An analysis of diagnoses that drive readmission: What can we learn from the hospitals in Southern New England with the highest and lowest readmission performance?

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ABSTRACT

BACKGROUND: The Hospital Readmission Reduction Program was instituted by the Centers for Medicare & Medicaid Services in 2012 to incentivize hospitals to reduce readmissions.

OBJECTIVE: To examine the most common diagnoses driving readmissions among fee-for-service Medicare beneficiaries in the hospitals with the highest and lowest readmission performance in Southern New England from 2014 to 2016.

METHODS: This is a retrospective observational study using publicly available Hospital Compare data and Medicare Part A claims data. Hospitals were ranked based on risk-adjusted excess readmission ratios. Patient demographic and hospital characteristics were compared for the two cohorts using t-tests. The percentages of readmissions in each cohort attributable to the top three readmission diagnoses were examined.

RESULTS: Highest-performing hospitals readmitted a significantly lower percentage of black patients (p=0.03), were less urban (p<0.01), and had higher Hospital Compare Star ratings (p=0.01). Lowest-performing hospitals readmitted higher percentages of patients for sepsis (9.4% [95%CI: 8.8%-10.0%] vs. 8.1% [95%CI: 7.4%-8.7%]) and complications of device, implant, or graft (3.2% [95%CI: 2.5%-3.9%] vs. 0.2% [95%CI: 0.1%-0.6%]), compared to highest-performing hospitals.

CONCLUSIONS: Ongoing efforts to improve care transitions may be strengthened by targeting early infection surveillance, promoting adherence to surgical treatment guidelines, and improving communication between hospitals and post-acute care facilities.

KEYWORDS: readmissions, Medicare, quality, aging

BACKGROUND

Readmissions result in increased costs, are burdensome for patients, and are often preventable. Prior to 2012, hospitals had few financial incentives to reduce readmissions. However, with the enactment of the Affordable Care Act and the creation of the Hospital Readmission Reduction Program (HRRP), the Centers for Medicare & Medicaid Services began to reduce payments to hospitals with high rates of readmissions.[1] The Medicare program initially targeted admissions for acute myocardial infarction, heart failure, and pneumonia. Starting in 2015, admissions for chronic obstructive pulmonary disease (COPD) and elective total knee and hip replacements were added.

By tracking and reporting readmissions as a quality measure, the Medicare program anticipated that efforts to curtail readmissions would encourage innovation, improve care coordination, and reduce healthcare utilization.[2] However, some experts criticize using a hospital's 30-day readmission rate as a quality measure because it may poorly correlate with quality[3,4] and mortality,[5] and because it may inadequately account for social determinants of health.[6, 7]

This study aims to compare the most prevalent readmission diagnoses in the highest- versus the lowest-performing cohorts of hospitals in Southern New England (Connecticut, Massachusetts, and Rhode Island). We hypothesized that the lowest-performing hospitals would have different diagnoses driving their readmissions than the highest-performing hospitals and that the findings could inform efforts to improve care and reduce readmission rates, particularly among hospitals in the bottom cohort.

METHODS

Data Sources

We used publicly available data from the Hospital Compare website to obtain a risk-adjusted list of the excess readmission ratios for hospitals in Connecticut, Massachusetts, and Rhode Island. The latest available data was for the performance measurement period of July 1, 2012 to June 30, 2015.[8] The excess readmission ratio is a measure of an individual hospital's readmission performance compared to the readmission performance for hospitals with a similar case mix across the country. The measure is calculated for the specific condition (e.g., pneumonia) that was the primary diagnosis for the original index admission. The measure is adjusted for certain patient demographic characteristics and comorbidities. In other words, individual hospitals are compared to other hospitals with similar patients for each of the conditions measured.[1] If the hospital has more unplanned readmissions than would be expected for a similar hospital for a given condition, it will have a ratio greater than 1.00 for that condition. For the present study, we combined these

ratios into a mean ratio for each hospital, as explained below under "Study Design."

We obtained hospital-level characteristics from Hospital Compare, including overall Star rating (which summarizes multiple hospital quality measures),[9] Medicare spending ratios, and whether patients reported they were given information about what to do during their recovery at home. The latter measure is derived from the Hospital Consumer Assessment of Healthcare Providers and Systems survey. We also examined whether the hospital was designated as a Disproportionate Share Hospital (DSH).[10] This designation allows for additional Medicare funding for hospitals based on the proportion of low-income and uninsured patients they serve. The DSH formula incorporates multiple factors, including whether patients receive Supplemental Security Income, are enrolled in Medicaid, and are uninsured. Based on this formula, Medicare assigns each designated hospital a DSH Index, which determines the hospital's DSH payment. The data source for this variable is the CMS Impact File Hospital Inpatient Prospective Payment System (IPSS).[11] Last, hospitals were designated as urban or non-urban based on the Quality Innovation Network National Coordinating Center's[12] ZIP Code analysis file, which uses population size determined by U.S. Census data.

In partnership with the Medicare Quality Innovation Network-Quality Improvement Organization for New England, Healthcentric Advisors, we used Medicare fee-for-service Part A claims to obtain demographic data for patients and readmission diagnoses. Readmission diagnoses represent the principal discharge diagnosis codes submitted on the claims for the hospital readmissions, regardless of the reason for the original index admission. Diagnoses are grouped according to the Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software.[13]

Study design

We ranked all acute-care hospitals in Southern New England based on their excess readmission ratios. The HRRP calculates separate excess readmission ratios for six conditions – acute myocardial infarction, COPD, heart failure, pneumonia, coronary artery bypass graft surgery, and elective hip or knee arthroplasty – when the conditions represent the primary reason for the original index admission. We included any hospital with at least one reported excess readmission ratio. For a hospital with more than one excess readmission ratio reported, we calculated the mean of the reported ratios for that hospital. We designated the ten hospitals with the lowest mean excess readmission ratios as the highest-performing cohort and the ten hospitals with the highest mean excess readmission ratios as the lowest-performing cohort.

We identified the percentage of readmissions attributable to the top three readmission diagnoses in each cohort, and calculated 95% confidence intervals (CIs). We examined readmission diagnoses for every other quarter from September 2014 through June 2016.

Statistical Analysis

Patient demographic and hospital characteristics for the two cohorts were compared using unpaired t-tests. We used ArcGIS® software to generate geographic information system (GIS) maps depicting population density (population per square mile) and mean household income in the counties immediately surrounding individual hospitals in the highest- and lowest-performing cohorts. We calculated the percentage of readmissions attributable to the top three readmission diagnoses for each of the cohorts using STATA.

RESULTS

Excess readmission ratios were reported for 94 hospitals in Southern New England. **Table 1** summarizes the patient and hospital characteristics for the highest and lowest performers in quarter 4 of 2014. The highest-performing cohort had 10,172 admissions in this period, while the lowest-performing cohort had 12,211 admissions. There was no significant difference between the cohorts regarding the percentage of admissions resulting in readmission (15% in the highest-performing hospitals vs. 19% in the lowest-performing hospitals, p=0.69). The two cohorts had similar characteristics with respect to gender, readmission to the same vs. different hospital, and the mean length of stay of the readmission. However, the lowest-performing hospitals readmitted a higher percentage of black patients (p=0.03) and patients younger than 65 years old (p<0.01), while the highest-performing hospitals readmitted a higher percentage of white patients (*p*=0.01).

The two cohorts had comparable mean DSH indices and mean Medicare spending ratios and similar percentages of patients who reported receiving discharge instructions (**Table 1**). Hospitals in the lowest-performing cohort had a lower mean overall Star rating (p=0.01).

Figures 1 and 2 show the geographic location of the hospitals included in the study. Seven of the twenty hospitals were in the Boston metropolitan area. Generally, both the highest and lowest-performing hospitals were located in areas with higher population density (**Figure 1**). Half of higher-performing hospitals were coastal, including hospitals located in South County and Newport, Rhode Island; Cape Cod and Nantucket. The mean household incomes in the counties surrounding highest- and lowest-performing hospitals were similar (**Figure 2**).

Patients were most frequently readmitted with a primary diagnosis of sepsis in both the highest- and lowest-performing hospital cohorts. Among the highest-performing cohort, readmissions with a primary diagnosis of sepsis comprised 8.1% (95%CI: 7.4%-8.7%) of all readmissions, while sepsis accounted for 9.4% (95%CI: 8.8%-10.0%) of readmissions in the lowest-performing cohort, a statistically significant difference (**Figure 3**). Heart failure was the next most common readmission diagnosis in both cohorts (7.9% [95%CI: 7.3%-8.6%] in the highest and 7.3% [95%CI: 6.8%-7.8%] in

Table 1. Patient and hospital characteristics for hospitals in Southern New England (Connecticut, Massachusetts, and Rhode Island) with the highest and lowest readmission performance† (October–December, 2014)

	Highest Performers	Lowest Performers	P-value
Total number of admissions	10,172	12,211	
Total number of readmissions	1,541	2,321	
Readmissions/admissions ratio	0.15	0.19	0.69
Patient characteristics			
Female, n (%)	830 (53.9)	1193 (51.4)	0.07
Race/ethnicity, n (%)			
White	1365 (88.6)	1988 (85.7)	0.01
Black	103 (6.7)	206 (8.9)	0.03
Hispanic	37 (2.4)	46 (2.0)	1.00
Asian	8 (0.5)	29 (1.2)	1.00
Other	26 (1.7)	48 (2.1)	1.00
Age in years, n (%)			
<65	314 (20.4)	557 (24.0)	<0.01
65-74	407 (26.4)	640 (27.6)	0.17
75-84	419 (27.1)	588 (25.3)	0.16
>84	401 (26.0)	536 (23.1)	0.16
Readmitted to same hospital, n (%)	1251 (81.2)	1861 (80.2)	0.44
Mean length of stay at readmission, in days	5.24	5.23	0.99
Hospital characteristics			
Urban, n (%)	9 (90.0)	10 (100.0)	<0.01
Mean DSH index°	0.22	0.21	0.46
State, n			
Connecticut	1	1	
Massachusetts	7	8	
Rhode Island	2	1	
Mean Hospital Compare overall Star rating*	3.89	3.00	0.01
Mean percent of patients reporting they received discharge instructionsT	89.7	89.2	0.32
Mean Medicare spending ratioΔ	0.98	1.01	0.17
Mean excess readmission ratio	0.94	1.10	<0.01

† Highest-performing hospitals had the lowest rates of readmission within 30 days of hospital discharge; lowest-performing hospitals had the highest rates of readmission within 30 days of hospital discharge.

° DSH: Disproportionate Share Hospital; the index is derived from the proportion of patients at the hospital who receive Supplemental Security Income, are enrolled in Medicaid, and/or are uninsured, with a higher index indicating a higher proportion of low-income patients.

* The Hospital Compare overall Star rating ranges from 1 to 5, with a higher number of Stars indicating higher quality of care at the hospital.

T Derived from the Hospital Consumer Assessment of Healthcare Providers and Systems survey results reported on Hospital Compare; included here is the percent of patients who responded that YES, they were given information at discharge about what to do during their recovery at home.

Δ The Medicare spending ratio shows whether Medicare spends more, less, or about the same for an inpatient stay at a particular hospital compared to what it spends per patient at all hospitals nationally; a ratio greater than one means that Medicare spends more per patient at a particular hospital and a ratio less than one means that Medicare spends less per patient compared to what it spends at all hospitals nationally.

the lowest); this difference was not statistically significant. In the lowest-performing hospitals, complications of surgical procedures or medical care accounted for 3.0% (95%CI: 2.6%-3.5%) versus 2.7% (95%CI: 2.2%-3.3%) in the highest-performing hospitals, which was also not statistically significant. Finally, complications of device, implant, or graft accounted for 3.2% (95%CI: 2.5%-3.9%) of all readmissions in the lowest-performing hospitals versus 0.2% (95%CI: 0.1%-0.6%) in the highest-performing hospitals, a statistically significant difference (**Figure 3**).

DISCUSSION

Readmission rates are an important quality measure – any potentially preventable hospital stay is undesirable to patients and payers, and hospitals are incurring penalties for excess readmissions. In comparing readmission diagnoses for the highest- and lowest-performing hospitals in Southern New England, we found that the lowest-performing cohort had higher proportions of its readmissions attributable to sepsis and complications of device, implant, or graft.

While Medicare initially targeted excess readmissions for heart failure, pneumonia, and acute myocardial infarction, some analyses suggest that readmissions for sepsis may be even more prevalent and may also be potentially preventable.[14, 15] The U.S. healthcare system spends more on hospitalizations for sepsis than any other cause.[14] In a California-wide study, the annual cost of sepsis readmissions was $500 million, compared to $229 million for heart failure readmissions.[16] Risk factors for sepsis readmissions in this study of 368,514 hospitalizations included dementia and malignancy as co-morbidities, hospital discharge to a skilled nursing facility, and longer length of stay during the original index admission. Approaches to reducing readmissions for sepsis include dedicated wound care programs, obtaining laboratory studies early after discharge to assess for renal failure in high-risk patients, avoiding urinary catheter insertion, and counseling patients on infection risks and signs prior to discharge.

Readmissions for complications of care also present an important quality improvement opportunity for hospitals. A recent study of 44,120 patients examined readmissions after elective orthopedic surgeries; the authors suggest that preventing surgical site infections,

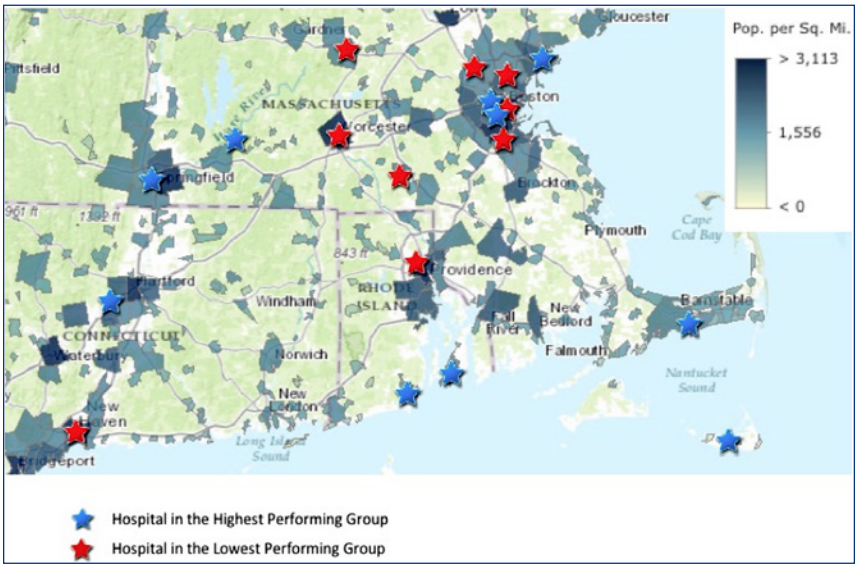
venous thromboembolism, and post-operative bleeding would be the highest-yield interventions for reducing readmissions in this cohort.[17] One-half to two-thirds of unplanned readmissions were related to the surgical procedure and could potentially be related to the patient's perioperative care. Proper use of antibiotic prophylaxis[18] and adherence to clinical standards such as those in the Surgical Care Improvement Project[19] have led to modest reductions in rates of surgical site complications. Further research into how to effectively reduce complications after surgery is needed.

Additionally, hospitals may be able to employ strategies during a patient's original index admission to decrease susceptibility to complications after discharge. Krumholz and colleagues have described a "post-hospital syndrome," in which a patient's vulnerability is not only due to their acute illness, but also a product of their hospitalization.[20] During the hospital stay, many patients experience stress, poor sleep, decreased nutritional intake, loss of muscle tone, adverse drug events, and exposure to potentially life-threatening pathogens.[20] Efforts that target any one of these hospital-imposed conditions, rather than solely addressing the principal reason for readmission, could potentially alter patients' post-discharge trajectories.

Currently hospitals incur most of the HRRP penalties for excess readmissions; however, post–acute care facilities likely also play a role in whether their patients are readmitted to the hospital. Although quality information on nursing homes is publicly available at Medicare's Nursing Home Compare website, patients may receive little information about facilities prior to discharge.[21] Medicare introduced a new readmission measure for short-stay residents in 2016; it reports the percentage of residents who are readmitted to the hospital within 30 days of their admission to the post–acute care facility. This measure has been incorporated into the Quality Measures Star Rating on Nursing Home Compare.[22] Nursing homes with higher quality ratings may have better strategies to avoid readmissions. Establishing referral networks between hospitals and post–acute care facilities may also decrease readmission rates, perhaps by improving communication and by facilitating collaboration on projects to address local barriers.[23]

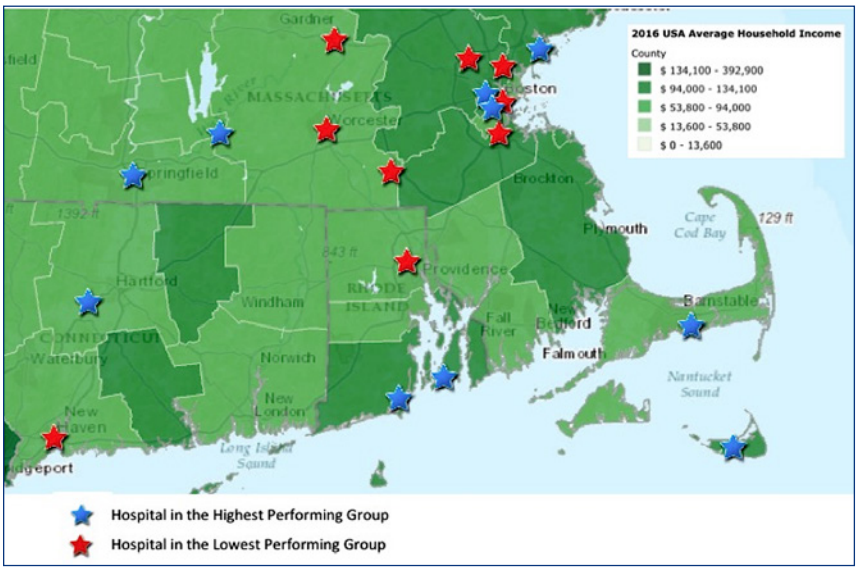
We note several limitations of this analysis. The study uses claims data, which relies on documentation by providers and may be incomplete. Second, the hospital cohorts in this study were derived from the most recent excess readmission ratios available on the Hospital Compare website. Hospital performance may change over time. Finally, readmission diagnoses were based on the principal discharge diagnosis of the readmission claim, but patients may be readmitted for multiple reasons that are not captured in the primary diagnosis.

Figure 1. Geographic information system (GIS) map showing population density (population per square mile) and locations of the highest-performing and lowest-performing hospitals



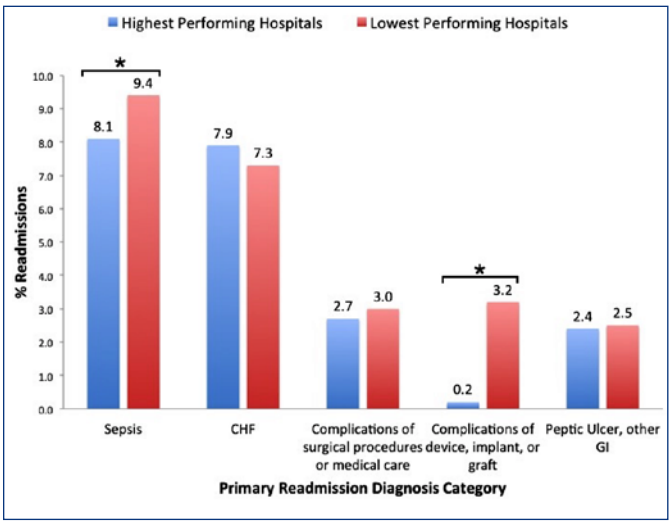
Note: Highest-performing hospitals had the lowest rates of readmission within 30 days of hospital discharge; lowest-performing hospitals had the highest rates of readmission within 30 days of hospital discharge.

Figure 2. Geographic information system (GIS) map showing mean household income by county and the location of the highest-performing and lowest-performing hospitals



Note: Highest-performing hospitals had the lowest rates of readmission within 30 days of hospital discharge; lowest-performing hospitals had the highest rates of readmission within 30 days of hospital discharge. Data source for mean income: Esri's 2016 Updated Demographic Data using Census 2010 geographies.

Figure 3. Percent of readmissions due to selected conditions, highest and lowest performing hospitals



Notes: Asterisk indicates that the difference between the highest- and lowest-performing hospitals for that diagnosis category is statistically significant at a $p<0.05$ level. Highest-performing hospitals had the lowest rates of readmission within 30 days of hospital discharge; lowest-performing hospitals had the highest rates of readmission within 30 days of hospital discharge.

CONCLUSIONS

In conclusion, we found that the lowest-performing hospitals in Southern New England had higher proportions of their readmissions attributable to sepsis and complications of device, implant, or graft, compared to the highest-performing hospitals. Ongoing efforts to improve care transitions may be strengthened by targeting early infection surveillance, promoting adherence to surgical treatment guidelines, and improving communication between hospitals and post-acute care facilities.

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