admitted to surgical services or community hospitals. The patients in this small sample were English-speaking and predominantly Caucasian, so our findings may not represent the perspectives of non-English-speaking or minority patients. We did not perform statistical analysis to quantify intercoder reliability. Last, as this was a qualitative study, we cannot comment on the relative importance or prevalence of the reasons cited for frequent hospitalizations, and we cannot estimate the proportion of patients who had recurrent hospitalizations and were hospital-dependent.

Implication

Although quantitative research is needed to confirm our findings, the hospital-dependent patients in this study thought their survival required hospital-level care and resources. From their perspective, increasing posthospital and community support may be insufficient to prevent some hospitalizations. The lack of goals-of-care discussion supports attempts to increase efforts to facilitate discussion about health trajectories and health priorities between patients and their preferred clinicians.

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Incidental Pulmonary Nodules Reported on CT Abdominal Imaging: Frequency and Factors Affecting Inclusion in the Hospital Discharge Summary

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Incidental imaging findings require an assessment of risk and clinical relevance, as well as consideration of further evaluation. Incidental findings are common on imaging obtained in the hospital, with pulmonary nodules being among the most frequent findings that may require additional evaluation. We conducted a retrospective study to determine the factors associated with documentation of incidental findings in the hospital discharge summary, using pulmonary nodules reported on abdominal computed tomography (CT) as an example of incidental findings with well-defined follow-up guidelines. Between January 1, 2012 and December 31, 2014, 7173 patients underwent in-patient abdominal CT without concurrent chest CT; of these patients, 62.2% were ≥60 years old, 50.6% were men, and 45.5% were current or former smokers. Incidental pulmonary nodules were reported in 402 patients (5.6%; 95% confidence interval [CI], 5.1%-6.2%). Based on nodule size, reported size stability, and patients' smoking status, 208 patients (2.9%; 95% CI, 2.5%-3.3%) required follow-up surveillance, per the 2005 Fleischner Society guidelines. Of these 208 patients, 48 (23%) received discharge summaries that included documentation of the incidental findings, with 34 summaries including a recommendation for nodule follow-up and 19 summaries including a time frame for repeat CT. Three factors were positively associated with the inclusion of the pulmonary nodule in the discharge summary: mention of the pulmonary nodule in the summary headings of the radiology report ($P \leq 0.001$), radiologist recommendations for further surveillance ($P \leq 0.001$), and medical discharging service ($P = 0.016$). These findings highlight the need for a multidisciplinary systems-based approach to incidental pulmonary nodule documentation and surveillance. *Journal of Hospital Medicine* 2017;12:454-457. © 2017 Society of Hospital Medicine

Incidental findings create both medical and logistical challenges regarding communication.[1,2] Pulmonary nodules are among the most frequent and medically relevant incidental findings, being noted in up to 8.4% of abdominal computed tomography (CT) scans.[3] There are guidelines regarding proper follow-up and management of such incidental pulmonary nodules, but appropriate evidence-based surveillance imaging is often not performed, and many patients remain uninformed. Collins et al.[4] reported that, before initiation of a standardized protocol, only 17.7% of incidental findings were communicated to patients admitted to the trauma service; after protocol initiation, the rate increased to 32.4%. The hospital discharge summary provides an opportunity to communicate incidental findings to patients and their medical care providers, but Kripalani et al.[5] raised questions regarding the current completeness and accuracy of discharge summaries, reporting that 65% of discharge summaries omitted relevant diagnostic testing, and 30% omitted a follow-up plan.

We conducted a study to determine how often incidental pulmonary nodules found on abdominal CT are documented in the discharge summary, and to identify factors associated with pulmonary nodule inclusion.

METHODS

This was a retrospective cohort study of hospitalized patients ≥35 years of age who underwent in-patient abdominal CT between January 1, 2012 and December 31, 2014. Patients were identified by cross-referencing hospital admissions with *Current Procedural Terminology* (*CPT*) codes indicating abdominal CT (74176, 74177, 74178, 74160, 74150, 74170). Patients with chest CT (*CPT* codes 71260, 71250, 71270) during that hospitalization or within 30 days before admission were excluded to ensure that pulmonary nodules were incidental and asymptomatic. The index hospitalization was defined as the first hospitalization during which the patient was diagnosed with an incidental pulmonary nodule on abdominal CT, or the first hospitalization during the study period for patients without pulmonary nodules. All patient charts were manually reviewed, and baseline age, sex, and smoking status data collected.

Radiology reports were electronically screened for the words *nodule* and *nodules* and then confirmed through manual review of the full text reports. Nodules described as *tiny* (without other size description) were assumed to be <4 mm in size, per manual review of a small sample. Nodules were deemed as falling outside the Fleischner Society criteria guidelines (designed for indeterminate pulmonary nodules), and were therefore excluded, if any of seven criteria were met: The nodule was (1) cavitary, (2) associated with a

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known metastatic disease, (3) associated with a known granulomatous disease, (4) associated with a known inflammatory process, (5) reported likely to represent atelectasis, (6) reported likely to be a lymph node, or (7) previously biopsied.[4]

For each patient with pulmonary nodules, a personal history of cancer was obtained. Nodule size, characteristics, and stability compared with available prior imaging were recorded. Radiology reports were reviewed to determine if pulmonary nodules were mentioned in the summary headings of the reports or in the body of the reports and whether specific follow-up recommendations were provided. Hospital discharge summaries were reviewed for documentation of pulmonary nodule(s) and follow-up recommendations. Discharging service (medical/medical subspecialty, surgical/surgical subspecialty) was noted, along with the patients' condition at discharge (alive, alive on hospice, deceased).

The frequency of incidental pulmonary nodules on abdominal CT during hospitalization and the frequency of nodules requiring follow-up were reported using a point estimate and corresponding 95% confidence interval (CI). The χ^2 test was used to compare the frequency of pulmonary nodules across patient groups. In addition, for patients found to have incidental nodules requiring follow-up, the χ^2 test was used to compare across groups the percentage of patients with discharge documentation of the incidental nodule. In all cases, 2-tailed *P*s are reported, with $P \leq 0.05$ considered statistically significant.

RESULTS

Between January 1, 2012 and December 31, 2014, 7173 patients ≥35 years old underwent in-patient abdominal CT without concurrent chest CT. Of these patients, 62.2% were ≥60 years old, 50.6% were men, and 45.5% were current or former smokers. Incidental pulmonary nodules were noted in 402 patients (5.6%; 95% CI, 5.1%-6.2%), of whom 68.7% were ≥60 years old, 56.5% were men, and 46.3% were current or former smokers. Increasing age ($P = 0.004$) and male sex ($P = 0.015$) were associated with increased frequency of incidental pulmonary nodules, but smoking status ($P = 0.586$) was not. Of patients with incidental nodules, 71.6% had solitary nodules, and 58.5% had a maximum nodule size of ≤4 mm (Table 1). Based on smoking status, nodule size, and reported size stability, 208 patients (2.9%; 95% CI, 2.5%-3.3%) required follow-up surveillance as per 2005 Fleischner Society guidelines. Among solitary pulmonary nodules requiring further surveillance (n = 147), the mean risk of malignancy based on the Mayo Clinic solitary pulmonary nodule risk calculator was 7.9% (interquartile range, 3.0%-10.5%), with 28% having a malignancy risk of ≥10%.[6]

Of the 208 patients with nodules requiring further surveillance, only 48 (23%) received discharge summaries documenting the nodule; 34 of these summaries included a recommendation for nodule follow-up, with 19 of the recommendations including a time frame for repeat CT. Three factors were positively associated with documentation of the pulmonary nodule in the discharge summary: mention of the pulmonary nodule in the summary headings of the radiology report ($P < 0.001$), radiologist recommendation for further surveillance ($P < 0.001$), and medical discharging service ($P = 0.016$) (Table 2). The highest rate of pulmonary nodule inclusion in the discharge summary (42%) was noted among patients for whom the radiology report included specific recommendations.

TABLE 1. Characteristics of Patients With Any Incidental Pulmonary Nodules and Patients With Nodules Requiring Further Follow-Up as per Fleischner Society Criteria

	Incidental Nodules (N = 402)		Nodules Needing Follow-Up (N = 208)	
Characteristic	n	%	n	%
Nodules, n				
Solitary	288	71.6	147	70.7
Multiple	114	28.4	61	29.3
Prior cancer				
Yes	138	34.3	70	33.6
No	264	65.7	138	66.4
Maximum nodule size, mm				
≤4.0	235	58.5	72	34.6
4.1-6.0	98	24.4	78	37.5
6.1-8.0	32	8.0	30	14.4
≥8.1	37	9.2	28	13.5

DISCUSSION

The frequency of incidental pulmonary nodules reported on abdominal CT in our study (5.6%) is consistent with frequencies reported in similar studies. Wu et al.[7] (reviewing 141,406 abdominal CT scans) and Alpert et al.[8] (reviewing 12,287 abdominal CT scans) reported frequencies of 2.5% and 3%, respectively, while Rinaldi et al.[3] (reviewing 243 abdominal CT scans) reported a higher frequency, 8.4%. Variation likely results from patient factors and the individual radiologist's attention to incidental pulmonary findings. Rinaldi et al. suggested that up to 39% of abdominal CT scans include pulmonary nodules on independent review, raising the possibility of significant underreporting. In our study, we focused on pulmonary nodules included in the radiology report to tailor the relevance of our study to the hospital medicine community. We also included only those incidental nodules falling within the purview of the Fleischner Society criteria in order to analyze only findings with established follow-up guidelines.

The rate of pulmonary nodule documentation in our study was low overall (23%) but consistent with the literature. Collins et al.,[4] for example, reported that only 17.7% of patients with trauma were notified of incidental CT findings by either the discharge summary or an appropriate specialist consultation. Various contributing factors can be hypothesized. First, incidental pulmonary nodules are discovered

TABLE 2. Characteristics Associated With Discharge Summary Documentation of Nodules Requiring Follow-Up as per Fleischner Society Criteria (N = 208)

Characteristic	Computed Tomography, N	Pulmonary Nodules Documented in Summary, n	%	
Total population	208	48	23	*P*
Age, y				0.90
35-49	22	4	8	
50-59	46	11	23	
60-69	52	14	29	
70-79	42	10	21	
80+	46	9	19	
Sex				0.34
Male	122	31	25	
Female	86	17	20	
Smoking status				0.64
Current	32	10	31	
Former	105	22	21	
Never	68	15	22	
Unknown	3	1	33	
Prior malignancy				0.15
No	138	36	26	
Yes	70	12	17	
Maximum nodule size, mm				0.11
≤4.0	72	13	18	
4.1-6.0	78	15	19	
6.1-8.0	30	10	33	
≥8.1	28	10	36	
Nodules, n				0.16
Solitary	147	30	20	
Multiple	61	18	30	
Probability of malignancy[a]				0.12
<.049	68	15	22	
.05-.099	40	4	10	
≥.1	39	11	28	
Location of nodule in radiology report				<0.001
Heading	78	33	42	
Body	130	15	12	
Radiologist follow-up recommendation				<0.001
None mentioned	132	17	13	
Follow-up recommended, no time frame	10	3	30	
Specific follow-up recommended	66	28	42	
Discharging service				0.016
Medical	125	36	29	
Surgical	83	12	14	

[a]Solitary incidental nodules only (n = 147).

largely in the context of evaluation for other symptomatic conditions, which can overshadow their importance. Second, the lack of clear patient-friendly education materials regarding incidental pulmonary nodules can complicate discussions with patients. Third, many electronic health record (EHR) systems cannot automatically pull incidental findings into the discharge summary and instead rely on provider vigilance.

As our study does, the literature highlights the importance of the radiology report in communicating incidental findings. In a review of >1000 pulmonary angiographic CT studies, Blagev et al.[9] reported an overall follow-up rate of 29% (28/96) among patients with incidental pulmonary nodules, but none of the 12 patients with pulmonary nodules mentioned in the body of the report (rather than in the summary headings) received adequate follow-up. Similarly, in Shuaib et al.,[10] radiology reports that included follow-up recommendations were more likely to change patient treatment than reports without follow-up recommendations (70% vs 2%). However, our data also show that radiologist recommendations alone are insufficient to ensure adequate communication of incidental findings.

The literature regarding the most cost-effective means of addressing this quality gap is limited. Some institutions have

integrated their EHR systems to allow radiologists to flag incidental findings for auto-population in a dedicated section of the discharge summary. Although these efforts can be helpful, documentation alone does not save lives without appropriate follow-up and intervention. Some institutions have hired dedicated nursing staff as incidental finding coordinators. For high-risk incidental findings, Sperry et al.[11] reported that hiring an incidental findings coordinator helped their level I trauma center achieve nearly complete documentation, patient notification, and confirmation of posthospital follow-up appointments. Such solutions, however, are labor-intensive and still rely on appropriate primary care follow-up.

Strengths of our study include its relatively large size and particular focus on the issues and decisions facing hospital medicine providers. By focusing on incidental pulmonary nodules reported on abdominal CT, and excluding patients with concurrent chest CT, we avoided including patients with symptomatic or previously identified pulmonary findings. Study limitations include the cross-sectional, retrospective design, which did not include follow-up data regarding such outcomes as rates of appropriate follow-up surveillance and subsequent lung cancer diagnoses. Our single-center study findings may not apply to all hospital practice settings, though they are consistent with the literature with comparison data.

Our study results highlight the need for a multidisciplinary systems-based approach to incidental pulmonary nodule documentation, communication, and follow-up surveillance.

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Empiric *Listeria monocytogenes* Antibiotic Coverage for Febrile Infants (Age, 0-90 Days)

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The "Things We Do for No Reason" series reviews practices which have become common parts of hospital care but which may provide little value to our patients. Practices reviewed in the TWDFNR series do not represent "black and white" conclusions or clinical practice standards, but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

Evaluation and treatment of the febrile infant 0 to 90 days of age are common clinical issues in pediatrics, family medicine, emergency medicine, and pediatric hospital medicine. Traditional teaching has been that *Listeria monocytogenes* is 1 of the 3 most common pathogens causing neonatal sepsis. Many practitioners routinely use antibiotic regimens, including ampicillin, to specifically target *Listeria*. However, a large body of evidence, including a meta-analysis and several multicenter studies, has shown that listeriosis is extremely rare in the United States. The practice of empiric ampicillin thus exposes the patient to harms and costs with little if any potential benefit, while increasing pressure on the bacterial flora in the community to generate antibiotic resistance. Empiric ampicillin for all infants admitted for sepsis evaluation is a tradition-based practice no longer founded on the best available evidence.

CASE REPORT

A 32-day-old, full-term, previously healthy girl presented with fever of 1 day's duration. Her parents reported she had appeared well until the evening before admission, when she became a bit less active and spent less time breastfeeding. The morning of admission, she was fussier than usual. Rectal temperature, taken by her parents, was 101°F. There were no other symptoms and no sick contacts.

On examination, the patient's rectal temperature was 101.5°F. Her other vitals and the physical examination findings were unremarkable. Laboratory test results included a normal urinalysis and a peripheral white blood cell (WBC) count of 21,300 cells/μL. Cerebrospinal fluid (CSF) analysis revealed normal protein and glucose levels with 3 WBCs/μL and a negative gram stain. Due to stratifying at higher risk for serious bacterial infection (SBI), the child was admitted and started on ampicillin and cefotaxime while awaiting culture results.

BACKGROUND

Evaluation and treatment of febrile infants are common clinical issues in pediatrics, emergency medicine, and general practice. Practice guidelines for evaluation of febrile infants recommend hospitalization and parenteral antibiotics for children younger than 28 days and children 29 to 90 days old if stratified at high risk for SBI.[1,2] Recommendations for empiric antibiotic regimens include ampicillin in addition to either gentamicin or cefotaxime.[1,2]

WHY YOU MIGHT THINK AMPICILLIN IS HELPFUL

Generations of pediatrics students have been taught that the 3 pathogens most likely to cause bacterial sepsis in infants are group B *Streptococcus* (GBS), *Escherichia coli*, and *Listeria monocytogenes*. This teaching is still espoused in the latest editions of pediatrics textbooks.[3] Ampicillin is specifically recommended for covering *Listeria*, and studies have found that 62% to 78% of practitioners choose empiric ampicillin-containing antibiotic regimens for the treatment of febrile infants.[4-6]

WHY EMPIRIC AMPICILLIN IS UNNECESSARY

In the past, *Listeria* was a potential though still uncommon infant pathogen. Over the past few decades, however, the epidemiology of infant sepsis has changed significantly. Estimates of the rate of infection with *Listeria* now range from extremely rare to nonexistent across multiple studies[4,7-15] (Table). In a 4-year retrospective case series at a single urban academic center in Washington, DC, Sadow et al.[4] reported no instances of *Listeria* among 121 positive bacterial cultures in infants younger than 60 days seen in the emergency department (ED). Byington et al.[7] examined all positive cultures for infants 0 to 90 days old at a large academic referral center in Utah over a 3-year period and reported no cases of *Listeria* (1298 patients, 105 SBI cases). A study at a North Carolina academic center found 1 case of *Listeria* meningitis among 72 SBIs (668 febrile infants) without a localizing source.[8] At a large group-practice in northern California, Greenhow et al.[9] examined all blood cultures (N = 4255) performed over 4 years for otherwise healthy infants 1 week to 3 months old and found no cases of *Listeria*. In a follow-up study, the same authors examined all blood (n = 5396), urine

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TABLE. Studies Reporting *Listeria* Cases in Infants

Study	Year	Design	Population	Setting	Outcome Measures	Results
Sadow et al.[4]	1999	Retrospective case series	Infants <60 days old seen in ED during 4-year period	Single urban university-affiliated ED in Washington, DC	Rates of all SBIs	0 case of *Listeria* among 121 isolated pathogens
Byington et al.[7]	2003	Retrospective case series	Febrile infants <90 days old evaluated for sepsis in ED during 3-year period	Single urban university-affiliated ED in Utah	Rates of all SBIs	0 case of *Listeria* among 105 SBIs in 1298 patients
Watt et al.[8]	2010	Retrospective case series	Febrile infants <90 days old without localizing source with blood culture in ED during 10-year period	Single university-affiliated ED in North Carolina	Rates of all SBIs	1 case of *Listeria* meningitis among 72 SBIs in 668 patients
Greenhow et al.[9]	2012	Retrospective case series	Previously healthy infants 1 week to 3 months old with blood culture collected in outpatient, ED, or inpatient setting during 4-year period	Large health maintenance organization practice in northern California	Rate of bacteremia	0 case of *Listeria* bacteremia among 93 positive cultures in 4255 total cultures
Biondi et al.[12]	2013	Retrospective case series	Febrile infants <90 days old with positive blood cultures admitted to general care unit during 7-year period	6 geographically diverse US healthcare systems	Rate of bacteremia	0 case of *Listeria* among 181 bacteremia cases
Greenhow et al.[10]	2014	Retrospective case series	Previously healthy infants 1 week to 3 months old with blood, urine, or CSF culture collected in outpatient, ED or inpatient setting during 7-year period	Large health maintenance organization practice in northern California	Rates of all SBIs	0 case of *Listeria* among: 129 positive cultures in 5396 blood cultures 823 positive cultures in 4599 urine cultures 16 bacterial meningitis cases in 1796 CSF cultures
Hassoun et al.[11]	2014	Retrospective case series	Infants <28 days old evaluated for SBIs in 2 EDs during 5-year period	1 ED at an urban children's hospital and 1 ED at a suburban academic hospital in Michigan	Rates of all SBIs	1 case of *Listeria* bacteremia among 72 SBIs in 1192 patients
Mischler et al.[13]	2015	Retrospective case series	Healthy febrile infants <90 days old admitted to general care unit during 8-year period	17 geographically diverse US healthcare systems	Rate of bacteremia	0 case of *Listeria* among 392 bacteremia cases
Leazer et al.[14]	2016	Meta-analysis	Studies of SBI rates in infants <90 days old	Studies conducted in United States between 1998 and 2014	Rates of all SBIs caused by *Listeria* or *Enterococcus*	16 studies in meta-analysis: 0.03% prevalence of *Listeria* bacteremia among 20,703 blood cultures 0.02% prevalence of *Listeria* meningitis among 13,775 CSF cultures 0 case of *Listeria* urinary tract infection among 18,283 urine cultures
Veesenmeyer & Edmonson[15]	2016	Retrospective cohort	Infants <1 year old with hospital discharge diagnosis of listeriosis, noncontinuous over 6-year period	Hospitals participating in Kids' Inpatient Database, a national (US) database	Cumulative discharges for listeriosis and pooled incidence rates of listeriosis	212 total *Listeria* cases in database during 6-year period were extrapolated to 344 total US cases, for pooled annual incidence of 1.41 in 100,000: In 40.1% of cases, infants were <7 days old In 77.6% of cases, infants were <28 days old 87.6% of infants 7-28 days old with listeriosis had meningitis

NOTE: Abbreviations: CSF, cerebrospinal fluid; ED, emergency department; SBI, serious bacterial infection.

(n = 4599), and CSF (n = 1796) cultures in the same population and found no *Listeria* cases.[10] Hassoun et al.[11] studied SBI rates among infants younger than 28 days with any blood, urine, or CSF culture performed over 4 years at two Michigan EDs. One (0.08%) of the 1192 infants evaluated had bacteremia caused by *Listeria*.

Multicenter studies have reported similar results. In a study of 6 hospital systems in geographically diverse areas of the United States, Biondi et al.[12] examined all positive blood cultures (N = 181) for febrile infants younger than 90 days admitted to a general pediatric ward, and found no listeriosis. Mischler et al.[13] examined all positive blood cultures (N = 392) for otherwise healthy febrile infants 0 to 90 days old admitted to a hospital in 1 of 17 geographically diverse healthcare systems and found no cases of *Listeria*. A recent meta-analysis of studies that reported SBI rates for febrile infants 0 to 90 days old found the weighted prevalence of *Listeria* bacteremia to be 0.03% (2/20,703) and that of meningitis to be 0.02% (3/13,375).[14] Veesenmeyer and Edmonson[15] used a national inpatient database to identify all *Listeria* cases among infants over a 6-year period and estimated listeriosis rates for the US population. Over the 6 years, there were 212 total cases, which were extrapolated to 344 in the United States during that period, yielding a pooled annual incidence rate of 1.41 in 100,000 births.

Ampicillin offers no significant improvement in coverage for GBS or *E coli* beyond other β-lactam antibiotics, such as cefotaxime. Therefore, though the cost and potential

harms of 24 to 48 hours of intravenous ampicillin are low for the individual patient, there is almost no potential benefit. Using the weighted prevalence of 0.03% for *Listeria* bacteremia reported in the recent meta-analysis,[14] the number needed to treat to cover 1 case of *Listeria* bacteremia would be 3333. In addition, the increasing incidence of ampicillin resistance, particularly among gram-negative organisms,[4,7,9] argues strongly for better antibiotic stewardship on a national level. A number of expert authors have advocated dropping empiric *Listeria* coverage as part of the treatment of febrile infants, particularly infants 29 to 90 days old.[16,17] Some authors continue to advocate empiric *Listeria* coverage.[6] It is interesting to note, however, that the incidence of *Staph aureus* bacteremia in recent case series is much higher than that reported for *Listeria,* accounting for 6-9% of bacteremia cases.[9,11,13] Yet few if any authors advocate for empiric *S. aureus* coverage.

WHEN EMPIRIC AMPICILLIN COVERAGE MAY BE REASONABLE

The rate of listeriosis remains low across age groups in recent studies, but the rate is slightly higher in very young infants. In the recent national database study of listeriosis cases over a 6-year period, almost half involved infants younger than 7 days, and most of these infants showed no evidence of meningitis.[15] Therefore, it may be reasonable to include empiric *Listeria* coverage in febrile infants younger than 7 days, though the study authors estimated 22.5 annual cases of *Listeria* in this age range in the United States. Eighty percent of the *Listeria* cases were in infants younger than 28 days, but more than 85% of infants 7 to 28 days old had meningitis. Therefore, broad antimicrobial coverage for infants with CSF pleocytosis and/or a high bacterial meningitis score is reasonable, especially for infants younger than 28 days.

Other potential indications for ampicillin are enterococcal infections. Though enteroccocal SBI rates in febrile infants are also quite low,[7-9,11,12] if *Enterococcus* were highly suspected, such as in an infant with pyuria and gram positive organisms on gram stain, ampicillin offers good additional coverage. In the case of a local outbreak of listeriosis, or a specific exposure to *Listeria*-contaminated products on a patient history, antibiotics with efficacy against *Listeria* should be used. Last, in cases in which gentamicin is used as empiric coverage for gram-negative organisms, ampicillin offers important additional coverage for GBS.

Some practitioners advocate ampicillin and gentamicin over cefotaxime regimens on the basis of an often cited study that found a survival benefit for febrile neonates in the intensive care setting.[18] There are a number of reasons that this study should not influence care for typical infants admitted with possible sepsis. First, the study was retrospective and limited by its use of administrative data. The authors acknowledged that a potential explanation for their results is unmeasured confounding. Second, the patients included in the study were dramatically different from the group of well infants admitted with possible sepsis; the study included neonatal critical care unit patients treated with antibiotics within the first 3 days of life. Third, the study's results have not been replicated in otherwise healthy febrile infants.

WHAT YOU SHOULD USE INSTEAD OF AMPICILLIN FOR EMPIRIC *LISTERIA* COVERAGE

For febrile children 0 to 90 days old, empiric antibiotic coverage should be aimed at covering the current predominant pathogens, which include *E coli* and GBS. Therefore, for most children and US regions, a third-generation cephalosporin (eg, cefotaxime) is sufficient.

RECOMMENDATIONS

- Empiric antibiotics for treatment of febrile children 0-90 days should target *E. coli* and GBS; a third generation cephalosporin, (e.g. cefotaxime) alone is a reasonable choice for most patients.
- Prescribing ampicillin to specifically cover *Listeria* is unnecessary for the vast majority of febrile infants
- Prescribing ampicillin is reasonable in certain subgroups of febrile infants: those less than seven days of age, those with evidence of bacterial meningitis (especially if also <28 days of age), those in whom enterococcal infection is strongly suspected, and those with specific *Listeria* exposures related to local outbreaks.

CONCLUSION

The 32-day-old infant described in the clinical scenario was at extremely low risk for listeriosis. Antibiotic coverage with a third-generation cephalosporin is sufficient for the most likely pathogens. The common practice of empirically covering *Listeria* in otherwise healthy febrile infants considered to be at higher risk for SBI is no longer based on best available evidence and represents overtreatment with at least theoretical harms. Avoidance of the risks associated with the side effects of antibiotics, costs saved by forgoing multiple antibiotics, a decrease in medication dosing frequency, and improved antibiotic stewardship for the general population all argue forcefully for making empiric *Listeria* coverage a thing of the past.

Disclosure: Nothing to report.

Do you think this is a low-value practice? Is this truly a "Thing We Do for No Reason?" Share what you do in your practice and join in the conversation online by retweeting it on Twitter (#TWDFNR) and Liking It on Facebook. We invite you to propose ideas for other "Things We Do for No Reason" topics by emailing TWDFNR@hospitalmedicine.org.

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Hot in the Tropics

The approach to clinical conundrums by an expert clinician is revealed through the presentation of an actual patient's case in an approach typical of a morning report. Similarly to patient care, sequential pieces of information are provided to the clinician, who is unfamiliar with the case. The focus is on the thought processes of both the clinical team caring for the patient and the discussant.

This icon represents the patient's case. Each paragraph that follows represents the discussant's thoughts

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A 42-year-old Malaysian construction worker with subjective fevers of 4 days' duration presented to an emergency department in Singapore. He reported nonproductive cough, chills without rigors, sore throat, and body aches. He denied sick contacts. Past medical history included chronic hepatitis B virus (HBV) infection. The patient was not taking any medications.

For this patient presenting acutely with subjective fevers, nonproductive cough, chills, aches, and lethargy, initial considerations include infection with a common virus (influenza virus, adenovirus, Epstein-Barr virus [EBV]), acute human immunodeficiency virus (HIV) infection, emerging infection (severe acute respiratory syndrome [SARS], Middle Eastern respiratory syndrome coronavirus [MERS-CoV] infection, avian influenza), and tropical infection (dengue, chikungunya). Also possible are bacterial infections (eg, with *Salmonella typhi* or *Rickettsia* or *Mycoplasma* species), parasitic infections (eg, malaria), and noninfectious illnesses (eg, autoimmune diseases, thyroiditis, acute leukemia, environmental exposures).

The patient's temperature was 38.5°C; blood pressure, 133/73 mm Hg; heart rate, 95 beats per minute; respiratory rate, 18 breaths per minute; and oxygen saturation, 100% on ambient air. On physical examination, he appeared comfortable, and heart, lung, abdomen, skin, and extremities were normal. Laboratory test results included white blood cell (WBC) count, 4400/μL (with normal differential); hemoglobin, 16.1 g/dL; and platelet count, 207,000/μL. Serum chemistries were normal. C-reactive protein (CRP) level was 44.6 mg/L (reference range, 0.2-9.1 mg/L), and procalcitonin level was 0.13 ng/mL (reference range, <0.50 ng/mL). Chest radiograph was normal. Dengue antibodies (immunoglobulin M, immunoglobulin G [IgG]) and dengue NS1 antigen were negative. The patient was discharged with a presumptive diagnosis of viral upper respiratory tract infection.

There is no left shift characteristic of bacterial infection or lymphopenia characteristic of rickettsial disease or acute HIV infection. The serologic testing and the patient's overall appearance make dengue unlikely. The low procalcitonin supports a nonbacterial cause of illness. CRP elevation may indicate an inflammatory process and is relatively nonspecific.

Myalgias, pharyngitis, and cough improved over several days, but fevers persisted, and a rash developed over the lower abdomen. The patient returned to the emergency department and was admitted. He denied weight loss and night sweats. He had multiple female sexual partners, including commercial sex workers, within the previous 6 months. Temperature was 38.5°C. The posterior oropharynx was slightly erythematous. There was no lymphadenopathy. Firm, mildly erythematous macules were present on the anterior abdominal wall (Figure 1). The rest of the physical examination was normal.

Laboratory testing revealed WBC count, 5800/μL (75% neutrophils, 19% lymphocytes, 3% monocytes, 2% atypical mononuclear cells); hemoglobin, 16.3 g/dL; platelet count, 185,000/μL; sodium, 131 mmol/L; potassium, 3.4 mmol/L; creatinine, 0.9 mg/dL; albumin, 3.2 g/dL; alanine aminotransferase (ALT), 99 U/L; aspartate aminotransferase (AST), 137 U/L; alkaline phosphatase (ALP), 63 U/L; and total bilirubin, 1.9 mg/dL. Prothrombin time was 11.1 seconds; partial thromboplastin time, 36.1 seconds; erythrocyte sedimentation rate, 14 mm/h; and CRP, 62.2 mg/L.

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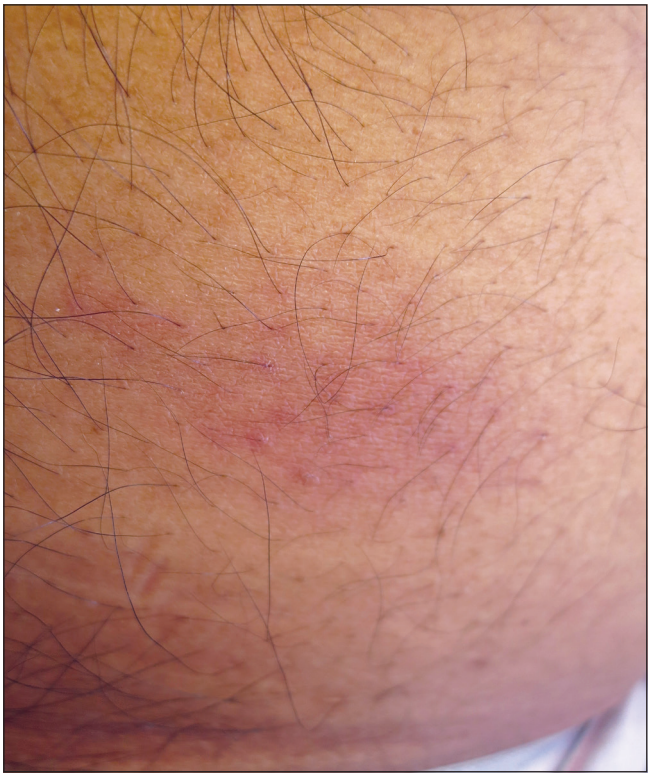

FIG. 1. Skin lesions on abdominal wall.

EBV, acute HIV, and cytomegalovirus infections often present with adenopathy, which is absent here. Disseminated gonococcal infection can manifest with fever, body aches, and rash, but his rash and the absence of penile discharge, migratory arthritis, and enthesitis are not characteristic. *Mycoplasma* infection can present with macules, urticaria, or erythema multiforme. *Rickettsia* illnesses typically cause vasculitis with progression to petechiae or purpura resulting from endothelial damage. Patients with secondary syphilis may have widespread macular lesions, and the accompanying syphilitic hepatitis often manifests with elevations in ALP instead of ALT and AST. The mild elevation in ALT and AST can occur with many systemic viral infections. Sweet syndrome may manifest with febrile illness and rash, but the acuity of this patient's illness and the rapid evolution favor infection.

The patient's fevers (35°-40°C) continued without pattern over the next 3 days. Blood and urine cultures were negative. Polymerase chain reaction (PCR) test of the nasal mucosa was negative for respiratory viruses. PCR blood tests for EBV, HIV-1, and cytomegalovirus were also negative. Antistreptolysin O (ASO) titer was 400 IU/mm (reference range, <200 IU/mm). Antinuclear antibodies were negative, and rheumatoid factor was 12.4 U/mL (reference range, <10.3 U/mL). Computed tomography (CT) of the thorax, abdomen, and pelvis was normal. Results of a biopsy of an anterior abdominal wall skin lesion showed perivascular and periadnexal lymphocytic inflammation. Amoxicillin was started for the treatment of possible group A streptococcal infection.

PCR for HIV would be positive at a high level in acute HIV. The skin biopsy is not characteristic of Sweet syndrome, which typically shows neutrophilic infiltrate without leukocytoclastic vasculitis, or of syphilis, which typically shows a plasma cell infiltrate.

The patient's erythematous oropharynx may indicate recent streptococcal pharyngitis. The fevers, elevated ASO titer, and CRP level are consistent with acute rheumatic fever, but arthritis, carditis, and neurologic manifestations are lacking. Erythema marginatum manifests on the trunk and limbs as macules or papules with central clearing as the lesions spread outward—and differs from the patient's rash, which is firm and restricted to the abdominal wall.

Fevers persisted through hospital day 7. The WBC count was 1100/μL (75.7% neutrophils, 22.5% lymphocytes), hemoglobin was 10.3 g/dL, and platelet count was 52,000/μL. Additional laboratory test results included ALP, 234 U/L; ALT, 250 U/L; AST, 459 U/L; lactate dehydrogenase, 2303 U/L (reference range, 222-454 U/L); and ferritin, 14,964 ng/mL (reference range, 47-452 ng/mL).

The duration of illness and negative diagnostic tests for infections increases suspicion for a noninfectious illness. Conditions commonly associated with marked hyperferritinemia include adult-onset Still disease (AOSD) and hemophagocytic lymphohistiocytosis (HLH). Of the 9 AOSD diagnostic (Yamaguchi) criteria, 5 are met in this case: fever, rash, sore throat, abnormal liver function tests, and negative rheumatologic tests. However, the patient lacks arthritis, leukocytosis, lymphadenopathy, and hepatosplenomegaly. Except for the elevated ferritin, the AOSD criteria overlap substantially with the criteria for acute rheumatic fever, and still require that infections be adequately excluded. HLH, a state of abnormal immune activation with resultant organ dysfunction, can be a primary disorder, but in adults more often is secondary to underlying infectious, autoimmune, or malignant (often lymphoma) conditions. Elevated ferritin, cytopenias, elevated ALT and AST, elevated CRP and erythrocyte sedimentation rate, and elevated lactate dehydrogenase are consistent with HLH. The HLH diagnosis can be more firmly established with the more specific findings of hypertriglyceridemia, hypofibrinogenemia, and elevated soluble CD25 level. The histopathologic finding of hemophagocytosis in the bone marrow, lymph nodes, or liver may further support the diagnosis of HLH.

Rash and fevers persisted. Hepatitis A, hepatitis C, *Rickettsia* IgG, *Burkholderia pseudomallei* (the causative organism of melioidosis), and *Leptospira* serologies, as well as PCR for herpes simplex virus and parvovirus, were all negative. Hepatitis B viral load was 962 IU/mL (2.98 log), hepatitis B envelope antigen was negative, and hepatitis B envelope antibody was positive. *Orientia tsutsugamushi* (organism responsible for scrub typhus) IgG titer was elevated at 1:128. Antiliver kidney microsomal antibodies and

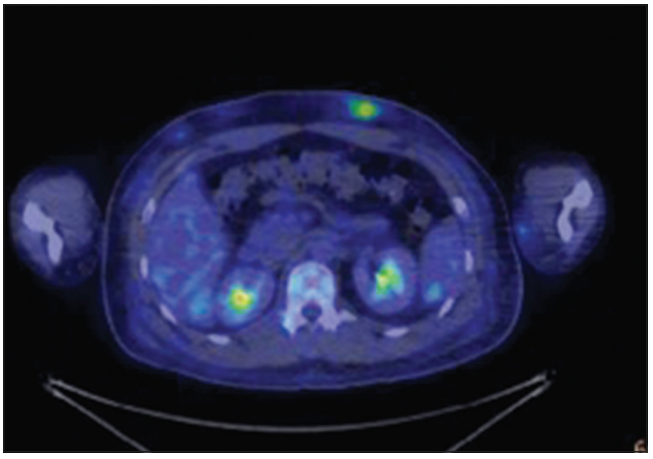

FIG. 2. Positron emission tomography computed tomography shows multiple fluorodeoxyglucose-avid cutaneous lesions (green) with surrounding patchy foci of subcutaneous fat stranding (blue-grey) in anterior abdominal wall and upper left arm, compatible with areas of lymphomatous infiltrates.

antineutrophil cytoplasmic antibodies were negative. Fibrinogen level was 0.69 g/L (reference range, 1.8-4.8 g/L), and beta-2 microglobulin level was 5078 ng/mL (reference range, 878-2000 ng/mL). Bone marrow biopsy results showed hypocellular marrow with suppressed myelopoiesis, few atypical lymphoid cells, and few hemophagocytes. Flow cytometry was negative for clonal B lymphocytes and aberrant expression of T lymphocytes. Bone marrow myobacterial PCR and fungal cultures were negative.

The patient's chronic HBV infection is unlikely to be related to his presentation given his low viral load and absence of signs of hepatic dysfunction. Excluding rickettsial disease requires paired acute and convalescent serologies. O *tsutsugamushi*, the causative agent of the rickettsial disease scrub typhus, is endemic in Malaysia; thus, his positive O *tsutsugamushi* IgG may indicate past exposure. His fevers, myalgias, truncal rash, and hepatitis are consistent with scrub typhus, but he lacks the characteristic severe headache and generalized lymphadenopathy. Although eschar formation with evolution of a papular rash is common in scrub typhus, it is often absent in the variant found in Southeast Asia. Although elevated β_2 microglobulin level is used as a prognostic marker in multiple myeloma and Waldenström macroglobulinemia, it can be elevated in many immune-active states. The patient likely has HLH, which is supported by the hemophagocytosis seen on bone marrow biopsy, and the hypofibrinogenemia. Potential HLH triggers include O *tsutsugamushi* infection or recent streptococcal pharyngitis.

A deep-punch skin biopsy of the anterior abdominal wall skin lesion was performed because of the absence of subcutaneous fat in the first biopsy specimen. The latest biopsy results showed irregular interstitial expansion of medium-size lymphocytes in a lobular panniculated pattern. The lymphocytes contained enlarged, irregularly contoured nucleoli and were positive for T-cell markers CD2 and CD3 with reduction in CD5 expression. The lymphomatous cells were of CD8+ with uniform expression of activated cytotoxic granule protein granzyme B and were positive for T-cell hemireceptor β.

Positron emission tomography (PET) CT, obtained for staging purposes, showed multiple hypermetabolic subcutaneous and cutaneous lesions over the torso and upper and lower limbs—compatible with lymphomatous infiltrates (Figure 2). Examination, pathology, and imaging findings suggested a rare neoplasm: subcutaneous panniculitis-like T-cell lymphoma (SPTCL). SPTCL was confirmed by T-cell receptor gene rearrangements studies.

HLH was diagnosed on the basis of the fevers, cytopenias, hypofibrinogenemia, elevated ferritin level, and evidence of hemophagocytosis. SPTCL was suspected as the HLH trigger.

The patient was treated with cyclophosphamide, hydroxydoxorubicin, vincristine, and prednisone. While on this regimen, he developed new skin lesions, and his ferritin level was persistently elevated. He was switched to romidepsin, a histone deacetylase inhibitor that specifically targets cutaneous T-cell lymphoma, but the lesions continued to progress. The patient then was treated with gemcitabine, dexamethasone, and cisplatin, and the rashes resolved. The most recent PET-CT showed nearly complete resolution of the subcutaneous lesions.

DISCUSSION

When residents or visitors to tropical or sub-tropical regions, those located near or between the Tropics of Cancer and Capricorn, present with fever, physicians usually first think of infectious diseases. This patient's case is a reminder that these important first considerations should not be the last.

Generating a differential diagnosis for tropical illnesses begins with the patient's history. Factors to be considered include location (regional disease prevalence), exposures (food/water ingestion, outdoor work/recreation, sexual contact, animal contact), and timing (temporal relationship of symptom development to possible exposure). Common tropical infections are malaria, dengue, typhoid, and emerging infections such as chikungunya, avian influenza, and Zika virus infection.[1]

This case underscores the need to analyze diagnostic tests critically. Interpreting tests as simply positive or negative, irrespective of disease features, epidemiology, and test characteristics, can contribute to diagnostic error. For example, the patient's positive ASO titer requires an understanding of disease features and a nuanced interpretation based on the clinical presentation. The erythematous posterior oropharynx prompted concern for postinfectious sequelae of streptococcal pharyngitis, but his illness was more severe and more prolonged than is typical of that condition. The isolated elevated O *tsutsugamushi* IgG titer provides an example of the role of epidemiology in test interpretation. Although a single positive value might indicate a new exposure for a visitor to an

endemic region, IgG seropositivity in Singapore, where scrub typhus is endemic, likely reflects prior exposure to the organism. Diagnosing an acute scrub typhus infection in a patient in an endemic region requires PCR testing. The skin biopsy results highlight the importance of understanding test characteristics. A skin biopsy specimen must be adequate in order to draw valid and accurate conclusions. In this case, the initial skin biopsy was superficial, and the specimen inadequate, but the test was not "negative." In the diagnostic skin biopsy, deeper tissue was sampled, and panniculitis (inflammation of subcutaneous fat), which arises in inflammatory, infectious, traumatic, enzymatic, and malignant conditions, was identified. An adequate biopsy specimen that contains subcutaneous fat is essential in making this diagnosis.[2]

This patient eventually manifested several elements of hemophagocytic lymphohistiocytosis (HLH), a syndrome of excessive inflammation and resultant organ injury relating to abnormal immune activation and excessive inflammation. HLH results from deficient down-regulation of activated macrophages and lymphocytes.[3] It was initially described in pediatric patients but is now recognized in adults, and associated with mortality as high as 50%.[3] A high ferritin level (>2000 ng/mL) has 70% sensitivity and 68% specificity for pediatric HLH and should trigger consideration of HLH in any age group.[4] The diagnostic criteria for HLH initially proposed in 2004 by the Histiocyte Society to identify patients for recruitment into a clinical trial included molecular testing consistent with HLH and/or 5 of 8 clinical, laboratory, or his-

TABLE 1. Diagnostic Criteria for Hemophagocytic Lymphohistiocytosis

The diagnosis of HLH may be established if either A or B is fulfilled.
A. A molecular diagnosis consistent with HLH is made (eg, mutations in PRF1, MUNC 13-4, STX11, SH2D1A)
or
B. Diagnostic criteria for HLH are fulfilled (≥5 of 8 must be present)
1. Fever, ≥38.5°C[a]
2. Splenomegaly
3. Cytopenias (affecting 2 lineages in peripheral blood)[a] • Hemoglobin <9 g/L (<10 g/L in infants <4 wk old) • Platelets $<100\times10^9$/L • Neutrophils $<1\times10^9$/L
4. Hypertriglyceridemia and/or hypofibrinogenemia[a] • Fasting triglycerides ≥3.0 mmol/L • Fibrinogen ≤1.5 g/L
5. Hemophagocytosis in bone marrow or spleen or lymph nodes[a]
6. Low or absent natural killer cell activity
7. Ferritin ≥500 ng/mL[a]
8. Soluble CD25 (soluble interleukin 2 receptor), ≥2400 U/mL

[a]Present in patient.

NOTE: Abbreviation: HLH, hemophagocytic lymphohistiocytosis.

TABLE 2. HScore for Diagnosing Hemophagocytic Lymphohistiocytosis (HLH)

Parameter	No. of Points (Criteria for Scoring)
Known underlying immunosuppression (eg, HIV positive or receiving long-term immunosuppressive therapy)	0 (no) 18 (yes)
Temperature (°C)	0 (<38.4) 33 (38.4-39.4) 49 (>39.4)
Organomegaly	0 (no) 23 (Hepatomegaly or splenomegaly) 38 (Hepatomegaly and splenomegaly)
No. of cytopenias (Defined as hemoglobin level of ≤9.2gm/dl and/or leukocyte count of ≤5000/mm^3 and/or a platelet count of ≤110,000/mm^3)	0 (1 lineage) 24 (2 lineages) 34 (3 lineages)
Ferritin (ng/mL)	0 (<2,000) 35 (2000-6000) 50 (>6000)
Triglyceride (mmol/L)	0 (<1.5) 44 (1.5-4) 64 (>4)
Fibrinogen (g/L)	0 (>2.5) 30 (≤2.5)
Serum glutamic oxaloacetic transaminase (IU/L)	0 (<30) 19 (≥30)
Hemophagocytosis features on bone marrow aspirate	0 (no) 35 (yes)
	Total >169: strongly consider HLH Sensitivity: 93% Specificity 86%

NOTE: Abbreviation: HIV, human immunodeficiency virus.

topathologic features (Table 1).[5] HScore is a more recent validated scoring system that predicts the probability of HLH (Table 2). A score above 169 signifies diagnostic sensitivity of 93% and specificity of 86%.[6]

The diagnosis of HLH warrants a search for its underlying cause. Common triggers are viral infections (eg, EBV), autoimmune diseases (eg, systemic lupus erythematosus), and hematologic malignancies. These triggers typically stimulate or suppress the immune system. Initial management involves treatment of the underlying trigger and, potentially, immunosuppression with high-dose corticosteroids or cytotoxic agents (eg, etoposide). Primary HLH is an inherited immunodeficiency, and treatment often culminates in stem cell transplantation.[5]

In this case, SPTCL triggered HLH. SPTCL is a rare non-Hodgkin lymphoma characterized by painless subcutaneous nodules or indurated plaques (panniculitis-like) on the trunk or extremities, constitutional symptoms, and, in some cases, HLH.[7-10] SPTCL is diagnosed by deep skin biopsy, with immunohistochemistry showing CD8-positive pathologic T cells expressing cytotoxic proteins (eg, granzyme B).[9,11] SPTCL can either have an alpha/beta T-cell phenotype (SPTCL-AB) or gamma/delta T-cell phenotype (SPTCL-GD). Seventeen percent of patients with SPTCL-AB and 45% of patients with SPTCL-GD have HLH on diagnosis. Concomitant HLH is associated with decreased 5-year survival.[12]

This patient presented with fevers and was ultimately diagnosed with HLH secondary to SPLTCL. His case is a reminder that not all diseases in the tropics are tropical diseases. In the diagnosis of a febrile illness, a broad evaluative framework and rigorous test results evaluation are essential—no matter where a patient lives or visits.

KEY TEACHING POINTS

- A febrile illness acquired in the tropics is not always attributable to a tropical infection.
- To avoid diagnostic error, weigh positive or negative test results against disease features, patient epidemiology, and test characteristics.
- HLH is characterized by fevers, cytopenias, hepatosplenomegaly, hyperferritinemia, hypertriglyceridemia, and hypofibrinogenemia. In tissue specimens, hemophagocytosis may help differentiate HLH from competing conditions.
- After HLH is diagnosed, try to determine its underlying cause, which may be an infection, autoimmunity, or a malignancy (commonly, a lymphoma).

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Postdischarge Clinics and Hospitalists: A Review of the Evidence and Existing Models

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Over the past 10 years, postdischarge clinics have been introduced in response to various health system pressures, including the focus on rehospitalizations and the challenges of primary care access. Often ignored in the discussion are questions of the effect of postdischarge physician visits on readmissions. In addition, little attention has been given to other clinical outcomes, such as reducing preventable harm and mortality. A review of dedicated, hospitalist-led postdischarge clinics, of the data supporting postdischarge physician visits, and of the role of hospitalists in these clinics may be instructive for hospitalists and health systems considering the postdischarge clinic environment. *Journal of Hospital Medicine* 2017;12:467-471. © 2017 Society of Hospital Medicine

Readmission prevention is paramount for hospitals and, by extension, hospitalist programs. Hospitalists see early and reliable outpatient follow-up as a safe landing for their most complicated patient cases. The option of a postdischarge clinic arises from the challenge to arrange adequate postdischarge care for patients who lack easy access because of insurance or provider availability. Guaranteeing postdischarge access by opening a dedicated, hospitalist-led postdischarge clinic appears to be an easy solution, but it is a solution that requires significant investment (including investment in physician and staff training and administrative support) and careful navigation of existing primary care relationships. In addition, a clinic staffed only with physicians may not be well equipped to address the complex social factors in healthcare utilization and readmission. Better understanding of the evidence supporting post discharge physician visits, several models of clinics, and the key operational questions are essential to address before crossing the inpatient-outpatient divide.

POSTDISCHARGE PHYSICIAN VISITS AND READMISSIONS

A postdischarge outpatient provider visit is often seen as a key factor in reducing readmissions. In 2013, Medicare added strength to this association by establishing transitional care management codes, which provide enhanced reimbursement to providers for a visit within 7 or 14 days of discharge, with focused attention on transitional issues.[1] However, whether a postdischarge visit reduces readmissions remains unclear. Given evidence that higher primary care density is associated with lower healthcare utilization,[2] CMS's financial investment in incentivizing post discharge physician visits may be a good bet. On the other hand, simply having a primary care physician (PCP) may be a risk factor for readmission. This association suggests that postdischarge vigilance leads to identification of medical problems that lead to rehospitalization.[3] This uncertainty is not resolved in systematic reviews of readmission reduction initiatives, which were not focused solely on the impact of a physician visit.[4,5]

The earliest study of postdischarge visits in a general medical population found an association between intensive outpatient follow-up by new providers in a Veterans Affairs population and an increase in hospital readmissions.[6] This model is similar to some hospitalist models for postdischarge clinics, as the visit was with a noncontinuity provider. The largest recent study, of patients hospitalized with acute myocardial infarction, community-acquired pneumonia, or congestive heart failure (CHF) between 2009 and 2012, found increased frequency of postdischarge follow-up but no concomitant reduction in readmissions.[7] Although small observational studies[8] have found a postdischarge primary care visit may reduce the risk for readmission in general medical patients, the bulk of the recent data is negative.

In high-risk patients, however, there may be a clear benefit to postdischarge follow-up. In a North Carolina Medicaid population, a physician visit after discharge was associated with fewer readmissions among high-risk patients, but not among lower risk patients, whose readmission rates were low to start.[9] The results of that study support the idea that risk stratification may identify patients who can benefit from more intensive outpatient follow-up. In general medical populations, existing studies may suffer from an absence of adequate risk assessment.

The evidence in specific disease states may show a clearer association between a postdischarge physician visit and reduced risk for readmission. One quarter of patients with CHF are rehospitalized within 30 days of discharge.[10] In this disease with frequent exacerbations, a clinic visit to monitor volume status, weight, and medication adherence might

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reduce the frequency of readmissions or prolong the interval between rehospitalizations. A large observational study observed that earlier post discharge follow up by a cardiologist or a PCP was associated with lower risk of readmission, but only in the quintile with the closest follow-up. In addition, fewer than 40% of patients in this group had a visit within 7 days.[11] In another heart failure population, follow-up with either a PCP or cardiologist within 7 days of discharge was again associated with lower risk for readmission.[12] Thus, data suggest a protective effect of postdischarge visits in CHF patients, in contrast to a general medical population. Patients with end-stage renal disease may also fit in this group protected by a postdischarge physician visit, as 1 additional visit within the month after discharge was estimated to reduce rehospitalizations and produce significant cost savings.[13]

With other specific discharge diagnoses, results are varied. Two small observational studies in chronic obstructive pulmonary disease had conflicting results—one found a modest reduction in readmission and emergency department (ED) visits for patients seen by a PCP or pulmonologist within 30 days of discharge,[14] and the other found no effect on readmissions but an associated reduction in mortality.[15] More data are needed to clarify further the interaction of postdischarge visits with mortality, but the association between postdischarge physician visits and readmission reduction is controversial for patients with chronic obstructive pulmonary disease.

Finally, the evidence for dedicated postdischarge clinics is even more limited. A study of a hospitalist-led postdischarge clinic in a Veterans Affairs hospital found reduced length of stay and earlier postdischarge follow-up in a postdischarge clinic, but no effect on readmissions.[16] Other studies have found earlier postdischarge follow-up with dedicated discharge clinics but have not evaluated readmission rates specifically.[17]

In summary, the effect of postdischarge visits on risk for readmission is an area of active research, but remains unclear. The data reviewed suggest a benefit for the highest risk patients, specifically those with severe chronic illness, or those deemed high-risk with a readmission tool.[9] At present, because physicians cannot accurately predict which patients will be readmitted,[18] discharging physicians often take a broad approach and schedule outpatient visits for all patients. As readmission tools are further refined, the group of patients who will benefit from postdischarge care will be easier to identify, and a benefit to postdischarge visits may be seen

It is also important to note that this review emphasizes the physician visit and its potential impact on readmissions. Socioeconomic causes are increasingly being recognized as driving readmissions and other utilization.[19] Whether an isolated physician visit is sufficient to prevent readmissions for patients with nonmedical drivers of healthcare utilization is unclear. For those patients, a discharge visit likely is a necessary component of a readmission reduction strategy for high-risk patients, but may be insufficient for patients who require not just an isolated visit but rather a more integrated and comprehensive care program.[8,20,21]

POSTDISCHARGE CLINIC MODELS

Despite the unclear relationship between postdischarge physician care and readmissions, dedicated postdischarge clinics, some staffed by hospitalists, have been adopted over the past 10 years. The three primary types of clinics arise in safety net environments, in academic medical centers, and as comprehensive high-risk patient solutions. Reviewing several types of clinics further clarifies the nature of this structural innovation.

Safety Net Hospital Models

Safety net hospitals and their hospitalists struggle with securing adequate postdischarge access for their population, which has inadequate insurance and poor access to primary care. Patient characteristics also play a role in the complex postdischarge care for this population, given its high rate of ED use (owing to perceived convenience and capabilities) for ambulatory-sensitive conditions.[22] In addition, immigrants, particularly those with low English-language proficiency, underuse and have poor access to primary care.[23,24] Postdischarge clinics in this environment focus first on providing a reliable postdischarge plan and then on linking to primary care. Examples of two clinics are at Harborview Medical Center in Seattle, Washington[25] and Texas Health in Fort Worth.

Harborview is a 400-bed hospital affiliated with the University of Washington. More than 50% of its patients are considered indigent. The clinic was established in 2007 to provide a postdischarge option for uninsured patients, and a link to primary care in federally qualified health centers. The clinic was staffed 5 days a week with one or two hospitalists or advanced practice nurses. Visit duration was 20 minutes, 270 visits occurred per month, and the no-show rate was 30%. A small subgroup of the hospitalist group staffed the clinic. Particular clinical foci included CHF patients, patients with wound-care needs, and homeless, immigrant, and recently incarcerated patients. A key goal was connecting to longitudinal primary care, and the clinic successfully connected more than 70% of patients to primary care in community health centers. This clinic ultimately transitioned from a hospitalist practice to a primary care practice with a primary focus on post-ED follow-up for unaffiliated patients.[26]

In 2010, Texas Health faced a similar challenge with unaffiliated patients, and established a nurse practitioner–based clinic with hospitalist oversight to provide care primarily for patients without insurance or without an existing primary care relationship.

Academic Medical Center Models

Another clinical model is designed for patients who receive primary care at practices affiliated with academic medical centers. Although many of these patients have insurance and a PCP, there is often no availability with their continuity provider, because of the resident's inpatient schedule or the facul-

ty member's conflicting priorities.[27,28] Academic medical centers, including the University of California at San Francisco, the University of New Mexico, and the Beth Israel Deaconess Medical Center, have established discharge clinics within their faculty primary care practices. A model of this type of clinic was set up at Beth Israel Deaconess in 2010. Staffed by four hospitalists and using 40-minute appointments, this clinic was physically based in the primary care practice. As such, it took advantage of the existing clinic's administrative and clinical functions, including triage, billing, and scheduling. A visit was scheduled in that clinic by the discharging physician team if a primary care appointment was not available with the patient's continuity provider. Visits were standardized and focused on outstanding issues at discharge, medication reconciliation, and symptom trajectory. The hospitalists used the clinic's clinical resources, including nurses, social workers, and pharmacists, but had no other dedicated staff. That there were only four hospitalists meant they were able to gain sufficient exposure to the outpatient setting, provide consistent high-quality care, and gain credibility with the PCPs. As the patients who were seen had PCPs of their own, during the visit significant attention was focused first on the postdischarge concerns, and then on promptly returning the patients to routine primary care. Significant patient outreach was used to address the clinic's no-show rate, which was almost 50% in the early months. Within a year, the rate was down, closer to 20%. This clinic closed in 2015 after the primary care practice, in which it was based, transitioned to a patient-centered medical home. Since that time, this type of initiative has spread further, with neurohospitalist discharge clinics established, and postdischarge neurology follow-up becoming faster and more reliable.[29]

Academic medical centers and safety net hospitals substitute for routine primary care to address the basic challenge of primary care access, often without significant enhancements or additional resources, such as dedicated care management and pharmacy, social work, and nursing support. Commonalities of these clinics include dedicated physician staff, appointments generally longer than average outpatient appointments, and visit content concentrated on the key issues at transition (medication reconciliation, outstanding tests, symptom trajectory). As possible, clinics adopted a multidisciplinary approach, with social workers, community health workers, and nurses, to respond to the breadth of patients' postdischarge needs, which often extend beyond pure medical need. The most frequent barriers encountered included the knowledge gap for hospitalist providers in the outpatient setting (a gap mitigated by using dedicated providers) and the patients' high no-show rate (not surprising given that the providers are generally new to them). Few clinics have attempted to create continuity across inpatient and outpatient providers, though continuity might reduce no-shows as well as eliminate at least 1 transition.

Comprehensive High-Risk Patient Solutions

At the other end of the clinic spectrum are more integrated postdischarge approaches, which also evolved from the hospitalist model with hospitalist staffing. However, these approaches were introduced in response to the clinical needs of the highest risk patients (who are most vulnerable to frequent provider transitions), not to a systemic inability to provide routine postdischarge care.[30]

The most long-standing model for this type of clinic is represented by CareMore Health System, a subsidiary of Anthem.[30-32] The extensivist, an expanded-scope hospitalist, acts as primary care coordinator, coordinating a multidisciplinary team for a panel of about 100 patients, representing the sickest 5% of the Medicare Advantage–insured population. Unlike the traditional hospitalist, the extensivist follows patients across all care sites, including hospital, rehabilitation sites, and outpatient clinic. For the most part, this relationship is not designed to evolve into a longitudinal relationship, but rather is an intervention only for the several-months period of acute need. Internal data have shown effects on hospital readmissions as well as length of stay.[30]

Another integrated clinic was established in 2013, at the University of Chicago. This was an effort to redesign care for patients at highest risk for hospitalization.[33] Similar to the CareMore process, a high-risk population is identified by prior hospitalization and expected high Medicare costs. A comprehensive care physician cares for these patients across care settings. The clinic takes a team-based approach to patient care, with team members selected on the basis of patient need. Physicians have panels limited to only 200 patients, and generally spend part of the day in clinic, and part in seeing their hospitalized patients. Although reminiscent of a traditional primary care setting, this clinic is designed specifically for a high-risk, frequently hospitalized population, and therefore requires physicians with both a skill set akin to that of hospitalists, and an approach of palliative care and holistic patient care. Outcomes from this trial clinic are expected in 2017 or 2018.

LOGISTICAL CONSIDERATIONS FOR DISCHARGE CLINICS

Considering some key operational questions (Table) can help guide hospitals, hospitalists, and healthcare systems as they venture into the postdischarge clinic space. Return on investment and sustainability are two key questions for postdischarge clinics.

TABLE. Key Questions Regarding Discharge Clinics

Factor	Question(s)
Patient population	What patient populations cannot access postdischarge primary care?
	Should patients with established primary care doctors be seen in the clinic?
Clinic structure	How will you provide the administrative services (eg, billing, triage, scheduling) needed for an outpatient clinic?
	Are there other value-added services (eg, pharmacy, social work) that would provide additional value added?
Staffing	Do I have a group of hospitalists interested in working in the postdischarge area?
	How will I compensate my providers?
Outcomes	How will I evaluate the performance of the clinic?

Return on investment varies by payment structure. In capitated environments with a strong emphasis on readmissions and total medical expenditure, a successful postdischarge clinic would recoup the investment through readmission reduction. However, maintaining adequate patient volume against high no-show rates may strain the group financially. In addition, although a hospitalist group may reap few measurable benefits from this clinical exposure, the unique view of the outpatient world afforded to hospitalists working in this environment could enrich the group as a whole by providing a more well-rounded vantage point.

Another key question surrounds sustainability. The clinic at the Beth Israel Deaconess Medical Center in Boston temporarily closed due to high inpatient volume and corresponding need for those hospitalists in the inpatient setting, early in its inception. It subsequently closed due to evolution in the clinic where it was based, rendering it unnecessary. Clinics that are contingent on other clinics will be vulnerable to external forces. Finally, staffing these clinics may be a stretch for a hospitalist group, as a partly different skill set is required for patient care in the outpatient setting. Hospitalists interested in care transitions are well suited for this role. In addition, hospitalists interested in more clinical variety, or in more schedule variety than that provided in a traditional hospitalist schedule, often enjoy the work. A vast majority of hospitalists think PCPs are responsible for postdischarge problems, and would not be interested in working in the postdischarge world.[34] A poor fit for providers may lead to clinic failure.

As evident from this review, gaps in understanding the benefits of postdischarge care have persisted for 10 years. Discharge clinics have been scantly described in the literature. The primary unanswered question remains the effect on readmissions, but this has been the sole research focus to date. Other key research areas are the impact on other patient-centered clinical and system outcomes (eg, patient satisfaction, particularly for patients seeing new providers), postdischarge mortality, the effect on other adverse events, and total medical expenditure.

CONCLUSION

The healthcare system is evolving in the context of a focus on readmissions, primary care access challenges, and high-risk patients' specific needs. These forces are spurring innovation in the realm of postdischarge physician clinics, as even the basic need for an appointment may not be met by the existing outpatient primary care system. In this context, multiple new outpatient care structures have arisen, many staffed by hospitalists. Some, such as clinics based in safety net hospitals and academic medical centers, address the simple requirement that patients who lack easy access, because of insurance status or provider availability, can see a doctor after discharge. This type of clinic may be an essential step in alleviating a strained system but may not represent a sustainable long-term solution. More comprehensive solutions for improving patient care and clinical outcomes may be offered by integrated systems, such as CareMore, which also emerged from the hospitalist model. A lasting question is whether these clinics, both the narrowly focused and the comprehensive, will have longevity in the evolving healthcare market. Inevitably, though, hospitalist directors will continue to raise such questions, and should stand to benefit from the experiences of others described in this review.

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Forgotten but Not Gone: Update on Measles Infection for Hospitalists

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Measles (rubeola) continues to be endemic and epidemic in many regions of the world. Measles is primarily a disease of childhood, but it can also affect adult populations, and therefore it is important that both adult and pediatric hospitalist physicians be able to recognize it. Although the disease is rarely encountered in the United States, measles infection can spread rapidly across vulnerable populations. In addition, infected adults can develop complications that may require hospitalization for treatment. This review summarizes the typical clinical course and complications of measles infection, along with recommendations for diagnosis and management for both adult and pediatric hospitalists. *Journal of Hospital Medicine* 2017;12:472-476. © 2017 Society of Hospital Medicine

Measles is a highly contagious acute respiratory illness that includes a characteristic rash. After exposure, up to 90% of susceptible persons develop measles.[1] Even though it is considered a childhood illness, measles can affect people of all age groups. Measles continues to be major health problem around the world, despite the availability of a safe and effective vaccine, and it remains one of the leading causes of childhood mortality, with nearly 115,000 deaths reported by the World Health Organization[2] in 2014. In 2000, measles was declared eliminated from the United States, but outbreaks still occasionally occur.[3-6]

The disease is self-limited, but some patients develop complications that may require hospitalization for treatment. People at highest risk for complications are children younger than 5 years, adults older than 20 years, pregnant women, and immunocompromised individuals.[7]

HISTORY AND EPIDEMIOLOGY

During the licensure of live measles vaccine in 1963, an average of 549,000 measles cases and 495 measles deaths, as well as 48,000 hospitalizations and 4000 encephalitis cases, were reported annually in the United States. Almost all Americans were affected by measles by adolescence.

Implementation of the 1-dose vaccine program substantially reduced reported incidence in the United States by 1988, and led to a dramatic decline in measles-related hospitalizations and deaths.[3-6] The 2-dose MMR (measles, mumps, rubella) vaccination was introduced in 1989, and measles was declared eliminated in the United States in 2000.[3-6]

National–level one-dose MMR coverage among children 19-35 months has remained above 90% during the last two decades.[8] NIS-Teen vaccination coverage data for 13- to 17-year-olds since 2008 has been near or above 90%,[9] and 94% of children enrolled in kindergarten had evidence of 2 MMR doses in the 2014-2015 school year.[10]

A large multistate measles outbreak was reported in the United States in 2014-2015.[4,11] One hundred fifty-nine cases were reported in the United States between January 4 and April 5, 2015. The majority of patients either were unvaccinated (45%) or had an unknown vaccination status (38%). Age ranged from 6 weeks to 70 years, and 22 patients (14%) were hospitalized.[4]

CLINICAL PRESENTATION AND PATHOPHYSIOLOGY

Measles is caused by an RNA-containing paramyxovirus that is spread by the respiratory route. Average incubation period from exposure to rash onset is 14 days (range, 7-21 days).[12,13] Peak infectivity occurs during the prodromal phase, before rash onset (Figure 1), but patients are infectious from 4 days before rash onset through 4 days after rash onset.[7,12,13]

The disease prodrome consists of a high fever (39°C-40.5°C), coryza, cough, and conjunctivitis followed by Koplik spots (Figure 2A). Koplik spots are pathognomonic for measles but rarely discovered. They appear before the skin rash alongside second molars on the buccal surface of the cheeks. The spots usually disappear when the characteristic maculopapular, nonpruritic rash erupts initially at the hairline and behind the ears, and within four days progresses toward the trunk and limbs, including the palms and soles (Figures 2B, 2C).

The patient remains febrile while the rash spreads.[12,13] Usually the fever resolves while the rash fades in the same order in which it appeared. Fever that persists for more than 5 days usually indicates complications.[13]

Cellular immunity plays an important role in host defense; the virus invades T lymphocytes and triggers suppressive cytokine (interleukin 4) production. Leukopenia, expansion of mainly measles-specific T and B lymphocytes, and replacement of lymphocyte memory cell population results in further depression of cellular immunity, and predisposes

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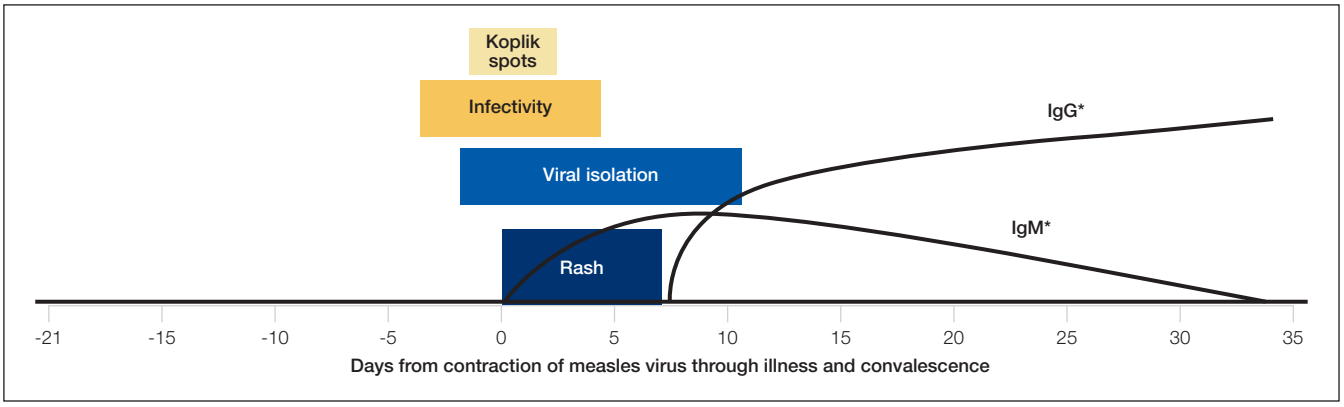

FIG. 1. Measles infection associated rash in relation to infectivity, viral detection, and serologic response. Immunocompromised patient can continue to shed virus for entire duration of disease. Viral isolation is optimal during 0 to 3 days of rash onset but can be detected through 2 days before and 10 days after rash onset. Average incubation period from exposure to rash is 14 days, but incubation period can vary from 7 to 21 days.

NOTE: *Applies to unvaccinated individuals. Dark blue box, rash duration; light blue box, viral isolation duration; gold box, infectivity duration; light gold box, Koplik spots duration; curve IgM*, duration immunoglobulin M (IgM) is detected in serum; curve IgG*, duration immunoglobulin G (IgG) is detected in serum.

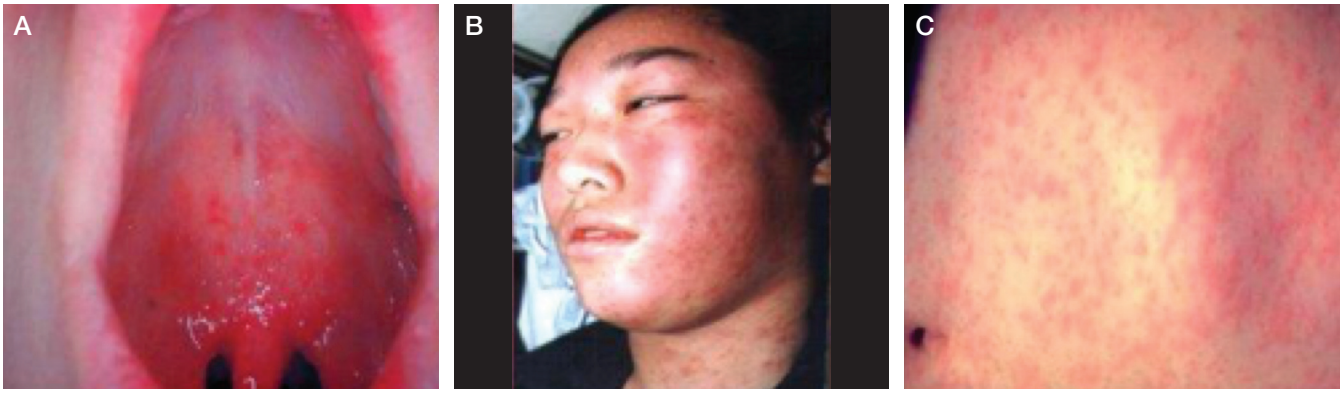

FIG. 2. (A) Pathognomonic buccal exanthem, Koplik spots. (B) Typical small, reddish, flat, macular and papular exanthemous rash on head and neck of patient with measles infection. (C) Rash spreads to arms, back, upper trunk, and legs. Courtesy of Centers for Disease Control and Prevention image library.

patients to secondary bacterial infections for up to 2 years after measles infection.[14,15]

Patients immunocompromised by congenital cellular immunity deficiency, cancer, human immunodeficiency virus (HIV) infection without effective antiretroviral therapy, or immunosuppression treatment are at higher risk for developing severe complications or dying from measles. As the rash may fail to develop in these patients, diagnosis can be challenging.[16]

Modified measles is milder and may occur in patients with preexisting partial immunity: those with an immunization history (2-dose vaccine effectiveness is ~97%), and infants with minimal immunity from their mothers.[1,7] Patients may have mild respiratory symptoms with rash but little or no fever.[7]

Atypical measles is now extremely rare. It was described only among people who were vaccinated with the killed vaccine in the United States between 1963 and 1968 and subsequently exposed to measles. The disease is characterized by high fever, edema of extremities, and a rash that develops on the palms and soles and spreads centerward. It is considered noncommunicable.[17]

Measles infection during pregnancy is associated with increased maternal and fetal morbidity. The virus can induce neonatal low birth weight, spontaneous abortion, intrauterine fetal death, and maternal death. Pregnant women with measles are more likely to be hospitalized.[18,19]

DIFFERENTIAL DIAGNOSIS

The presenting symptoms of primary measles infection are nonspecific, particularly if Koplik spots are not identified. The differential diagnosis for a patient who presents with high fever and rash include Kawasaki disease, dengue, parvovirus B19, serum sickness, syphilis, systemic lupus erythematous, toxic shock syndrome, enterovirus infection, human herpes virus 6 (roseola), viral hemorrhagic fever, drug eruption, infectious mononucleosis, Rocky Mountain spotted fever, rubella, scarlet fever, chikungunya, and Zika virus infection.

COMPLICATIONS

Measles complications can affect nearly every organ system (Table). Rates of complications from measles infection depend on age and underlying condition. Coexisting vitamin

A deficiency increases complication rates.[20]

Bacterial infections in the setting of measles infection are more common in adults than in children, and are more severe among people who are malnourished or have an immunodeficiency disorder. The most common infectious complications, which involve the respiratory tract, include pneumonia, laryngotracheitis ("measles croup"), bronchitis, otitis media (most common complication among children in the United States), and sinusitis.[7,13,21]

Indications for hospitalizing children include respiratory distress, laryngeal obstruction, dehydration that requires intravenous fluids, diarrhea with more than 10 stools a day or bloody stool, severe anemia, altered mental status, convulsion, severe rash with developing hemorrhagic areas, extensive mouth ulcers, corneal clouding or ulcers, visual disturbance, and mastoiditis.[22]

Pneumonia is a common indication for hospitalizing adults.[23,24] Measles-associated interstitial giant cell (Hecht) pneumonia is most often recognized among immunocompromised and malnourished patients.[13] Primary pneumonia is caused by the measles virus, but bacterial superinfection can occur. The most common bacterial pathogens include *Streptococcus*, *Pneumococcus*, and *Staphylococcus*,[13,24] and less commonly isolated organisms include gram-negative bacteria, such as *Haemophilus influenzae*, *Pseudomonas aeruginosa*, *Neisseria meningitides*, and *Enterobacter cloacae*.[23]

Uncommon complications of measles are myocarditis, glomerulonephritis, acute renal failure, and thrombocytopenic purpura.[25,26]

Neurologic complications in measles are an important concern. Measles-associated central nervous system complications are considered a result of an immune-mediated reaction to myelin protein and not from direct viral insult.[26-28] Immunocompromised patients are at risk for developing fatal encephalitis, and those who survive often experience cognitive decline or seizures.

Measles is associated with four different encephalitic diseases: primary measles encephalitis, acute post-measles encephalomyelitis, measles inclusion body encephalitis, and subacute sclerosing panencephalitis.

Primary measles encephalitis is characterized by fever, headache, stiff neck, and meningeal signs. Onset occurs between 1 and 15 days after rash onset, and the disease affects 1/1000 patients. Seizure, altered mental status, and coma can also develop. Viral RNA detection in the cerebrospinal fluid (CSF) confirms the diagnosis.[29]

Acute post-measles encephalomyelitis is more common in adults than in children.[12] It typically develops after the rash fades and the other symptoms subside. Patients suddenly experience a recurrence of fevers or seizures. Deafness, intellectual decline, epilepsy, postencephalitic hyperkinesia, hemiplegia, and/or paraplegia also can develop.[27-29]

Measles inclusion body encephalitis is described only in immunocompromised patients, and onset occurs within 1 year of infection. Seizures are an initial and common symptom, and some patients also experience hemiplegia, stupor, hypertonia, and dysarthria.[29] Diagnostic findings include seroconversion during the disease course, improvement after withholding of the immunosuppressive regimen, and normal CSF. Brain biopsy confirms the diagnosis.

Subacute sclerosing panencephalitis (SSPE) is a slowly pro-

TABLE. Measles Infection Complications by Organ Systems

Organ System	Complications
Respiratory	Laryngotracheitis (measles croup)
	Measles pneumonitis
	Pneumonia (bacterial)
	Hecht (giant cell) pneumonia
	Bronchitis
	Respiratory distress
	Acute respiratory distress syndrome
	Pneumothorax
	Pneumomediastinum
Ears, nose, throat	Otitis media
	Pharyngitis
	Sinusitis
	Mastoiditis
	Stomatitis
Dermatologic	Severe desquamation
	Ulceration
	Cellulitis
Neurologic	Headache
	Nuchal rigidity
	Febrile seizure
	Delirium
	Optic neuritis
	Guillain-Barré syndrome
	Acute viral encephalitis
	Post-measles encephalomyelitis
	Inclusion body encephalitis (in immunocompromised patients)
	Subacute sclerosing panencephalitis
	Transverse myelitis (rare)
	Ataxia
	Cognitive decline
	Paralysis
	Coma
Gastrointestinal	Hepatitis
	Elevated liver enzymes without jaundice
	Diarrhea
	Mesenteric adenitis
	Colitis
	Ileitis
	Appendicitis
Renal	Glomerulonephritis (rare)
	Acute renal injury
	Dehydration
	Rhabdomyolysis
Cardiac	Myocarditis (rare)
	Pericarditis
Ophthalmologic	Photophobia
	Corneal clouding
	Corneal ulcers
	Blindness
Hematologic	Anemia
	Thrombocytopenia with purpura
	Leukopenia

gressing and untreatable degenerative neurologic disorder characterized by demyelination of multiple brain areas. SSPE develops 7 to 10 years after natural measles infection, and usually affects children or adolescents. Clinical presentation includes intellectual decline, frequent rhythmic myoclonic jerks, seizure, and dementia. As the disease progresses, coma, quadriplegia, vegetative state, and autonomic instability develop. Death usually occurs within 2 years of onset.[30,31] In children, the risk for SSPE after measles infection is estimated to be 4 to 11 per 100,000 infections. After the 1989-1991 resurgence of measles in the United States, however, the risk for SSPE was estimated to be 22 per 100,000 infections.[30-32] The pathogenesis of SSPE is not fully understood but is thought to result from persistent aberrant measles virus infection.[32]

The SSPE diagnosis is based on clinical presentation, presence of anti-measles antibodies in CSF, typical electroencephalography pattern (periodic paroxysmal bursts) with accompanying myoclonus, tissue analysis, and magnetic resonance imaging.[30]

LABORATORY DIAGNOSIS

Suspicion for measles should prompt immediate consultation with local or state public health officials. Laboratory testing can be carefully considered after consultation, and care is needed in interpreting serologic studies.

The mainstays of measles infection diagnosis are detection of viral RNA by reverse transcriptase–polymerase chain reaction, or isolation of the virus in the clinical specimen, and detection of measles-specific IgM (immunoglobulin M) antibodies. A detailed protocol for collecting specimens for viral isolation appears on the Centers for Disease Control and Prevention website (http://www.cdc.gov/measles/labtools/rt-pcr.html).

IgM antibodies are detectable over the 15 weeks after rash onset, but the recommendation is to collect serum between 72 hours and 4 weeks after rash onset.[33] Clinicians should be aware that false-positive IgM results may occur with rheumatologic diseases, parvovirus B19 infection, rubella, and infectious mononucleosis.

IgG (immunoglobulin G) antibodies are usually detectable a week after rash onset. The laboratory can confirm measles by detecting more than a 4-fold increase in IgG titers between the acute phase and the convalescent phase. After measles infection, most adults develop lifelong immunity with positive IgG serology.[34]

Additional tests, such as IgG avidity and plaque reduction neutralization assay, can be used to confirm suspected cases in previously vaccinated individuals.[34]

MANAGEMENT

General Principles

Uncomplicated measles treatment is supportive and includes oral fluids and antipyretics.[7,22] Severe bacterial infections, encephalitis, or dehydration may require hospitalization, and in these cases infectious disease consultation is recommended. Patients with pneumonia, purulent otitis media, or tonsillitis should be treated with antibiotics.[35] Observational data suggest antibiotics may reduce the occurrence of bacterial infection in children, but there are no usage guidelines.[35] Vitamin A supplementation has been associated with a 50% decrease in morbidity and mortality and with blindness prevention.[22] This supplementation should be considered in severe measles cases (all hospitalized patients), especially for children, regardless of country of residence, and for adult patients who exhibit clinical signs of vitamin A deficiency.[22,24]

Antiviral Treatment

No specific treatment is available.[36] Ribavirin demonstrates in vitro activity against the virus, but the Food and Drug Administration has not approved the drug for treatment of measles. Ribavirin has been used for cases of severe measles, and for patients with SSPE along with intrathecal interferon alpha. This antiviral treatment is considered experimental.[37]

All patients hospitalized with measles infection should be cautioned about the potential downstream complications of the disease and should follow up with their primary care physician for surveillance after discharge.[38]

If measles symptoms develop, patients should self-quarantine and contact their primary care physician or public health department as soon as possible. Regardless of immune status, family members and other exposed persons should be educated about the measles symptoms that may occur during the 21 days after exposure.[38]

Both suspected and confirmed cases of measles should be reported immediately to local public health authorities.

Infection Control and Prophylaxis

Current guidelines recommend 2 doses of measles-containing vaccine to all adults at higher risk for contracting measles: international travelers, healthcare personnel, and high school and college students. Infants 6 or 11 months old should receive 1 MMR dose before international travel.[1,38]

Strict airborne isolation—use of N95 respirator or respirator with similar effectiveness in preventing airborne transmission—is mandatory from 3 to 5 days before rash onset to 4 days after rash onset (immunocompetent patients) or for the duration of the disease (immunocompromised patients).[38]

Healthcare workers should have documented presumptive evidence of immunity to measles.[39] Healthcare providers without evidence of immunity should be excused from work from day 5 to day 21 of exposure, even if they have received postexposure vaccine or intramuscular immunoglobulin. They should be offered the first MMR dose within 72 hours of measles exposure to prevent or modify the disease. Susceptible family members or visitors should not be allowed in the patient's room.[1]

Postexposure Prophylaxis

Standard MMR vaccination within 72 hours after exposure may protect against disease in people without a contraindication to measles vaccine. The public health department usually identifies these individuals and provides postexposure prophylaxis recommendations.[38,39]

People with HIV, patients receiving immunosuppressive therapy, and pregnant women and infants who have been exposed to measles and who are at risk for developing morbid disease can be treated with immunoglobulin (IG). If administered within 6 days of exposure, IG can prevent or modify disease in people who are unvaccinated or severely immunocompromised (ie, not immune). The recommended dose of IG administered intramuscularly is 0.5 mL/kg of body weight (maximum, 15 mL), and the recommended dose of IG given intravenously is 400 mg/kg. Anyone heavier than 30 kg would require intravenous IG to achieve adequate antibody levels.

Physicians should not vaccinate pregnant women, patients with severe immunosuppression from disease or therapy, patients with moderate or severe illness, and people with a history of severe allergic reaction to the vaccine.[1,40] The measles vaccine should be deferred for 6 months after IG administration.[36] More details are available in the recommendations made by the Advisory Committee on Immunization Practices.[1]

CONCLUSION

Although rare in the United States, measles remains a common and potentially devastating infection among patients who have not been vaccinated. Diagnosis requires clinical suspicion, engagement of public health authorities, and judicious use of laboratory testing. Hospitalists may encounter infectious and neurologic complications of measles long after the initial infection and should be aware of these associations.

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Mobility Assessment in the Hospital: What Are the "Next Steps"?

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Mobility impairment (reduced ability to change body position or ambulate) is common among older adults during hospitalization[1] and is correlated with higher rates of readmission,[2] long-term care placement,[3] and even death.[4] Although some may perceive mobility impairment during hospitalization as a temporary inconvenience, recent research suggests disruptions of basic activities of daily life such as mobility may be "traumatic" [5] or "toxic"[6] to older adults with long-term post-hospital effects.[7] While these studies highlight the underestimated effects of low mobility during hospitalization, they are based on data collected for research purposes using mobility measurement tools not typically utilized in routine hospital care.

The absence of a standardized mobility measurement tool used as part of routine hospital care poses a barrier to estimating the effects of low hospital mobility and programs seeking to improve mobility levels in hospitalized patients. In this issue of the *Journal of Hospital Medicine*, Valiani et al.[8] found a novel approach to measure mobility using a universally disseminated clinical scale (Braden). Using the activity subscale of the Braden scale, the authors found that mobility level changes during hospitalization can have a striking impact on post-discharge mortality. Their results indicate that older adults who develop mobility impairment during hospitalization had higher odds of death, specifically 1.23 times greater risk, within 6 months after discharge (23% decreased chance of survival). Most of the risk applies in the first 30 days and remains to a lesser extent for up to 5 years post-hospitalization. An equally interesting finding was that those who enter the hospital with low mobility but improve have a 46% higher survival rate. Again, most of the benefit is seen during hospitalization or immediately afterward, but the benefit persists for up to 5 years. A schematic of the results are presented in the Figure. Notably, Valiani et al.[8] did not find regression to the mean Braden score of 3.

This novel use of the Braden activity subscale raises a question: Should we be using the Braden activity component to measure mobility in the hospital? Put another way, what scale *should* we be using in the hospital? Using the Braden activity subscale is convenient, since it capitalizes on data already being gathered. However, this subscale focuses solely on ambulation frequency; it doesn't capture other mobility domains, such as ability to change body position. Ambulation is only half of the mobility story. It is interesting that although the Braden scale does have a mobility subscale that captures body position changes, the authors chose not to use it. This begs the question of whether an ideal mobility scale should encompass both components.

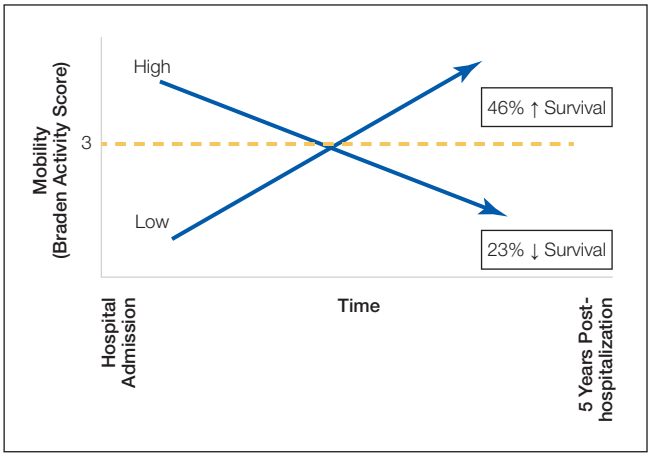

FIG. Changes in admission mobility level impact post-hospitalization survival.

Previous studies of hospital mobility have deployed tools such as Katz Activities of Daily Living (ADLs)[9] and the Short Physical Performance Battery (SPPB),[10] and there is a recent trend toward using the Activity Measure for Post-Acute Care (AM-PAC).[11] However, none of these tools, including the one discussed in this review, were designed to capture mobility levels in hospitalized patients. The Katz ADLs and the SPPB were designed for community living adults, and the AM-PAC was designed for a more mobile post-acute-care patient population. Although these tools do have limitations for use with hospitalized patients, they have shown promising results.[10,12]

What does all this mean for implementation? Do we have enough data on the existing scales to say we should be implementing them—or in the case of Braden, continuing to use them—to measure function and mobility in hospitalized patients? Implementing an ideal mobility assessment tool into the routinized care of the hospital patient may be necessary but insufficient. Complementing the use of these tools with more objective and precise mobility measures (eg, activity counts or steps from wearable sensors) would greatly increase the ability to accurately assess mobility and potentially enable providers to recommend specific mobility goals for patients in the form of steps or minutes of activity per

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day. In conclusion, the provocative results by Valiani et al.[8] underscore the importance of mobility for hospitalized patients but also suggest many opportunities for future research and implementation to improve hospital care, especially for older adults.

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It's Time for a Strategic Approach to Observation Care

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After patients have experienced an illness requiring a hospital stay, they are increasingly finding that despite having received treatment in a hospital bed, they were never actually admitted—at least not from the perspective of their insurers. Instead, these patients were kept under observation, an outpatient designation that allows a hospital to bill for observation services without formally admitting a patient.

Recent studies have recorded significant increases in hospitals' use of observation stays among the Medicare population,[1-3] raising concerns about the financial ramifications for patients. Under observation, patients are potentially responsible for a greater share of the cost and bear the financial consequences of inappropriate observation stays. Currently, around 6% of Medicare patients hospitalized as outpatients spend more than 48 hours (or two midnights) in observation, sometimes much longer, exposing them to significant out-of-pocket costs.[3] In addition, liberal use of observation can lead to increased hospital stays, for example among lower-severity emergency department (ED) patients who could have been safely discharged but were instead kept for a costly observation stay.[4] At the same time, hospitals do not necessarily benefit from this cost shifting; in fact, hospital margin is worse for patients under Medicare observation care.[5] Yet hospitals are obligated to be compliant with CMS observation regulations and may try to avoid the consequences (eg, audits, non-payment) for inpatient stays that are deemed inappropriate by CMS.

While the nuances of how CMS finances observation stays have made the practice controversial, the use of observation care in other payer groups that may not have the same reimbursement policies, and its impact on patients, have not been well studied. In this issue of the *Journal of Hospital Medicine*, Nuckols et al.[6] begins to address this gap by carefully exploring trends in observation stays in a multipayer data set.

The authors use data for four states (Georgia, Nebraska, South Carolina, and Tennessee) from the Healthcare Cost and Utilization Project (Agency for Healthcare Quality and Research) and the American Community Survey (US Census Bureau) to calculate population based rates of ED visits, observation stays, and inpatient admissions. To date, this is the first study to examine and compare the use of observation stays in an all-payer data set. Similar to prior work that examined the Medicare population, the authors find increased rates of treat-and-release ED visits and observation stays over time with a corresponding decline in inpatient admissions. As this study clearly shows, observation stays are comprising a greater fraction of the total hospital care delivered to patients with acute illnesses.

In many ways, the findings of Nuckols et al.[6] raise more questions than they answer. For example, does the rise in observation stays represent a fundamental shift in how hospitals deliver care, an alternative to costly inpatient admissions? Are changing payer incentives driving hospitals to be more prudent in their inpatient admission practices, or are similar services simply being delivered under a new billing designation? And, most important, does this shift have any repercussions for the quality and safety of patient care?

Ultimately, the answer to these questions is, "It depends." As the authors mention, most US hospitals admit observation patients to general medical wards, where they receive care at the admitting provider's discretion instead of utilizing specific care pathways or observation protocols.[7] In some of these hospitals, there may be little to no difference in how the observation patient is treated compared with a similar patient who is hospitalized as an inpatient.

However, a minority of hospitals has been more strategic in their delivery of observation care and have developed observation units. While observation units vary in design, common features include a dedicated location in the hospital with dedicated staff, reliance on clear inclusion-exclusion criteria for admission to the unit, and the use of rapid diagnostic or treatment protocols for a limited number of conditions. About half of these observation units are ED-based, reducing transitions of care between services. Protocol-driven observation units have the potential to prevent unnecessary inpatient admissions, standardize evidence-based practice, and reduce practice variation and resource use, apparently without increasing adverse events.[8] In addition, they may also lead to better experiences of care for many patients compared with inpatient admissions.

Medicare's own policy on observation hospital care succinctly describes ED observation units: "Observation services are commonly ordered for patients who present to the emergency department and who then require a significant period of treatment in order to make a decision concerning their admission or discharge…usually in less than 24 hours." Due to regulatory changes and auditing pressure, observation care has expanded beyond this definition in length of

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stay, scope, and practice such that much of observation care now occurs on general hospital wards. Ideally, observation policy must be realigned with its original intent and investment made in ED observation units.

The shifting landscape of hospital-based care as described by Nuckols et al.[6] highlights the need for a more strategic approach to the delivery of acute care. Unfortunately, to date, there has been a lack of attention among policymakers towards promoting a system of emergent and urgent care that is coordinated and efficient. Observation stays are one major area for which innovations in the acute care delivery system may result in meaningful improvement in patient outcomes and greater value for the healthcare system. Incentivizing a system of high-value observation care, such as promoting the use of observation units that employ evidence-based practices, should be a key priority when considering approaches to reducing the cost of hospital-based and other acute care.

One strategy is to better define and possibly expand the cohort of patients likely to benefit from care in an observation unit. Hospitals with significant experience using observation units treat not only common observation conditions like chest pain, asthma, or cellulitis, but also higher-risk inpatient conditions like syncope and diabetic ketoacidosis using rapid diagnostic and treatment protocols.

Identifying high-value observation care also will require developing patient outcome measures specific for observation stays. Observation-specific quality measures will allow a comparison of hospitals that use different care pathways for observation patients or treat certain populations of patients in observation units. This necessitates looking beyond resource use (costs and length of stay), which most studies on observation units have focused on, and examining a broader range of patient outcomes like time to symptomatic resolution, quality of life, or return to productivity after an acute illness.

Finally, observation care is also a good target for payment redesign. For example, incentive payments could be provided to hospitals that choose to develop observation units, employ observation units that utilize best known practices for observation care (such as protocols and clearly defined patient cohorts), or deliver particularly good acute care outcomes for patients with observation-amenable conditions. On the consumer side, value-based contracting could be used to shunt patients with acute conditions that require evaluation in an urgent care center or ED to hospitals that use observation units.

While the declines in inpatient admission and increases in treat-and-release ED patients have been well-documented over time, perhaps the biggest contribution of this study from Nuckols et al.[6] lies in its identification of the changes in observation care, which have been increasing in all payer groups. Our opportunity now is to shape whether these shifts toward observation care deliver greater value for patients.

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Monitor Watchers and Alarm Fatigue: Cautious Optimism

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Monitor watcher personnel are frequently used to assist nurses with identifying meaningful events on telemetry monitors. Although effectiveness of monitor watchers on patient outcomes has not been demonstrated conclusively,[1] as many as 60% of United States hospitals may be using monitor watchers in some capacity.[2] Presumed benefits of monitor watchers include prompt recognition of changes in patients' conditions and the potential to reduce alarm fatigue among hospital staff. Alarm fatigue is desensitization resulting from overexposure to alarm signals that are either invalid or clinically irrelevant. Alarm fatigue has resulted in missed patient events and preventable deaths.[3] In this issue of the *Journal of Hospital Medicine*, Palchaudhuri et al.[4] report findings from their observational study of telemetry monitor alarms intercepted by monitor watchers as a mechanism for reducing both nurses' exposure to alarm signals and subsequent alarm fatigue.

To our knowledge, the study by Palchaudhuri et al.[4] is the first to report the effect of monitor watchers on nurses' exposure to alarm signals. In this study, over a 2-month period monitor watchers intercepted 87% of alarms before they were sent to the nurse's telephone. Monitor watchers intercepted over 90% of bradycardia and tachycardia alarms, indicating that they believed these alarms to be clinically irrelevant. Monitor watchers also intercepted about 75% of alarms for lethal arrhythmias, indicating that they believed these alarms to be invalid.

In this study, decisions about alarm validity and relevance were made through close communication between monitor watchers and nursing staff. If an alarm was sounding and the monitor watcher had already spoken with the nurse about it and established that the nurse was addressing the problem, the monitor watcher would intercept subsequent alarms for that issue or event (according to personal communication with S. Palchaudhuri). The results of the study not only indicate that monitor watchers can reduce the number of alarms to which a nurse is exposed, but also support previous findings that few alarms are valid or clinically relevant.[5-7] The results of this study also suggest that "nuisance" alarms should include not only clinically irrelevant alarms, but also relevant alarms for which the nurse is actively seeking a solution. Monitor watchers may have an important role in addressing these alarms.

The study raises important considerations regarding monitor watcher practice and alarm fatigue. If monitor watchers are to be effective in reducing nurses' exposure to alarms, they must use good judgment to determine when to intercept an alarm, call the nurse, or both. In the absence of proper judgment, monitor watchers may inadvertently increase nurses' fatigue through redundant calls or inappropriately suppress valid relevant alarms. In free-text responses to our national monitor watcher survey, nurses expressed frustration over redundant calls from monitor watchers for invalid and irrelevant alarms.[2] Research suggests that monitor watchers may not identify potentially dangerous alarms with complete accuracy. In a recent study reported in *The Journal of the American Medical Society* (*JAMA*), monitor watchers missed about 18% of patients with detectable rhythm or rate changes on telemetry in the hour before an emergency response team was activated.[8]

Several factors and conditions may affect monitor watchers' judgment: 1) education and training, 2) location and access to contextual patient information, and 3) fatigue. First, across the US, the level of education required for monitor watcher positions ranges from a high school diploma to licensure as a registered nurse. The content and frequency of in-service training required also varies.[2] These differing requirements may influence monitor watchers' ability to interpret alarms.

Second, most monitor watchers are located off the patient care unit,[2] which influences their access to information. Even in remote locations, monitor watchers can assess alarm validity by reviewing parameter waveforms for artifact. However, determining the relevance of an alarm to a particular patient is a more complex task requiring contextual information about the patient.[9] Monitor watchers must work closely with clinicians at the bedside to determine the relevance of alarms, and repeated contact between monitor watchers and nurses over alarm conditions may itself increase nurses' alarm fatigue.

Finally, fatigue may affect monitor watchers themselves and reduce their effectiveness. This issue was raised by Palchaudhuri et al. Both the number of monitors watched and the length of the monitor watcher's shift likely influence alertness and effectiveness. In a simulation study, Segall et al.[10] found that monitor watchers' recognition of serious arrhythmias was significantly delayed when they were responsible for more than 40 patient monitors. Monitor watchers often work 12-hour shifts,[2] and although no research has

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been reported on their shift-related alertness, this is a long time to remain attentive.

Given these potential challenges, future research should specifically address adverse patient outcomes and missed clinically relevant alarms. Only two of the seven patients who arrested during the study by Palchaudhuri et al.[4] were on telemetry, and neither arrested due to lethal arrhythmias. While this is an important indication that no alarms for lethal arrhythmias were inadvertently suppressed, it is difficult to achieve adequate statistical power to assess rare outcomes like cardiac arrests. In a future study, alarms intercepted by monitor watchers could be assessed for accuracy and relevance to patient care to determine whether important alarms were inadvertently suppressed.

In summary, the study by Palchaudhuri et al.[4] represents a preliminary step in considering the potential utility of monitor watchers for reducing invalid and clinically irrelevant alarms as well as subsequent alarm fatigue. As the authors note, dedicated monitor watchers can screen alarms much more quickly than nurses who may be engaged in other activities when an alarm signals. The study raises interesting questions about how monitor watchers should be incorporated into workflow. Should their only responsibility be to call regarding potentially critical events, or should they be able to prevent alarms from reaching the nurse? Could monitor watchers provide guidance to reduce alarm fatigue, such as suggesting parameter changes when they see trends in irrelevant alarms? Future research is warranted to understand how monitor watchers can be used most effectively to reduce alarm fatigue, and which characteristics of monitor watchers and their practice result in the best patient outcomes.

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DIVISION HEAD OF HOSPITAL MEDICINE

The Henry Ford Medical Group (HFMG), one of the largest multispecialty group practices in the country, is seeking a highly qualified applicant to serve as Division Head in its Division of Hospital Medicine. With nearly 30 years of experience in Hospital Medicine, HFMG established a separate Division of Hospital Medicine in 2008, and is the largest Division in the Department of Medicine with over 50 hospitalist and palliative medicine faculty serving at three different hospitals.

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- serve as a resource for Henry Ford Health System (HFHS) initiatives including observation medicine, physician advising, use of information technology, value based care, and improved patient experience

This is an excellent leadership opportunity with continued professional growth in a strong hospitalist group committed to the development of high quality hospitalists. The Division continues to be a leader in HFHS efforts to promote systemic integration/alignment, clinical excellence, innovation, and value in an accountable care environment.

The successful candidate will be ABIM certified (preference Internal Medicine with a Focused Practice in Hospital Medicine) and have at least 7 years of hospitalist practice experience with progressive proven leadership skills in a large hospitalist program preferably in an integrated healthcare organization. Strong clinical and communication skills are essential. Significant experience with quality and care management initiatives, operational management, as well as medical education are also desired.

Generous group practice benefits are provided including: vacation, CME time/allowance, insurance (life/disability/malpractice), and retirement package. A faculty appointment at Wayne State University School of Medicine is available commensurate with prior experience.

Review of applications will begin immediately and continue until the position is filled. Please submit your letter of interest and cv to Dr. Kimberly Baker-Genaw, Vice Chair of Medicine, in c/o Scott Johnson, Senior Physician Recruiter, at sjohns10@hfhs.org. For a detailed position description, please visit: http://p.rfer.us/HENRYFORDIHH1rb.

Henry Ford Health System is committed to the hiring, advancement and fair treatment of all individuals without regard to race, color, national origin, sex, sexual orientation, age, disability, religion, weight/height, marital status, familial status, veteran status or any other characteristic protected by law.

NOCTURNIST and Staff Opportunities in Maine

Central Maine Medical Center is a 250 bed tertiary care facility that attracts regional referrals and offers a comprehensive array of the highest level healthcare services to approximately 400,000 people in central and western Maine.

Our well-established and stable group seeks BC/BE IM or FM physicians to work in a team environment with NP and PA providers.

Nocturnists are supported by physician and NP/PA swing shift staff, full-time hours are reduced and compensation is highly incented. We also offer:

Competitive compensation package with generous moving allowance, medical student loan repayment, and signing bonus.

The opportunity to expand your professional interests in areas such as our nationally recognized Palliative Care team and award-winning Quality Improvement initiatives.

Encouragement of innovation and career growth at all stages starting with mentoring for early hospitalists, and progressing to leadership training and opportunities.

The only Hospital Medicine Fellowship in northern New England with active roles in fellow, resident and medical student education.

Enjoy the abundance of outdoor and cultural opportunities that are found in our family-friendly state. Check out our website: www.cmmc.org. And, for more information, contact Julia Lauver, CMMC Medical Staff Recruitment at LauverJu@cmhc.org; 800/445-7431 or 207/755-5854 (fax).

CHA Cambridge Health Alliance — AFFILIATED WITH Beth Israel Deaconess Medical Center, MassGeneral Hospital for Children, Harvard Medical School Teaching Hospital

Hospitalist/Nocturnist Opportunities

Cambridge Health Alliance (CHA) is a well respected, nationally recognized and award-winning public healthcare system, which receives recognition for clinical and academic innovations. Our system is comprised of three campuses and an integrated network of both primary and specialty care practices in Cambridge, Somerville and Boston's Metro North Region. CHA is a teaching affiliate of both Harvard Medical School (HMS) and Tufts University School of Medicine and opportunities for teaching medical students and residents are plentiful.

We are currently recruiting **BC/BE Hospitalist/Nocturnist** to join our division of approximately 20 physicians to cover inpatient services at both our Cambridge and Everett campuses. This position has both day and night clinical responsibilities. Ideal candidates with be FT (will consider PT), patient centered, posses excellent clinical/communication skills and demonstrate a strong commitment to work with a multicultural, underserved patient population. Experience and interest in performing procedures, as well as resident and medical student teaching is preferred. **All of our Hospitalists/Nocturnist hold academic appointments at Harvard Medical School**. At CHA we offer a supportive and collegial environment, a strong infrastructure, a fully integrated electronic medical record system (EPIC) and competitive salary/benefits package.

Please send CV's to Deanna Simolaris, Department of Physician Recruitment, Cambridge Health Alliance, 1493 Cambridge Street, Cambridge, MA 02139, via e-mail: dsimolaris@challiance.org, via fax (617) 665-3553 or call (617) 665-3555. www.challiance.org. We are an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability status, protected veteran status, or any other characteristic protected by law.