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Higher Hospital Spending on Occupational Therapy Is Associated With Lower Readmission Rates

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Abstract

Hospital executives are under continual pressure to control spending and improve quality. While prior studies have focused on the relationship between overall hospital spending and quality, the relationship between spending on specific services and quality has received minimal attention. The literature thus provides executives limited guidance regarding how they should allocate scarce resources. Using Medicare claims and cost report data, we examined the association between hospital spending for specific services and 30-day readmission rates for heart failure, pneumonia, and acute myocardial infarction. We found that occupational therapy is the only spending category where additional spending has a statistically significant association with lower readmission rates for all three medical conditions. One possible explanation is that occupational therapy places a unique and immediate focus on patients' functional and social needs, which can be important drivers of readmission if left unaddressed.

Keywords

hospital spending, quality, readmissions, hospital management, occupational therapy

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Introduction

As public and private insurers place greater attention on value-based purchasing, hospital chief executive officers (CEOs) are under increasing pressure to improve quality. While CEOs do not directly deliver care, they have significant discretion over resource allocation within a hospital. The relationship between hospital spending and quality, however, is poorly understood in the literature; most studies have focused on aggregate spending without addressing how spending for specific services relates to quality (Hussey, Wertheimer, & Mehrotra, 2013). Hospital CEOs, therefore, face challenges making informed resource allocation decisions that can improve their hospital's performance on quality metrics.

This study aims to provide information that hospital executives can use to make efficient resource allocation decisions. We investigated the association between hospital spending per Medicare patient for different categories of services and three clinical outcomes: 30-day readmission rates for heart failure (HF), pneumonia (PN), and acute myocardial infarction (AMI). We used these outcome measures because they are included in Medicare's Hospital Readmissions Reduction Program (HRRP; Gilman et al., 2015). HRRP is a quality-based payment program, where hospitals are at risk for up to 3% of their Medicare Diagnosis-Related Group (DRG) payments if their readmission rates for these medical conditions are higher than what would be expected given the characteristics of their patient population (Gilman et al., 2015). HRRP, therefore, provides financial incentives for hospitals to take actions that would lower readmission rates for these three conditions. Our most important finding is that occupational therapy (OT) is the only category where higher spending has a statistically significant association with lower readmission rates for all three medical conditions.

Background

Prior Research

After conducting a systematic review, Hussey et al. (2013) concluded that there is inconsistent evidence regarding the direction and magnitude of the association between health care spending and quality. They noted that the studies they reviewed used only aggregate spending measures and none of the studies examined the association between specific types of spending and quality. This gap in the literature has been recognized by several other studies, leading to the suggestion that greater attention should be paid to specific categories of spending that can improve care quality (Silber, Kaestner, Even-Shoshan, Wang, & Bressler, 2010; Weinstein & Skinner, 2010).

Several recent studies suggest a positive link between hospital overall spending and care quality. Joynt, Orav, and Jha (2011) documented that high-volume hospitals had higher costs but lower readmission rates for patients with congestive HF. Stukel et al. (2012) suggested a positive association between hospital spending intensity and care quality, as measured by mortality, readmissions, and cardiac event rates. Jha, Orav, and Epstein (2011) found that high-cost hospitals provided better care and obtained greater

patient satisfaction than low-cost hospitals. Using data from California hospitals between 1999 and 2008, Romley, Jena, and Goldman (2011) concluded that higher spending was associated lower mortality for six common medical conditions. Silber, Kaestner, et al. (2010) found that hospitals with more aggressive resource use had lower odds of mortality for surgical patients. Romley, Chen, Goldman, and Williams (2014) found that greater hospital spending is associated with lower mortality for children undergoing congenital heart disease surgery.

New Contributions

Prior studies on the relation between hospital spending and care quality have focused on aggregate spending at the hospital level. Our study examines the effect of additional hospital spending for specific services. This more granular focus can be of significant value to hospital CEOs making budgetary decisions with a fixed level of aggregate spending. Policy makers, designing value-based purchasing programs, can also use it to guide the development of payment reforms, especially those involving bundled payments and postacute care.

Conceptual Framework

The conceptual framework for our study, illustrated in Figure 1, begins with the model put forth by Donabedian (1988), which posits causal linkages among the structural characteristics of health care settings, processes, and outcomes. Motivated by considerable research on the predictors of and strategies to improve various clinical outcomes, we augment the Donabedian (1988) model by including clinical and social determinants of health, as conceptualized by Calvillo-King et al. (2013).

A number of studies have examined the link between the skill of physicians or nurses and quality of care (Currie, Harvey, West, McKenna, & Keeney, 2005; Tourangeau, Cranley, & Jeffs, 2006). However, it can be difficult to improve this aspect of care by simply altering resource allocation. Other areas of care can be more easily improved by resource allocation decisions. For example, clinical interventions focused on medication reconciliation, discharge planning, care transitions, patient education, and postdischarge care have been demonstrated to reduce readmissions (Bradley et al., 2013; Dharmarajan & Krumholz, 2014; Horwitz et al., 2015; Kripalani, Theobald, Anctil, & Vasilevskis, 2014).

It has also been suggested that social factors, such as socioeconomic status, living situation, home resources, and social support, are associated with readmission risk (Calvillo-King et al., 2013). There is also increasing recognition of a period of vulnerability to a variety of adverse health events following hospitalization, deemed "post-hospital syndrome" by Krumholz (2013). During this period, significant impairments in patient functional status, caused by allostatic stress from hospitalization, may contribute to readmissions. Therefore, inpatient interventions that can address deficits in social resources and patient functional ability following the hospital discharge may be particularly effective in lowering readmissions.

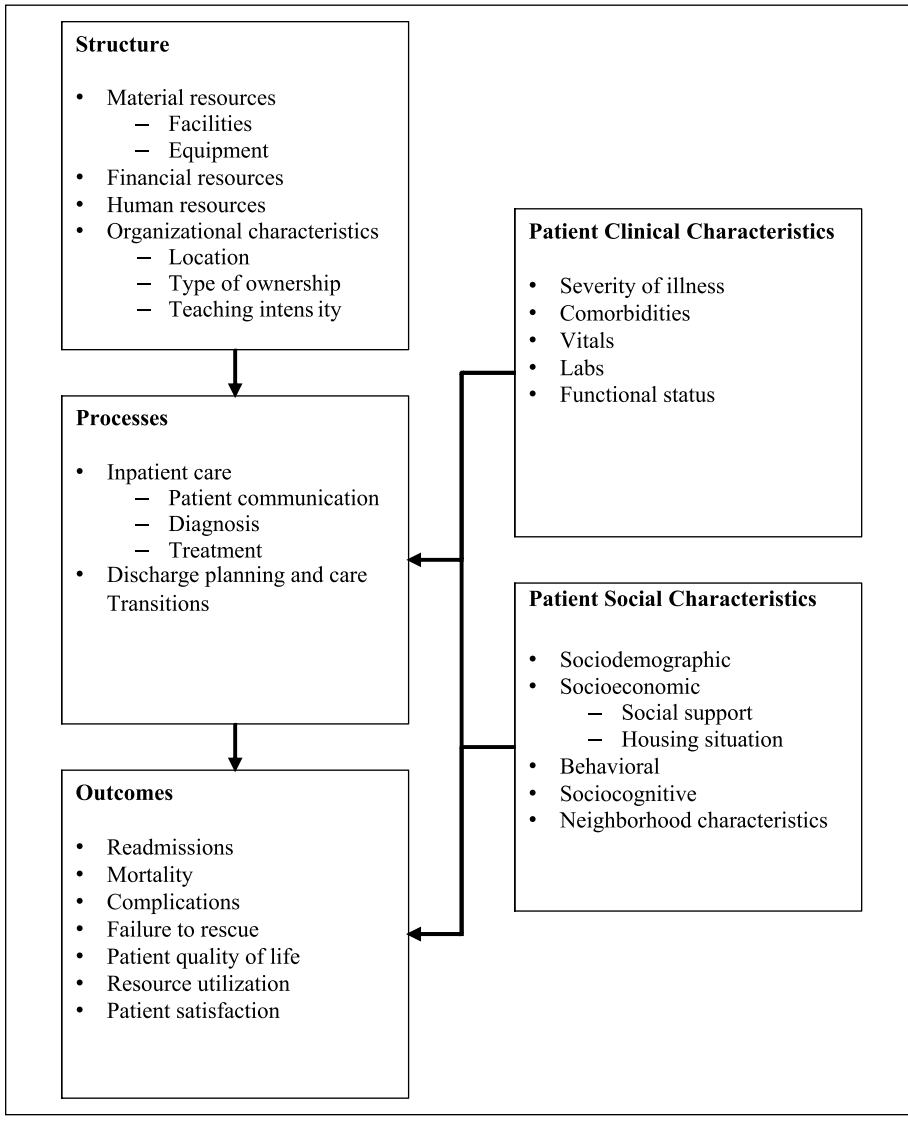

Figure 1. Conceptual framework.

Using the literature regarding the clinical and social determinants of health as a guide, we hypothesize that the association between hospital spending in individual service categories and readmissions will vary depending on the specific service and medical condition being assessed. We expect spending categories that play an important role in discharge planning or addressing patients' social and functional needs to be associated with lower readmission rates. We also expect strong associations for service

categories closely related to the clinical outcome (e.g., cardiology spending more strongly associated with AMI readmission rates than with PN readmissions rates). Our ultimate objective is to identify specific spending categories where higher spending has the potential to reduce readmissions across the three clinical conditions.

One spending category that affects both the clinical and social determinants of health but has received relatively little attention is occupational therapy (OT). The geriatric population is particularly vulnerable to the effects of immobility associated with acute hospitalization, since the debilitated elderly already have lower physiologic reserves (Segal, Pedersen, Freeman, & Fast, 2008). Consequently, they are more prone to a decline in muscle mass, bone density, and cardiopulmonary function. They are also more prone to venous thromboembolism, pressure sores, depression, and confusion. By focusing on patient immobility and its consequences, OT may play an important role in reducing readmissions. In addition, OT may be in a better position than many other spending categories to recognize deficits in self-care and function that might lead to a readmission, such as problems related to meal preparation, access to medications, bathroom access, toileting, and the need for nursing aides or family education. Occupational therapists can recommend alternative discharge plans that address these deficits and thus reduce the likelihood of readmissions. Collectively, we expect that higher OT spending is associated with lower readmission rates.

Method

Data and Measurement

Three hospital-level outcomes were obtained from CMS Hospital Compare: 30-day risk-standardized readmission rates following admission for HF, PN, and AMI. 30-day readmission rates for HF, PN, and AMI patients are used in the Medicare program to encourage hospitals to provide high-quality care (Keenan et al., 2008; Krumholz et al., 2011; Lindenauer et al., 2011). These measures were calculated using Medicare claims and enrolment data from 2009 to 2012. CMS risk adjusts for patient age, sex, and over 20 types of comorbidities and indicators of patient frailty using a methodology endorsed by the National Quality Forum (Keenan et al., 2008; Krumholz et al., 2011; Lindenauer et al., 2011).

We used the 2009 Medicare Provider Analysis and Review (MedPAR) 100% files to identify patients with principal diagnoses of HF, PN, or AMI and the hospital charge for each spending category associated with their care. The measurement period for hospital charges (2009) precedes the measurement period we used for quality outcomes (2009-2012) because hospitals make resource allocation decisions based on what they intend to accomplish and there is usually a time lag between spending and outcome.

We replicated the patient cohort inclusion and exclusion criteria used by CMS (Keenan et al., 2008; Krumholz et al., 2011; Lindenauer et al., 2011) to the extent possible, but faced certain data limitations. Specifically, we included patients (a) enrolled in Medicare fee-for-service; (b) aged 65 years or older; (c) discharged from nonfederal

acute care hospitals; and (d) with a principal discharge diagnosis of HF (International Classification of Diseases, Ninth Revision [ICD-9] codes 402.x1, 404.x1, 404.x3, and 428.0-428.9), PN (ICD-9 codes 480-486, 487.0, and 488.11), or AMI (ICD-9 codes 410.x0 and 410.x1). Consistent with CMS measure specifications, we then excluded admissions for patients (a) with an in-hospital death, since they are not eligible for readmission; (b) discharged alive on the day of admission or the following day who were not transferred, because it is unlikely they had a clinically significant diagnosis of HF, PN, or AMI; (c) transferred to another hospital, since CMS attributes the readmission to the hospital that ultimately discharges the patient to a nonacute care setting (i.e., the admissions at transferring hospitals are excluded but the admissions at the final discharging hospitals are kept); (d) with inconsistent or unknown vital status or other unreliable data; and (e) discharged against medical advice.

The CMS measure specifications we were unable to apply due to data limitations include (a) restricting admissions only to patients who have been enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission and (b) restricting admissions only to patients with at least 30 days postdischarge enrolment in fee-for-service Medicare. However, these two criteria, meant to allow for valid measurement and risk adjustment of outcomes by CMS, were not critical for our purposes. We also did not include Veterans Health Administration (VA) beneficiaries at VA hospitals, which CMS does. After applying all these criteria, we arrived at the final index patient cohorts for each of the outcome measures.

The MedPAR files contain charges for the following spending categories: accommodations (e.g., room and board, nursing, and room upkeep), other services,[1] pharmacy, medical/surgical supplies, new durable medical equipment (DME), used DME, physical therapy, OT, speech pathology, inhalation therapy, blood, blood administration, operating room, lithotripsy, cardiology, anesthesia, laboratory, radiology, MRI, outpatient service, emergency room, ambulance, professional fees, organ acquisition, end-stage renal disease (dialysis), and clinic visit. For this analysis, we combined blood and blood administration into one variable, "blood," as well as radiology and MRI into one variable, "radiology." We consolidated new DME, used DME, lithotripsy, ambulance, professional fees, and organ acquisition into one variable, "other," since over 99% of hospitals had $0 charges for each of these variables. Ultimately, we used 19 distinct spending categories.

In order to estimate category-level spending, we first calculated the average category-level charges for patients with HF, PN, or AMI for each hospital; we then converted charges to costs by applying each hospital's overall cost-to-charge ratio, obtained from the CMS Hospital Cost Reports (HCR). To adjust for patient severity and local market conditions, we divided costs by a hospital-level, condition-specific case mix index and the Medicare wage index, an approach consistent with the health care finance literature (Bai, 2016; Bai & Anderson, 2016; Gapenski, 1999). We constructed the condition-specific case mix indices by summing the Medicare Severity Diagnosis-Related Group (MS-DRG) relative weights associated with each HF, PN, or AMI inpatient stay at a given hospital and dividing by the total number of associated HF, PN, or AMI stays. MS-DRG relative weights were obtained from the hospital

inpatient prospective payment system final rule for fiscal year 2009 (FY 2009 Final Rule Historical DRG Weight File; Centers for Medicare & Medicaid Services, 2009) and linked with patient-level DRGs provided by the 2009 MedPAR data.

Statistical Analysis

To explore the associations between spending category and readmissions, we performed three multivariable regressions at the hospital level. The dependent variables were the readmission rates for three conditions—HF, PN, and AMI. The independent variables included the estimated costs for the aforementioned 19 spending categories. Recognizing that structural features, such as hospital ownership, teaching intensity, and patient volume, may have an important influence on outcomes (Figure 1), we included in the models the following control variables obtained from the HCR: ownership (for-profit, nonprofit, public), location (rural, urban), teaching intensity (resident-to-bed ratio), and hospital eligibility for disproportionate-share hospital payments (DSH). We also controlled for patient volume for each condition, obtained from MedPAR, and the median household income of the county where each hospital is located, obtained from the U.S. Census Small Area Income and Poverty Estimates (U.S. Census Bureau, 2011).

As a sensitivity analysis, we applied the same regression models using category-level cost quartiles, instead of the absolute cost amount, as independent variables. This approach allowed us to examine how outcomes varied across quartiles of category-level spending without the assumption of a linear relationship between spending and outcomes (Jha, Orav, Dobson, Book, & Epstein, 2009). In a supplementary test, we evaluated how hospitals characteristics are associated with spending categories. We conducted all analyses using SAS 9.4.

Results

The final index patient cohorts for the HF, PN, and AMI readmission analyses totaled 538,056, 461,268, and 194,927 discharges, respectively. After aggregating to the hospital-level; merging with the HCR and Hospital Compare data; eliminating hospitals with less than 25 patients in the final index cohort (as CMS Hospital Compare does to ensure measure reliability); eliminating hospitals with extreme outlier charge-to-cost ratios (<0.2); and eliminating hospitals with missing data from either the HCR, Hospital Compare, or the Census files, we obtained the final sample that consists of 2,761 hospitals for the HF analysis, 2,818 hospitals for the PN analysis, and 1,595 hospitals for the AMI analysis.

Table 1 reports descriptive statistics of hospitals in the sample. Hospital structural characteristics were similar across the three medical conditions. Over half of hospitals in each medical condition had between 100 and 399 beds, were nonprofit, were urban, and received disproportionate-share hospital payments. Table 1 also reports the mean values and standard deviations for the risk-standardized readmission rates, the final index patient cohort, and the county median household income for each condition.

Table 1. Hospital Characteristics by Outcome Analysis.

	HF readmissions (*N* = 2,761)		PN readmissions (*N* = 2,818)		AMI readmissions (*N* = 1,595)	
Hospital characteristics	Number	%	Number	%	Number	%
Bed size						
Small (<100)	788	29	860	31	93	6
Medium (100-399)	1,601	58	1,589	56	1,144	72
Large (≥400)	372	13	369	13	358	22
Ownership						
Public	415	15	440	16	171	11
Nonprofit	1,763	64	1,786	63	1,133	71
For-profit	583	21	592	21	291	18
Location						
Urban	2,027	73	2,039	72	1,393	87
Rural	734	27	779	28	202	13
DSH payment eligibility						
Yes	2,379	86	2,423	86	1,357	85
No	382	14	395	14	238	15
Other characteristics	Mean	*SD*	Mean	*SD*	Mean	*SD*
Readmission rate (%)	23.12	1.94	17.72	1.5	18.30	1.31
Resident-to-bed ratio	0.08	0.19	0.07	0.18	0.11	0.21
Final index patient cohort	160	137	119	82	105	84
County median household income ($)	48,910	13,198	48,772	13,186	51,126	13,105

Note. HF = heart failure; PN = pneumonia; AMI = acute myocardial infarction; DSH = disproportionate-share hospital.

Table 2 displays the average estimated spending by category, the corresponding percentage of average total spending, and the proportion of patients with a charge in each spending category. Accommodations was the largest spending category for all conditions. The percentage of total spending for other categories varied across conditions. For example, spending on cardiology comprised nearly the same percentage of total spending (21.5%) as accommodations (22.4%) for AMI, but was much lower for HF or PN.

Table 3 summarizes the regression results for the associations between category-level spending and readmissions. OT was the only category where spending had a statistically significant negative association with all three readmission measures. For HF, PN, and AMI, 26%, 29%, and 21% of patients received OT services in our sample. These relatively low percentages of patients receiving OT services suggests that encouraging OT services for more patients might be a feasible approach to realize any beneficial effects of OT on readmissions. Following OT, spending on emergency room and cardiology services had the second most consistent statistically significant negative association with readmissions, but the results were not statistically significant for all three outcome measures.

Hospital characteristics also varied in their directionality and magnitude of associations with readmission rates. For-profit status, resident-to-bed ratio, and patient volume had consistent and statistically significant positive associations with readmission rates. Median household income had a negative association with readmission rates for PN but not for the other two conditions.

As a sensitivity analysis, we reestimated the models with category-level spending quartiles. The direction and statistical significance of estimated coefficients were similar to those presented in Table 3 (results available in online supplementary material at http://mcr.sagepub.com/content/by/supplemental-data). We also conducted a supplementary test to understand how hospital category-level spending is associated with hospitals characteristics, which are included as control variables in the main and sensitivity analyses. We regressed the average estimated hospital total and category-level spending on hospital characteristics for each of the three medical conditions (results available in online supplementary material). There are two findings that are consistent among all medical conditions and echo results from previous reports (Kaiser Family Foundation, 2014; Newhouse, 2003). First, for-profit hospitals spent less in total and in many categories than nonprofit and government hospitals. Second, hospital teaching intensity is positively associated with total spending.

Discussion and Conclusions

We found that OT is the only service category where there is a statistically significant relationship between increased spending and lower readmission rates across all three medical conditions. Hospital CEOs may have the ability to increase spending on OT, because the average spending on OT per patient across hospitals is relatively low ($12-$20) and the vast majority of patients did not receive OT services (72%-79%).

Table 2. Average per Patient Risk-Adjusted Costs by Outcome Analysis.

	HF readmissions (*N* = 2,761)			PN readmissions (*N* = 2,818)			AMI readmissions (*N* = 1,595)		
Costs	Mean ($)	Percentage of total costs	Percentage of patients with the charge	Mean ($)	Percentage of total costs	Percentage of patients with the charge	Mean ($)	Percentage of total costs	Percentage of patients with the charge
Total costs	5769.0	—	—	6040.9	—	—	6496.7	—	—
Accommodations	1764.8	30.6	100.0	1782.2	29.5	100.0	1457.6	22.4	100.0
Lab	941.1	16.3	96.2	908.2	15.0	94.1	692.0	10.7	98.4
Pharmacy	712.9	12.4	98.5	1,172.9	19.4	98.3	756.7	11.6	99.2
Medical/surgical supplies	579.2	10.0	81.0	402.0	6.7	81.9	1008.2	15.5	91.7
Cardiology	485.7	8.4	85.8	194.0	3.2	66.9	1399.7	21.5	95.8
Radiology	387.2	6.7	89.7	501.2	8.3	87.3	285.0	4.4	88.3
Inhalation therapy	285.0	4.9	63.1	515.6	8.5	75.1	178.9	2.8	54.8
Emergency room	237.2	4.1	68.0	255.0	4.2	64.2	153.2	2.4	66.7
Operating room	112.3	1.9	11.8	65.0	1.1	9.7	319.5	4.9	27.7
Other services	84.5	1.5	36.1	64.9	1.1	26.4	69.0	1.1	44.6
Physical therapy	62.8	1.1	51.2	68.1	1.1	52.0	33.5	0.5	42.1
Blood	38.1	0.7	11.0	40.1	0.7	10.0	58.7	0.9	22.0
ESRD (dialysis)	37.0	0.6	4.7	23.5	0.4	2.5	23.6	0.4	3.7
Occupational therapy	19.4	0.3	26.4	21.2	0.4	28.5	12.1	0.2	21.1
Anesthesia	9.7	0.2	3.9	6.7	0.1	2.7	38.6	0.6	13.4
Speech pathology	7.4	0.1	8.2	17.4	0.3	16.3	7.8	0.1	8.9
Outpatient services	1.9	0.0	0.4	1.7	0.0	0.4	1.9	0.0	0.6
Other	1.8	0.0	0.2	0.4	0.0	0.3	0.2	0.0	0.2
Clinic visit	1.1	0.0	1.8	0.9	0.0	1.4	0.5	0.0	1.6

Note. HF = heart failure; PN = pneumonia; AMI = acute myocardial infarction; ESRD = end-stage renal disease.

Table 3. Associations Between Costs, Hospital Characteristics, and Outcomes.[a]

		HF readmissions (*N* = 2,761)			PN readmissions (*N* = 2,818)			AMI readmissions (*N* = 1,595)		
	Independent variables[b]	Coefficient	*SE*	*p*	Coefficient	*SE*	*p*	Coefficient	*SE*	*p*
Variables with statistically significant negative associations only	Occupational therapy	−0.55	0.177	.0018	−0.36	0.132	.0068	−0.68	0.295	.0217
	Cardiology	−0.11	0.016	<.0001	0.00	0.030	.9480	−0.02	0.005	.0006
	Emergency room	−0.07	0.032	.0296	−0.10	0.024	<.0001	−0.04	0.040	.2908
	Medical/surgical supplies	−0.05	0.010	<.0001	−0.01	0.010	.1518	−0.01	0.007	.0746
	Operating room	−0.06	0.030	.0318	0.03	0.056	.6086	0.00	0.015	.9127
	Other services	−0.03	0.026	.2668	0.03	0.022	.1438	−0.07	0.027	.0099
	Median household income	−0.02	0.032	.4422	−0.08	0.026	.0012	−0.02	0.028	.4592
Variables with statistically significant positive associations only	Accommodations	0.01	0.003	<.0001	0.01	0.003	<.0001	0.01	0.004	.0067
	Inhalation therapy	0.07	0.017	<.0001	0.01	0.010	.1501	−0.01	0.031	.7318
	For-profit	0.56	0.125	<.0001	0.32	0.098	.0012	0.27	0.130	.0414
	Resident-to-bed ratio	1.70	0.227	<.0001	1.10	0.182	<.0001	0.99	0.180	<.0001
	Index patient volume	0.13	0.029	<.0001	0.13	0.036	.0003	−0.03	0.043	.5473
	DSH	0.22	0.106	.0392	0.11	0.083	.1894	−0.01	0.094	.9140
	Rural	0.27	0.096	.0056	−0.04	0.075	.5752	−0.12	0.103	.2310

(continued)

Table 3. (continued)

		HF readmissions (*N* = 2,761)			PN readmissions (*N* = 2,818)			AMI readmissions (*N* = 1,595)		
	Independent variables[b]	Coefficient	*SE*	*p*	Coefficient	*SE*	*p*	Coefficient	*SE*	*p*
Variables with no statistically significant associations	Anesthesia	−0.38	0.292	.1997	0.36	0.329	.2804	0.00	0.082	.9589
	Outpatient services	−0.01	0.178	.9742	0.07	0.266	.7946	0.27	0.226	.2385
	Clinic visit	−0.24	0.566	.6760	−0.88	0.724	.2263	−0.89	1.665	.5933
	Other	0.05	0.214	.8286	0.26	0.303	.3860	−0.44	1.125	.6975
	Pharmacy	0.00	0.012	.8516	−0.01	0.006	.1740	−0.01	0.011	.1854
	ESRD (dialysis)	0.13	0.070	.0608	0.05	0.081	.5353	0.04	0.113	.7106
	Lab	0.02	0.012	.1500	0.00	0.011	.7964	0.00	0.014	.7570
	Radiology	−0.01	0.030	.6772	−0.03	0.020	.1945	0.03	0.029	.3473
	Physical therapy	0.01	0.108	.9260	−0.06	0.079	.4510	0.10	0.202	.6294
	Speech pathology	−0.75	0.458	.1004	0.01	0.182	.9605	0.25	0.460	.5818
	Blood	0.04	0.124	.7694	0.01	0.075	.9112	0.13	0.077	.0962
	Nonprofit	−0.07	0.106	.5203	0.02	0.084	.8194	0.09	0.109	.4287

Note. HF = heart failure; PN = pneumonia; AMI = acute myocardial infarction; *SE* = standard error; DSH = disproportionate-share hospital; ESRD = end-stage renal disease.

[a]Shaded cells indicate statistically significant associations. [b]Coefficients for cost variables represent absolute change in readmission rate per $100 of spending. Coefficient for median household income represents absolute change in readmission rate per $10,000 of income. Coefficient for index patient volume represents absolute change in readmission rate per 100 patients.

Therefore, investing in OT has the potential to improve care quality without significantly increasing overall hospital spending.

OT focuses on a vital issue related to readmission rates—can the patient be discharged safely into her or his environment? If the answer is negative, then occupational therapists can provide a variety of interventions aimed at addressing the social factors and functional deficits that place the patient at increased risk of adverse health events and readmission. For example, the characteristics of patient's social environment outside the hospital, including their living situation and support network, have been shown to affect their risk of readmission for a wide range of clinical conditions, including HF and PN (Calvillo-King et al., 2013).

In addition, the concept of "posthospitalization syndrome" has been used to describe a period of general vulnerability experienced by discharged patients, including loss of strength and mobility, the development of new disabilities, and difficulty in performing activities of daily living (ADL; Dharmarajan et al., 2013; Krumholz, 2013). Inadequately addressed ADL needs are associated with increased readmissions (Arbaje et al., 2008; DePalma et al., 2013). By focusing on the wide range of factors that affect patient health outside of the hospital, OT is well-positioned to address these risk factors for readmissions (Leland, Crum, Phipps, Roberts, & Gage, 2015; Roberts & Robinson, 2014).

We are unaware of any studies that report an association between OT and cardiopulmonary patient readmissions. Two related studies found that hospital readmission rates were strongly associated with low functional status at the time of discharge and that impaired functional status was not adequately treated or routinely assessed for risk of readmission (Hoyer et al., 2013; Hoyer et al., 2014). Forty-five percent of these patients were readmitted for medically related reasons (i.e., cardiac, debility, or medical complexity), and this association was particularly strong for motor function deficits (Hoyer et al., 2013). Many of these patients had longer hospitalizations during their initial acute care admission, suggesting that the length of stay may be associated with further complications and debilitation. The authors concluded that identification and therapeutic treatment of patients at risk for rehospitalization are potentially modifiable factors. Moreover, a study of ischemic stroke patients noted that readmission rates were lower for hospitals that made greater use of OT (Burke, Skolarus, Adelman, Reeves, & Brown, 2014). The authors suggested that OT could be causally related to earlier and more intensive rehabilitation therapies. In another study of acute inpatient poststroke rehabilitation, readmissions were inversely related to the intensity of rehabilitation therapy, and a dose-response relationship was noted (Andrews, Li, & Freburger, 2015).

There are several interventions provided by occupational therapists that could potentially lower readmissions. First, occupational therapists can provide recommendations and training for caregivers that affect both safety and the ability of patients to meet basic needs after discharge. Furthermore, occupational therapists are able to assess the level of supervision and care patients will require after discharge, including the need for health aids. Health literacy has also been shown to be a modifiable risk factor for 30-day readmission rates for AMI (Bailey et al.,

2015). Further research is needed to determine whether the additional individualized and family training provided by an occupational therapist improves these outcomes.

Second, occupational therapists are more often consulted when patients have severe disabilities that affect their ability to safely function independently after discharge. These disabilities include cognitive deficits and mobility problems that affect feeding, bathing, toileting, and dressing. These frail, deconditioned, and sicker patients also require more comprehensive discharge planning to avoid being readmitted. Occupational therapists, who are trained to assess functional needs, are able to determine whether patients can safely live independently, or require further rehabilitation or nursing care (Crennan & MacRae, 2010). Consequently, occupational therapists are able to strongly affect discharge plans, which have been shown to be associated with lower readmission rates (Bradley et al., 2013; Dharmarajan & Krumholz, 2014; Epstein, Jha, & Orav, 2011; Kociol et al., 2012).

Third, occupational therapists can accommodate for existing disabilities by prescribing assistive devices like long-handled reachers, long-handled shoehorns, sock donners, Velcro shoe ties, elevated commode seats, bedside commodes, and special utensils for eating (de Craen, Westendorp, Willems, Buskens, & Gussekloo, 2006). If patients cannot perform ADLs such as going to the bathroom, attending to hygiene, getting dressed, and making a meal, then they are less likely to function safely and independently and more likely to be readmitted (Arbaje et al., 2008; DePalma et al., 2013; Leland et al., 2015; Roberts & Robinson, 2014).

Fourth, occupational therapists can perform home safety assessments as part of the inpatient rehabilitation discharge planning to address potential hazards (like removal of throw rugs or installation of nightlights), suggest safety modifications (like installing grab bars in bathrooms), and ensure essential items are easily within reach (Leland et al., 2015; Roberts & Robinson, 2014). Home assessment performed by occupational therapists has been found to prevent falls (Clemson, Mackenzie, Ballinger, Close, & Cumming, 2008; Johnston, Barras, & Grimmer-Somers, 2010), which are an important cause of readmissions (Hill, Hoffmann, & Haines, 2013; Mahoney et al., 2000).

Fifth, occupational therapists provide cognitive and physical training for patients and assess patients' cognitive abilities and their ability to manipulate objects. Their assistance with medication management has been shown to be an effective component of readmission reduction strategies (Bradley et al., 2013). For example, OT can assess whether patients can open medication containers and manipulate pill boxes. Occupational therapists also focus on improving patients' strength and mobility, which may play an important role in preventing readmissions (Dharmarajan & Krumholz, 2014; Roberts & Robinson, 2014).

Sixth, consulting OT in addition to physical therapy increases the intensity of inpatient rehabilitation therapy. It is likely that greater exposure to rehabilitation will improve strength and function and lead to fewer readmissions (Andrews et al., 2015; Burke et al., 2014). Also, hospitals that offer OT services may have a greater emphasis on rehabilitation and may be more sensitive to the functional needs of their patients, which could potentially translate into fewer readmissions.

In addition to the important roles played by OT, the results for specific diseases warrant attention. For example, spending on cardiology services had a statistically significant negative association with both HF and AMI readmissions. This is consistent with evidence that hospitals that offer more cardiac services, such as care in cardiac intensive care units, cardiac catheterization, or cardiac surgery, have lower HF readmission rates (Joynt & Jha, 2011). Spending on cardiology services had no association with PN readmissions, evidence of the counterfactual. This result suggests that if hospital CEOs want to lower readmission rates for patients discharged with a specific condition, then additional investments in services closely tied to the treatment of those conditions should be considered.

Patient volume, for-profit status, and resident-to-bed ratio had relatively consistent positive associations with readmission rates. These findings are in line with previous evidence that higher volume hospitals, for-profit hospitals, and teaching hospitals tend to have higher readmission rates (Horwitz et al., 2015; Joynt & Jha, 2011; Tsai, Joynt, Orav, Gawande, & Jha, 2013).

Our study has several limitations. First, our findings are specific to HF, PN, and AMI readmissions outcomes in the Medicare population. The impact of OT may not be generalizable to other patient cohorts, conditions, or measures of quality. Second, while we utilized quality measures vetted by the National Quality Forum and approved by CMS for use in its quality-based payment programs, their validity has been subject to criticism (Silber, Rosenbaum, et al., 2010). Nonetheless, we chose to utilize these measures, as they remain highly relevant to policy makers and hospital CEOs given the financial incentives provided by the Medicare program. Third, Hospital Compare's method of risk adjustment and our method of risk-adjusting costs relies on administrative claims data, which may inadequately capture severity of illness and thus bias our findings. Fourth, due to the lack of category-level hospital cost data for patients with specific diagnoses, category-level hospital spending was estimated using reported category-level charges from MedPAR and overall hospital cost-to-charge ratios, which might bring noise to the analysis in the presence of considerable cross-subsidization across hospital departments. While it is possible to calculate cost-to-charge ratios at the department level from the HCR, no standard and validated crosswalk exists between the MedPAR category-level charges and the HCR department-level cost-to-charge ratios. In addition, studies have shown the empirical results are similar when a departmental or an overall cost-to-charge ratio is used, perhaps because hospitals apply similar allocation formulas and cross-subsidization patterns (Lave et al., 1994). Fifth, even after adjustment with the Medicare wage index, differences in costs across hospitals may still include variations in the price of the same inputs, obscuring true differences in resource utilization across hospitals. Finally, because our analysis was based on observational data, we cannot make conclusive statements about causality.

In summary, we found that higher spending on OT is associated with lower readmission rates for all three medical conditions—HF, PN, and AMI. Hospital CEOs seeking to efficiently allocate resources to improve quality of care may wish to consider whether additional investment in OT services is a cost-effective approach to improving patient care and reducing readmissions, since OT has the potential to

lower readmissions across multiple conditions without significantly increasing overall hospital spending. We acknowledge that this analysis is exploratory, and future studies are needed to establish a better understanding of the relationship between OT and readmissions. There are at least four directions for future research to consider. First, similar analyses should be conducted at the patient level to more directly assess the link between the receipt of OT services by individual patients and readmissions. Second, future studies should utilize more detailed clinical data to explore whether different OT services vary in their association with readmissions (e.g., home visits vs. cognitive training sessions) and to identify which types of patients are the best target for increased OT services. Third, causality may be better assessed by studying outcomes at hospitals before and after the addition of OT services. Fourth, assuming the benefits of OT on readmissions withstand scrutiny, cost-effectiveness assessments of investing in OT will be needed to provide guidance for hospital quality improvement efforts.

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Note

1. "Other services" includes charges for the following items as specified by corresponding revenue center codes: special charges, incremental nursing charge, all-inclusive ancillary, free-standing clinic, osteopathic services, skilled nursing, medical social services, home health aide, other visits (home health; under Home Health Prospective Payment System, not allowed as covered charges), oxygen/home health, home IV therapy, hospice services, respite care (home health aide), outpatient special residence charges, cast room, treatment or observation room, preventative care services, telemedicine, behavior health treatment/services, other diagnostic services, medical rehabilitation day program, other therapeutic services, professional fees, and patient convenience items.

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