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ORIGINAL RESEARCH

# Hospital Characteristics and 30-Day All-Cause Readmission Rates

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**BACKGROUND:** The Centers for Medicare and Medicaid Services (CMS) publicly reports hospital-wide all-cause readmission rates, which are key indicators of quality and waste. Understanding hospital characteristics that are associated with lower readmission rates is important.

**OBJECTIVES:** The main objective of this article is to identify hospital characteristics associated with lower readmission rates. Specifically, we focus on the relationship between hospitalist staffing levels, the level of physician integration, and physician ownership with hospital-wide all-cause readmissions.

**METHODS:** We rely on data from CMS, American Hospital Association Annual Survey Database, and Area Health Resource File. We use ordinary least square regression to assess the association between readmission rates and hospitalist staffing levels, physician integration, physician ownership, and the presence of a medical home model, while controlling for key organizational and market factors such as registered nurse (RN) staffing levels and competition.

**RESULTS:** Higher hospitalist staffing levels, the fully integrated physician model, and physician ownership were associated with lower readmission rates. The addition of 1 hospitalist per general and surgical bed was associated with a 0.77 percentage-points decrease in adjusted 30-day all-cause readmission rates. Fully integrated hospitals had adjusted 30-day all-cause readmission rates 0.09 percentage points lower than non–fully integrated hospitals, and hospitals partially or fully owned by physicians had adjusted readmission rates 0.36 percentage points lower than non–physician-owned hospitals.

**CONCLUSIONS:** Hospitals should focus on modifiable organizational factors that influence patient outcomes such as hospitalist and RN staffing levels and explore hospital-physician arrangements that result in the greatest alignment between hospital and physician incentives. *Journal of Hospital Medicine* 2016;11:682–687. © 2016 Society of Hospital Medicine

The hospital-wide all-cause 30-day readmission rate is a key quality measure associated with patient outcomes, cost of care, and wasted hospital resources.[1] The estimated 20% readmission rate of Medicare patients and the associated $17 billion annual cost of readmissions led the Centers for Medicare and Medicaid Services (CMS) to implement policies that limit reimbursement for 30-day unplanned readmissions and thus place hospitals with high readmission rates at financial risk.[1,2]

The variation in readmission rates between hospitals is well documented in the literature.[3,4] Singh et al. found that 9.3% of the variation in readmissions can be explained by hospital characteristics.[4] Hospital factors associated with lower readmission rates include not-for-profit ownership, hospital size, and nursing staffing levels.[5–7] Other studies found an association between environmental factors such as the percent of patients living under the poverty line and higher readmission rates.[7] The recent publicly available CMS data on readmission rates allows us to further our understanding of hospital characteristics that explain the variation in readmission rates. In this article, we are specifically interested in hospitalist staffing levels and hospital-physician arrangements such as physician integration level and physician ownership. Moreover, we are interested in novel organizational variables, specifically, the adoption of a medical home model, which has been ignored by previous research. Medical homes are associated with better quality[8]; hospitals that already adopted the medical home model might be better equipped to coordinate care after the patients are discharged.

In recent years, the number of hospitals relying on hospitalists to provide inpatient care has been on the rise. As more hospitals employ hospitalists, it is important to understand how hospitalist staffing levels are associated with quality. Previous studies have linked hospitalists with lower hospital mortality rates,[7] lower cost of care,[9,10] and lower readmission rates.[10,11] Goodrich et al., on the other hand, did not find a significant relationship between the presence of hospitalists and mortality or readmission rates.[12] In a recent study, hospitalists indicated that heavy workloads limited the time they had available to communicate with patients, which negatively influenced quality and patient satisfaction, and resulted in delayed admissions and discharges.[13]

The main objective of this article was therefore to study the association between hospitalist staffing levels

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and hospital-wide all-cause readmission rates. Most empirical studies examining the relationship between hospitalist staffing and quality of inpatient care have predominantly focused on whether the presence of hospitalists who provided care at a hospital influenced mortality or readmissions.[11,12] In this article, we contribute to the literature by examining how staffing levels measured by the ratio of hospitalists to general medical and surgical beds is associated with 30-day readmission rates. We predict that there is a positive association between readmission rates and hospitalists per bed.

Hospitals have a broad range of contractual arrangements or integration levels with physicians, with employment being the highest level. A hospital can rely on physicians who have admitting privileges but are not salaried employees of the hospital to treat a large portion of its inpatient population. In the past few years, with the passage of the Patient Protection and Affordable Care Act (2010) and the shift in reimbursement towards Value Based Purchasing (VBP), more hospitals are choosing to ensure that physicians are strongly integrated within the hospital by adopting an employment-based model. Moreover, hospitals view physician employment as a strategic move that will help ensure or expand their market share.[14] For instance, the number of surgeons who identified as self-employed dropped from 48% in 2001 to 28% in 2011, and this reduction is attributed to the shift toward hospital employment of physicians.[15] Despite the evolving models of hospital-physician arrangements, little is understood on how the adoption of the integrated salary model, in addition to the equity and foundation models, which are classified by Baker et al. as the highest level of integration, influence quality.[16] Therefore, another objective of this article was to examine the association between hospital-physician arrangements and all-cause unplanned readmission rates.

## METHODS

### Data Source and Sample

Data from the American Hospital Association (AHA) Annual Survey (2013), CMS Hospital Compare (October 2013), and Area Health Resource File (2013) were merged to analyze the association between readmission rates with hospital characteristics and environmental factors. We limited the analysis to private (nonpublic) hospitals with no missing data. Our final sample consisted of 1756 hospitals. Of the hospitals in our sample, 14% were for profit, 70% were nonteaching, 23% were minor teaching, 7% were major teaching hospitals, 73% belonged to a system, and 31% were classified as small hospitals. Table 1 provides descriptive statistics for all the variables included in the analysis.

### Variables

#### *Dependent Variable*

Risk standardized 30-day hospital-wide all-cause readmission rates (HWR) were obtained from CMS. This measure was publicly reported in October 2013. The HWR is estimated using standardized risk ratios at the hospital level for the following 5 discharge diagnosis groups: surgery/gynecology, neurology, cardiorespiratory, cardiovascular, and general medicine.[17] The measure adjusts, in addition to a hospital's case mix, for patients' ages, principal discharge diagnoses, and comorbidities.[17] HWR is calculated as a predicted-to-expected readmissions ratio. Predicted and expected readmissions were calculated for each of the 5 groups for each hospital using each hospital's patient mix and a hospital random effects estimate. A standardized readmission ratio was then derived by dividing predicted readmissions by expected readmissions for each group for each hospital. A single hospital score was obtained by multiplying the volume-weighted logarithmic average of the 5 diagnostic groups by the average national readmission rate.[18]

#### *Independent Variables*

The primary independent variable of interest to this study is hospitalist staffing levels. We calculate the staffing levels of hospitalists by dividing the full-time equivalent (FTE) of hospitalists by the number of general medical and surgical beds. FTE hospitalists are calculated by the AHA Annual Survey database (2013) as the sum of full-time hospitalists and 0.5*number of part-time hospitalists. In addition to hospitalist staffing levels, a main predictors is whether the hospital fully integrates physicians or not. We follow Baker et al. in our classification of full integration. Baker et al. define fully integrated hospitals as those that adopted 1 of the following models with their physicians: integrated salary, foundation or equity model.[16] We predict that fully integrated hospitals are more likely to have better readmission rates. Another key physician variable that is likely to influence outcomes is physician partial or full ownership of the hospital. Ownership aligns physicians' incentives with hospital performance[19] and is therefore likely to be associated with better readmission rates. We also include a dichotomous variable that indicates whether a hospital has an established medical home program or not. Medical homes indicate an organizational culture that is patient centered and committed to continuity and coordination of care; all of which are important for better quality. We predict that the presence of a medical home model will be associated with better readmission rates.

#### *Control Variables*

We control for registered nurses per 100 inpatient days ratio, critical access designation, Medicare share

**TABLE 1.** Summary Statistics

| Variable | Value | Data Source |
|---|---|---|
| 30-day all-cause readmissions, median (IQR) | 15.8% (15.2%–16.5%) | Centers for Medicare and Medicaid Services |
| Hospitalists per general medicine and surgical beds, median (IQR) | 0.09 (0.06–0.15) | American Hospital Association |
| RNs per 100 inpatient days, median (IQR) | 0.84 (0.66–10.10) | American Hospital Association |
| Medicare admissions, median (IQR) | 48.45% (40.84%–55.14%) | American Hospital Association |
| Medicaid admissions, median (IQR) | 16.45% (11.06%–22.76%) | American Hospital Association |
| Competition, median (IQR) | 0.56 (0.23–0.83) | American Hospital Association |
| Unemployment, median (IQR) | 2.9% (2.54%–3.37%) | Area Resource File |
| Fully integrated | | American Hospital Association |
| Yes | 51% | |
| No | 49% | |
| Physician ownership | | American Hospital Association |
| Physician partial or complete ownership | 5% | |
| No physician ownership | 95% | |
| Established medical home program | | American Hospital Association |
| Yes | 29% | |
| No | 71% | |
| High technology | | American Hospital Association |
| Yes | 40% | |
| No | 60% | |
| Teaching level | | American Hospital Association |
| Nonteaching | 70% | |
| Minor teaching | 23% | |
| Major teaching | 7% | |
| Size | | American Hospital Association |
| Small | 31% | |
| Medium | 34% | |
| Large | 35% | |
| Ownership | | American Hospital Association |
| For profit | 14% | |
| Not for profit | 86% | |
| Critical access hospital | | American Hospital Association |
| Yes | 11% | |
| No | 89% | |
| System membership | | American Hospital Association |
| Yes | 73% | |
| No | 27% | |

NOTE: **Abbreviations:** IQR, interquartile range; RNs, registered nurses.

of hospital admissions, Medicaid share of hospital admissions, teaching status, size, and technology level. Previous research indicates that these variables are associated with patient outcomes.[20,21] We follow the Aiken et al. characterization of teaching status: hospitals with no residency programs (nonteaching), hospitals with a resident-to-bed ratio of 1 to 4 or less (minor teaching), and hospitals with a resident-to-bed ratio of more than 1 to 4 (major teaching).[20] We also classify hospitals as small if they have less than 100 beds, medium if they have 101 to 250 beds, and large if they have more than 250 beds. We modify the Aiken et al. classification of technology level and control for the level of technology adopted at a hospital by classifying hospitals as high technology if they offer any of the following services: any major organ transplant, computer-assisted orthopedic surgery, or electron beam computed tomography.[21] We also control for 2 market level variables: (1) competition estimated by the county level Herfindahl-Hirschman Index (HHI) and (2) the percentage of individuals in the county who are unemployed. Unemployment rates are derived from the Area Health Resource File (2013). HHI is calculated by summing the squares of market shares of admissions. For ease of interpretation, competition is coded as 1-HHI.

### Statistical Analysis

We ran a multivariate ordinary least squares (OLS) regression on Stata 12 (StataCorp, College Station, TX) to assess the relationship between 30-day all-cause readmissions and hospitalist staffing levels, physician integration, physician ownership, and other organizational characteristics. We checked for multicollinearity by using a variance inflation factor (VIF). The VIF of all independent variables was less than 10, and therefore multicollinearity was not of concern to this analysis.

## RESULTS

Among our sample of 1756 hospitals, the median 30-day all-cause readmission rate was 16%, with the

**TABLE 2.** Comparisons Between Readmission Rates: *t* Tests and Analysis of Variance

| Variable | Readmission Rates | *P* Value |
|---|---|---|
| Hospitalist staffing levels | | |
| Low | 16.06% | 0.00 |
| High | 15.72% | |
| Physician ownership | | |
| Fully or partially physician-owned hospitals | 15.46% | 0.00 |
| Non–physician-owned hospitals | 15.9 % | |
| Physician integration | | |
| Fully integrated hospitals | 15.86% | 0.00 |
| Nonintegrated hospitals | 15.93% | |
| Teaching status | | |
| Nonteaching hospitals | 15.83% | 0.00 |
| Minor teaching hospitals | 15.76% | |
| Major teaching hospitals | 16.9% | |

**TABLE 3.** Regression Results: Organizational and Environmental Predictors of Hospital Readmissions

| Variable | Coefficient | Standard Error | *P* Value |
|---|---|---|---|
| Hospitalists per general and surgical beds | −0.77 | 0.172 | 0.00 |
| Full integration | −0.086 | 0.049 | 0.08 |
| Physician ownership | −0.355 | 0.119 | 0.00 |
| RNs per 100 inpatient days | −0.174 | 0.050 | 0.00 |
| Established medical home program | −0.132 | 0.057 | 0.02 |
| Medicare admissions | 0.063 | 0.002 | 0.21 |
| Medicaid admissions | 0.015 | 0.003 | 0.00 |
| Competition | 0.115 | 0.08 | 0.17 |
| Unemployment | 0.244 | 0.037 | 0.00 |
| System membership | −0.041 | 0.055 | 0.45 |
| Teaching level | | | |
| Minor teaching | 0.007 | 0.066 | 0.92 |
| Major teaching | 1.032 | 0.106 | 0.00 |
| Size | | | |
| Medium | 0.032 | 0.071 | 0.66 |
| Large | −0.066 | 0.085 | 0.44 |
| For-profit ownership | 0.206 | 0.078 | 0.01 |
| High technology | −0.077 | 0.055 | 0.17 |
| Critical access hospital | 0.202 | 0.092 | 0.03 |

NOTE: Adjusted $R^2$ = 16, $F$ = 20.62, $P$ = 0.00. **Abbreviations:** RNs, registered nurses.

middle 50% of hospitals with readmission rates between 15.2% and 16.5%. All of the hospitals in this study reported that hospitalists provide care at the hospitals. The median Medicare share of hospital admissions was 48.46%, and the median Medicaid share of hospital admissions was 16.4%. Fifty-one percent of the hospitals in our sample were fully integrated. Fifty percent of hospitals had 9 or fewer hospitalists per 100 general medical and surgical beds. Only 5% of the hospitals had partial or full physician ownership. Twenty-nine percent of hospitals had an established medical home program. Table 1 provides summary statistics and the data sources of all the variables included in the study.

To compare readmission rates, we created a dummy variable that divided the sample into 2 categories: hospitals with low hospitalist staffing levels (hospitalists per general medical and surgical beds is less than the median) and high hospitalist staffing (hospitalists per general medical and surgical bed ratio is more than the median). We then used *t* tests to compare all-cause readmission rates between hospitals with low and high hospitalist staffing levels, physician owned versus non–physician owned, and fully integrated versus not fully integrated. We also used single-factor analysis of variance (ANOVA) to compare readmission rates between nonteaching, minor teaching, and major teaching hospitals. Results are displayed in Table 2. There was a significant difference in the mean readmission rates between hospitals with low hospitalist staffing levels (mean readmission rate = 16.06%) versus high staffing levels (mean readmission rate = 15.72%). The mean readmission rate for physician-owned hospitals was significantly lower than for non–physician-owned hospitals (15.46% vs 15.9%). Also, fully integrated hospitals had a lower readmission rate than hospitals where physicians were not fully integrated (15.93% vs 15.86%). Based on the ANOVA results, there was a significant difference between teaching levels. According to a Tukey honest significant difference post hoc test, there was no significant difference between nonteaching and minor teaching hospitals, but the readmission rate was significantly higher in major teaching hospitals (nonteaching = 15.83%, minor teaching = 15.76%, major teaching = 16.9%).

The OLS regression model was significant and explained 16% of the variability in readmission rates (Table 3). Higher hospitalists staffing levels were associated with lower 30-day all cause readmission rates ($P$ = 0.00). The addition of 1 hospitalist per general and surgical bed was associated with a 0.77 percentage points decrease in adjusted readmission rates. In terms of hospital-physician arrangements, fully integrated hospitals had adjusted 30-day all-cause readmission rates 0.09 percentage points lower than non–fully integrated hospitals ($P$ = 0.08). Physician partial or full ownership was significantly associated with lower readmission rates ($P$ = 0.00); hospitals partially or fully owned by physicians had adjusted readmission rates 0.36 percentage points lower than non–physician-owned hospitals.

Based on the regression analysis, major teaching hospitals on average had adjusted readmission rates 1.03 percentage point higher than nonteaching hospitals ($P$ = 0.000), whereas there was no significant difference between minor and nonteaching hospitals ($P$ > 0.1). As the number of registered nurses (RNs) per 100 inpatient days increased by 1, readmission rates dropped by 0.17 ($P$ = 0.00). Hospitals with higher Medicaid shares of admission had significantly higher readmission rates ($P$ < 0.05). Hospitals located in counties with higher unemployment rates also had higher readmission rates ($P$ = 0.000), whereas market competition had no significant association with

readmissions. For-profit hospitals had adjusted readmission rates 0.21 percentage points higher than not-for-profit hospitals ($P = 0.01$). Finally, hospitals that have adopted a medical home model had significantly lower readmission rates ($P = 0.02$); hospitals with an established medical home model had adjusted readmission rates 0.17 percentage points lower than their counterparts.

## DISCUSSION

In the era of VBP and mounting pressures on hospitals to improve quality and lower cost, it is important to understand the association between modifiable hospital characteristics, such as hospitalist staffing levels, and unmodifiable characteristics, such as teaching status and size, with quality of care. There are many factors that can contribute to higher readmission rates. Some of these factors are hospital related and others are patient related, such as the environment in which a patient resides. Benbassat and Taragin argue that 9% to 48% of hospital readmissions are avoidable and are related to factors such as inadequate resolution of the problem the patient was admitted for and poor discharge care.[22] In this article, we have focused on hospital and market factors. Our main variables of interest were hospitalist staffing level, physician full integration, physician ownership, and the adoption of the medical home model at the hospital. Moreover, we examined the association between the hospital environment, specifically, market competition, and the patient environment, specifically, unemployment rates, with readmission rates.

Hospitalists' provision of inpatient care has been on the rise. From 1997 to 2006, the likelihood of receiving inpatient care from a hospitalist grew by 29.2% per year.[23] Based on AHA (2013) data, 65% of hospitals reported that hospitalists provided care at the hospital. The main driver behind the adoption of the hospitalists' model is the positive role hospitalists play in improving hospital efficiency and their familiarity and specialization in hospital care.[24] However, concerns exist that hospitalists might negatively influence patient outcomes given the discontinuity of care that occurs once the patient is discharged from the hospital and back to the care of their primary care physician.[25] Based on our analysis though, higher hospitalist staffing levels were associated with lower readmission rates. Therefore, to better understand the relationship between hospitalists and quality, it is important to account for staffing levels, not merely whether hospitalists provide care at the hospital or not. Higher patient load per hospitalist might still improve hospital efficiency by lowering costs, but is it likely to impede the quality of care provided by hospitalists. This is not surprising given similar findings, including in this article, which document a similar positive relationship between nursing staffing levels and quality.

Hospitals utilize various arrangements with physicians that range from employment to more relaxed arrangements such as physicians with privileges who are neither employed by the hospital nor under individual or group contracts. Historically, the main incentive for hospitals to integrate physicians was referrals to hospital services and specialties.[16,26] The Affordable Care Act, however, provided further incentives, such as ease of care coordination, physicians' involvement, and commitment to quality improvement and cost-containment efforts. Based on this study, hospitals that were classified as fully integrated had lower readmission rates. Also, hospitals partially or fully owned by physicians had better readmission rates. These findings indicate that hospital-physician arrangements play a significant role not only in influencing efficiency and market share but also patient outcomes. Physician integration and physician ownership align physicians' financial incentives with those of the hospital. For instance, given the recent changes in reimbursement and the shift toward VBP, physician income in physician-owned hospitals is at risk if the hospital has poor patient outcomes.

Other significant predictors of readmission rates included the adoption of the medical home model and RN staffing levels. Hospitals that adopted a medical home model and had a higher registered nurse-to-inpatient days ratio had significantly better readmission rates. The finding on the adoption of the medical home model is especially important. Previous research indicates that patient-centered medical homes are associated with lower emergency room visits but not necessarily lower admissions.[27] Our findings indicate that medical homes might play a role in lowering readmission rates, and therefore this outcome needs to be included in studies examining the performance of medical homes. Critical access hospitals and those with higher admissions share of Medicaid patients had worst readmission rates. Finally, hospitals located in counties with higher unemployment rates also had the worst readmission rates. This finding is not surprising and is consistent with previous research, which indicates that the patients' environment and social risk factors play a significant role.

This article contributes to our understanding of readmission rates despite its several limitations, which include the measurement of hospitalist staffing levels based on general medical and surgical beds rather than general medicine admissions. Moreover, some hospitals had missing data on key variables, which warranted their exclusion from this study. In conclusion, many structural, operational and market-level factors influence all-cause readmission rates. However, some of these variables are modifiable and can thus be adjusted by a hospital to improve readmission rates. These variables include hospitalists and registered nurse staffing levels; physician integration

through the salaried, equity, or foundation model; and the adoption of a medical home model.

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