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Patient race, site of care, and 30-day readmission rates among elderly Americans

Karen E. Joynt, MD, MPH, **E. John Orav, PhD**, and **Ashish K. Jha, MD, MPH**
Department of Health Policy and Management, Harvard School of Public Health (KEJ, AKJ), Division of Cardiovascular Medicine (KEJ) and General Internal Medicine (EJO, AKJ), Brigham and Women's Hospital, and the VA Boston Healthcare System (AKJ), all in Boston, MA

Abstract

Context—Understanding whether and why there are racial disparities in readmissions has implications for efforts to reduce readmissions.

Objective—To determine whether black patients have higher odds of readmission than white patients, and if these disparities are related to where black patients receive care.

Design—Using national Medicare data, we examined 30-day readmissions after hospitalization for acute myocardial infarction (AMI), congestive heart failure (CHF), and pneumonia. We categorized hospitals in the top decile of proportion of black patients as "minority-serving." We determined the odds of readmission for black patients compared with white patients at minority-serving versus non-minority-serving hospitals.

Setting—U.S. hospitals.

Participants—3.1 million Medicare fee-for-service recipients, discharged in 2006–2008.

Intervention—None.

Main Outcome Measure—Risk-adjusted odds of 30-day readmission.

Results—Overall, black patients had higher readmission rates than white patients (24.8% versus 22.6%, odds ratio [OR] 1.13, 95% confidence interval [CI] 1.11 to 1.14, p<0.001); patients from minority-serving hospitals had higher readmission rates than those from non-minority-serving hospitals (25.5% versus 22.0%, OR 1.23, 95% CI 1.20, 1.27, p<0.001). Among AMI patients, using white patients from non-minority-serving hospitals as our reference group (readmission rate 20.9%), we found that black patients from non-minority-serving hospitals had the highest readmission rate (26.4%, OR 1.20, 95% CI 1.16, 1.23), while white patients from minority-serving hospitals had a 24.6% readmission rate (OR 1.23, 95% CI 1.18, 1.29) and black patients from minority-serving hospitals had a 23.3% readmission rate (OR 1.35, 95% CI 1.28, 1.42, p<0.001 for each); patterns were similar for CHF and pneumonia. The results were unchanged after adjusting for hospital characteristics including markers of caring for poor patients.

Conclusions—Among elderly Americans, black patients were more likely to be readmitted after hospitalization for three common conditions, a gap that was related to both race and to the site where care was received.

Introduction

Racial disparities in health care are well documented,[1] and eliminating them remains a national priority.[2] Reducing readmissions have become a policy focus because they

Corresponding author: Karen Joynt, Brigham and Women's Hospital, 75 Francis St., Boston MA 02115. kjoynt@partners.org.

represent an opportunity to simultaneously improve quality and reduce costs, yet we know little about racial disparities in this area. While at least one study has found that in aggregate, across all conditions, black patients have slightly increased odds of readmission,[3] others have found no such effect.[4] We are unaware of prior work on racial disparities in readmission rates at the national level for common medical conditions.

Beyond simply describing whether disparities exist, there is also an increasing urgency to understand why these disparities exist. One possibility is that site of care plays a role. Prior studies have found that care for minorities is highly concentrated: a small number of hospitals provide a disproportionate share of the care for minority patients, and these hospitals appear to have worse performance on processes of care,[5–8] though data on outcomes are mixed.[4, 9, 10] Thus, if black patients have higher readmission rates than white patients, it may be due to these patients seeking care at low-quality hospitals rather than due to race itself.

Understanding whether, and why, black patients have higher readmission rates for common, publicly-reported conditions can help improve the design of interventions that target the most vulnerable patients and hospitals. Therefore, we sought to answer three questions: first, are there disparities in readmission rates between elderly black and white patients admitted for acute myocardial infarction (AMI), congestive heart failure (CHF), or pneumonia? Second, if these disparities exist, are they related primarily to race itself, or primarily to the *site* where care is provided? And finally, if disparities based on the site of care do exist, are they associated with particular structural features of the hospitals that disproportionately care for minorities (such as size or teaching status), or markers of financial stress, such as public ownership or disproportionately caring for the poor?

Methods

Data

We used the Medicare Provider Analysis Review (MedPAR) 100% files to examine all hospitalizations with the primary discharge diagnoses of AMI, CHF, or pneumonia occurring between January 1, 2006 and November 30, 2008 (International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9) codes for AMI 410.xx, excluding 410.x2, for CHF 398.91, 404.x1, 404.x3, 428.0–428.9, and for pneumonia 480–486) for Medicare fee-for-service beneficiaries age 65 or older. Discharges occurring in December 2008 were excluded because we lacked a full 30 days of follow-up. Only patients surviving to discharge were included.

We excluded patients discharged from federal hospitals and those located outside the 50 states and the District of Columbia. Our final sample consisted of 3,163,011 discharges: for AMI, 579,492 discharges from 4,322 hospitals; for CHF, 1,346,768 discharges from 4,560 hospitals; and for pneumonia, 1,236,751 discharges from 4,588 hospitals. Patient race was categorized based on self-report, and, as has been convention in other studies using these data, non-black patients were categorized as white.[11, 12]

We used the 2007 American Hospital Association survey to identify hospitals' size, nurse-to-census ratio, ownership, proportion of hospitalized patients with Medicaid or Medicare, membership in a hospital system, teaching status, location, and census region. Nurse-to-census ratios were calculated by dividing the number of full-time equivalent nurses by 1000 patient-days.[13] We obtained hospitals' Disproportionate Share Index (a marker of caring for the poor) from the Medicare Impact File. We examined, using the Hospital Quality Alliance (HQA) data, each hospital's performance on processes of care during 2007 and assigned a summary score to each hospital for each condition using standard methodology (eTable 1).[14]

Risk-adjusted odds of readmission

Our primary outcome was risk-adjusted odds of all-cause 30-day readmission; the unit of analysis was the patient. We also examined risk-adjusted 30-day readmissions with the same diagnosis as the index admission. Each patient's likelihood of readmission was adjusted using the Elixhauser risk-adjustment scheme, a validated tool developed by the Agency for Healthcare Research and Quality (AHRQ) that was designed to be used with administrative data.[15–17] The Elixhauser approach has been widely used in the field[18–23] and details are provided in the Technical Appendix (text and eTable 2).

Identifying minority-serving hospitals

For each hospital, we calculated the proportion of its Medicare patients that were black, and categorized institutions in the highest decile of proportion of black patients as minority-serving; the other 90% of hospitals were categorized as non-minority-serving. In sensitivity analyses, we examined alternative cut-points including the highest quartile and highest 5%; the results were similar, and we therefore only present results using the highest decile as the cut-point.

Analysis

We compared the characteristics of black versus white patients for each condition and the characteristics of minority versus non-minority-serving hospitals using Wilcoxon tests for continuous data and chi-square tests for categorical data. For our primary outcome, risk-adjusted odds of readmission, we created multivariate patient-level logistic regression models; all models included within-hospital clustering. For each condition, we first examined patient race as the primary predictor of readmission, and then site of care (minority-serving vs. non-minority-serving hospital) as the primary predictor; we then added both patient race and site of care to the model to evaluate their relative impact on readmissions. We tested for an interaction between race and site of care for each condition.

We then categorized all patients into four categories that we had defined *a priori:* black patients at minority-serving hospitals, white patients at minority-serving hospitals, black patients at non-minority-serving hospitals, and white patients at non-minority-serving hospitals. We ran logistic regression models using indicator variables to examine the relationship between these groups and odds of readmission, first using only age for risk-adjustment (Model 1), and next using our formal risk-adjustment scheme[15, 16] (Model 2). We added discharge destination (home, nursing or rehabilitation facility, hospice, or other) to our model for each condition, as well as length of stay, to address possible confounding by these factors (Model 3),[24, 25] and then added hospital characteristics including size, system membership, teaching status, ownership, location, and region (Model 4). We then added the proportion of Medicaid patients and each hospital's Disproportionate Share Index,[26, 27] as proxies for the proportion of poor patients a hospital serves (Model 5).[28] Finally, we further adjusted for condition-specific HQA scores.

Sensitivity analyses

We performed a number of sensitivity analyses. We excluded Hispanics, Asian Americans, and other racial/ethnic groups (4.4% of the patient sample). Further, in order to address the concern that black patients are less likely to die in the 30 days following an admission and thus might be more likely to be readmitted based on this fact alone, we performed two related analyses. First, we censored patients who died between discharge and 30 days of follow-up. Next, we used a composite endpoint of all-cause death or readmission in 30 days as our primary outcome. We also added each patient's number of admissions in the prior year and in-hospital procedures into the model.

To account for multiple comparisons, we considered a two-sided p-value of less than 0.008 to be significant. All analyses were performed using SAS (version 9.2, Cary, NC, USA). This study was granted exemption by the Harvard School of Public Health Institutional Review Board.

Results

Characteristics of black and white patients

Of the 3,163,011 discharges in our sample, 276,681 (8.7%) were for black patients and 2,886,330 (91.3%) were for white patients. For each condition, black patients were younger, more often female, and more likely to have diabetes, hypertension, chronic kidney disease, and obesity; black patients were less likely to have chronic pulmonary disease, valvular heart disease, and depression (Table 1). Roughly 40% of black patients and 6% of white patients were cared for at hospitals designated as “minority-serving”. A significantly higher proportion of black patients were Medicaid eligible. Black patients were more likely to be discharged home for CHF, but that was less likely after AMI and pneumonia; black patients were less likely to die between hospital discharge and 30 days of follow-up for CHF, but there was no difference in this outcome for AMI or pneumonia.

Characteristics of minority and non-minority-serving hospitals

At minority-serving hospitals, on average, 37% of patients were black, compared with 1.4% of patients at non-minority-serving hospitals (Table 2). Minority-serving hospitals were more often large, public or for-profit hospitals. Seventy percent of the minority-serving hospitals were located in the south, compared with 35% of the non-minority-serving hospitals. Minority-serving hospitals were more often teaching hospitals, and served a higher proportion of Medicaid patients; they also had a higher Disproportionate Share Index. Minority-serving hospitals had fewer nurses per 1000 patient-days, and had somewhat lower performance on HQA measures (Table 2). Length of stay was greater at minority-serving hospitals for each condition.

Readmissions based on patient race and site of care

Overall, when we considered our entire group of AMI, CHF, and pneumonia patients in a single sample, black patients had 13% higher odds of all-cause 30-day readmission than white patients (odds ratio [OR] 1.13, 95% confidence interval [CI] 1.11 to 1.14, $p<0.001$); patients discharged from minority-serving hospitals had 23% higher odds of readmission than patients from non-minority-serving hospitals (OR 1.23, 95% CI 1.20, 1.27, $p<0.001$). When we examined the conditions separately, and examined patient race and site of care simultaneously, both factors were significantly associated with readmission rates. Among patients with AMI, black patients had 13% higher odds of readmission (OR 1.13, 95% CI 1.10, 1.16, $p<0.001$), irrespective of the site of care, while patients from minority-serving hospitals had 22% higher odds of readmissions (OR 1.22, 95% CI 1.17, 1.27, $p<0.001$), even accounting for patient race. The results for the other two conditions were similar (Table 3). There was no significant interaction between race and site of care (p-values for interaction > 0.10).

Readmissions based on race/site groups

Examining readmissions in our pre-specified groups, we found that white patients at non-minority-serving hospitals consistently had the lowest odds of readmission, and black patients at minority-serving hospitals the highest. For example, among patients with AMI, using white patients at non-minority-serving hospitals as our reference group, black patients at non-minority-serving hospitals (OR 1.20, 95% CI 1.16, 1.23), white patients at minority-serving hospitals (OR 1.23, 95% CI 1.18, 1.29) and black patients at minority-serving

hospitals (OR 1.35, 95% CI 1.28, 1.42) had progressively higher odds of readmission ($p<0.001$ for each). The results for CHF and pneumonia were similar (Table 4). When we further adjusted these analyses for discharge destination, length of stay, and key hospital characteristics, we found comparable results. Further adjusting for markers of caring for the poor had only modest effects, with the exception of CHF, in which the disparity between black and white patients at non-minority-serving hospitals was no longer statistically significant (Table 4). Finally, adjusting for a hospital's HQA score had no impact on readmission rates (data not shown).

Same-cause readmissions

When we examined race, site of care, and same-cause readmissions, we found similar results for both AMI and CHF. Among AMI patients, black patients had 13% higher odds of readmission than white patients (OR 1.13, 95% CI 1.07, 1.20), controlling for site of care, and patients discharged from minority-serving hospitals had 15% higher odds of readmission than patients discharged from non-minority-serving hospitals (OR 1.15, 95% CI 1.06, 1.25), controlling for race. The findings were similar for CHF, but not for pneumonia, where the differences were not statistically significant (eTable 3a). Our four-group analyses were similar as well; among patients with AMI, using white patients at non-minority-serving hospitals as our reference group, black patients at non-minority-serving hospitals (OR 1.13, 95% CI 1.06, 1.21), white patients at minority-serving hospitals (OR 1.15, 95% CI 1.05, 1.25) and black patients at minority-serving hospitals (OR 1.30, 95% CI 1.17, 1.45) all had significantly higher odds of readmission ($p<0.001$ for each). These results were similar for CHF, but were not significant for pneumonia (eTable 3b).

Sensitivity analyses

In sensitivity analyses, we found that excluding Hispanics, Asian-Americans, and other non-white, non-black racial or ethnic groups did not significantly change our results (eTables 4a–b). Excluding patients who died between discharge and 30 days or considering a composite outcome of death or readmission, as well as adding prior hospitalizations and in-hospital procedures to our model, eliminated the disparities in one subgroup: for patients with CHF at non-minority-serving hospitals, there were no racial disparities in readmissions. However, the disparities persisted for patients with CHF at minority-serving hospitals, and for patients with AMI or pneumonia at either type of hospital (eTables 5a–b, 6a–b, and 7a–c).

Discussion

We found that elderly black patients had higher odds of 30-day readmission than white patients for AMI, CHF, and pneumonia. These disparities were related to race itself as well as to the site where care was provided: black patients had a 13% higher odds of readmission than white patients, while patients discharged from minority-serving hospitals had a 23% higher odds of readmission than patients discharged from non-minority-serving hospitals.

Understanding why healthcare disparities exist is the key first step in eliminating them. Persistent racial disparities in health care utilization and outcomes are well-documented,[1] and Healthy People 2010, the federal government's set of published health objectives, includes the elimination of health disparities as an overarching goal.[2] Further, reducing readmissions has become a top priority for policymakers, and to that end, the recently passed Patient Protection and Affordable Care Act (PPACA)[29] authorizes financial penalties for hospitals performing poorly on this measure. However, until now, we have had little information on whether there are disparities in readmission rates and why they might exist.

Despite ongoing interest in understanding disparities, much of the previous work has focused on differential outcomes between racial groups, without taking into account the

systems within which care is delivered. Given that care for black patients is concentrated among a small number of hospitals,[5] understanding how outcomes vary as a function of where patients receive care can help policymakers target interventions. We found that the magnitude of the site of care effect was consistently greater than the magnitude of the race effect, suggesting that racial disparities in readmissions are, at least in part, a systems problem – the hospital at which a patient seeks care appears to be at least as important as his or her race.

It is unclear why patients discharged from hospitals that serve a high proportion of black patients had higher odds of readmission. Adjusting for differences in structural characteristics such as teaching status, size, and ownership had little impact on our primary findings. Similarly, adjusting for the proportion of Medicaid patients and hospitals' Disproportionate Share Index did not explain the differences between hospitals, suggesting that either our measures of financial stress are inadequate, or that the higher readmission rates among these hospitals are due to other factors, such as a failure to prioritize quality or inadequate focus on transitions of care and coordination of care. Several studies have found that interventions beginning in the hospital and focusing on transitional care can reduce readmissions,[30–32] but whether minority-serving hospitals engage in such programs as often or as effectively as non-minority-serving hospitals is unclear.

There are factors beyond hospitals' control that might explain our findings. Chronic medical illness requires close outpatient management, and early outpatient follow-up after hospitalization,[33] as well as disease management and patient education,[34–36] can reduce readmissions among both white and minority populations. It may be that availability of high-quality outpatient care is limited for patients discharged from minority-serving hospitals; these issues should be better understood before we choose to hold hospitals solely accountable for high readmission rates.

Others have examined the role of site of care in determining patient outcomes. For example, black patients may have worse outcomes than white patients following major surgeries,[37, 38] but taking features of the surgeon and hospital into account explains some of those gaps.[38–40] For Medicare patients with AMI, hospitals serving a high proportion of black patients have higher 90-day mortality rates,[41] and for pneumonia, these hospitals are less likely to provide timely antibiotics.[42] Others have found that racial disparities in the quality of medical care, as measured by HQA metrics, may be due, in part, to where minorities and whites receive care.[43, 44]

We are unaware of prior work that has focused on readmissions and site of care. Given that reducing readmissions has the potential to both improve quality and decrease costs, this measure has gained support as an important component of tracking hospital performance. It is critical to understand how recently enacted policies, especially those that penalize hospitals with high readmission rates, might impact disparities in care. Our findings suggest that minority-serving hospitals might be disproportionately affected by such penalties.

Our study has limitations. Because we used administrative data, our risk adjustment may have been limited in its ability to account for variations in severity of illness across racial groups and across hospitals. We lacked data on the specific medications and non-procedural treatments that patients received during their hospitalization and were unable to assess if these were different between black and white patients. Because we lacked data on transitions of care and outpatient care, we could not assess whether our findings were due to inadequacies in these areas. Our sample was limited to Medicare patients; while these patients make up the majority of admissions for CHF, AMI, and pneumonia,[45, 46] whether our findings apply to readmissions for younger patients is unclear. Finally, we could not

assess whether the relationships we found were causal, or rather simply markers of other unmeasured factors that may influence readmission rates.

Conclusions

We found that elderly black patients in the U.S. had higher 30-day readmission rates than white patients for three common medical conditions, and these differences were related, in part, to worse outcomes among hospitals that disproportionately care for black patients. These effects persisted even after accounting for a series of potential confounders including markers of caring for poor patients, suggesting that measured features of hospitals and lower reimbursements alone are unlikely to explain these gaps. Our findings, that racial disparities in readmissions are related to both patient race and the site where care is provided, should spur clinical leaders and policymakers to find ways new ways to reduce disparities in this important health outcome.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Discharge characteristics

		Acute Myocardial Infarction		Congestive Heart Failure		Pneumonia	
		Black (n=42,401)	**White (n=537,091)**	**Black (n=149,758)**	**White (n=1,197,010)**	**Black (n=84,522)**	**White (n=1,152,229)**
Age, years (median, IQR)		76 (70, 83)	78 (71, 84)	76 (70, 83)	81 (74, 86)	77 (71, 84)	80 (73, 86)
Female sex		24,894 (59%)	263,532 (49%)	91,519 (61%)	662,235 (55%)	48,822 (58%)	631,130 (55%)
Comorbidities							
Diabetes without complications		12,530 (30%)	119,344 (22%)	50,954 (34%)	311,741 (26%)	24,196 (29%)	231,498 (20%)
Diabetes with complications		2,704 (6%)	20,184 (4%)	11,730 (8%)	65,701 (5%)	4,598 (5%)	36,092 (3%)
Hypertension		28,044 (66%)	310,656 (58%)	106,340 (71)%	673,720 (56%)	56,488 (67%)	616,288 (53%)
Chronic kidney disease		13,057 (31%)	96,278 (18%)	57,657 (39%)	331,653 (28%)	19,247 (23%)	146,863 (13%)
Chronic pulmonary disease		8,015 (19%)	117,922 (22%)	47,266 (32%)	412,000 (34%)	33,231 (39%)	574,759 (50%)
Valvular heart disease		472 (1%)	7,092 (1%)	2,305 (2%)	25,893 (2%)	3,883 (5%)	85,600 (7%)
Peripheral vascular disease		3,833 (9%)	46,817 (9%)*	10,977 (7%)	86,583 (7%)*	4,585 (5%)	57,456 (5%)
Depression		708 (2%)	17,658 (3%)	3,535 (2%)	55,021 (5%)	3,061 (4%)	84,405 (7%)
Obesity		1,672 (4%)	18,928 (4%)	9,006 (6%)	43,903 (4%)	2,791 (3%)	24,781 (2%)
Other Patient Characteristics							
Medicaid eligible		17,482 (41%)	82,624 (16%)	69,201 (46%)	239,111 (20%)	43,258 (51%)	264,941 (23%)
Discharged from MSH		17,212 (41%)	32,895 (6%)	65,596 (44%)	72,790 (6%)	34,703 (41%)	61,227 (5%)
Length of stay, days (median, IQR)		5 (3, 9)	4 (3, 8)	4 (3, 7)	4 (3, 6)	5 (3, 8)	5 (3, 7)
Died between discharge and 30d†		708 (2%)	17,658 (3%)	4,345 (3%)	60,719 (5%)	4,041 (5%)	59,433 (5%)*
Discharge destination	Home	29,644 (70%)	384,443 (72%)	114,224 (76%)	849,146 (71%)	52,097 (62%)	739,796 (64%)
	SNF/rehab	11,328 (27%)	133,955 (25%)	31,822 (21%)	309,656 (26%)	29,902 (35%)	378,902 (33%)
	Hospice	1,066 (3%)	15,159 (3%)	2,419 (2%)	31,152 (2%)	1,886 (2%)	26,802 (2%)
	Other‡	334 (1%)	3,150 (1%)	1,233 (1%)	6,550 (1%)	585 (1%)	5,929 (1%)

IQR=interquartile range. MSH=minority-serving hospital. SNF=skilled nursing facility.

*=p is nonsignificant. All other p values less than 0.001. P values were generated using chi-square tests for categorical variables, and using Wilcoxon tests for continuous variables.

†=excludes patients who were readmitted prior to dying.

‡=includes psychiatric facilities, specialty hospitals, and unknown.

Table 2

Hospital characteristics

		Minority-serving hospitals (n=472)	Non-minority-serving hospitals (n=4244)	P value
Percentage black patients (median, IQR)		37.3% (30.4, 50.7)	1.4% (0.2, 6.1)	<0.001
Structural Characteristics				
Hospital size (n, %)	Small (0–99 beds)	169 (36%)	2,152 (51%)	<0.001
	Medium (100–399 beds)	216 (46%)	1735 (41%)	
	Large (400+ beds)	87 (18%)	357 (8%)	
Ownership (n, %)	For-profit	102 (22%)	726 (17%)	<0.001
	Nonprofit	221 (47%)	2,541 (60%)	
	Public	149 (32%)	977 (23%)	
Urban location (n, %)		373 (79%)	3158 (74%)	0.03
Region (n, %)	Northeast	46 (10%)	560 (13%)	<0.001
	Midwest	69 (15%)	1,325 (31%)	
	South	334 (71%)	1,486 (35%)	
	West	21 (4%)	870 (21%)	
Hospital system member (n, %)		187 (40%)	1,835 (43%)	0.13
Major teaching hospital (n, %)		82 (17%)	203 (5%)	<0.001
Cardiac catheterization services (n, %)		174 (37%)	1,486 (35%)	0.34
Cardiac surgical services (n, %)		108 (23%)	942 (22%)	0.65
Medical intensive care unit (n, %)		270 (57%)	2,691 (63%)	0.02
Patient Population and Nurse Staffing Levels				
Disproportionate Share Index (median, IQR)*		0.36 (0.27, 0.48)	0.21 (0.14, 0.29)	<0.001
Percentage Medicaid patients (median, IQR)		20% (15, 29)	15% (9, 20)	<0.001
Percentage Medicare patients (median, IQR)		44% (37, 53)	48% (42, 56)	<0.001
Nurses per 1000 patient days (median, IQR)		5.5 (4.2, 7.2)	6.5 (4.7, 9.0)	0.28
Performance on Quality and Cost Measures				
HQA AMI score (median, IQR), 2,073 hospitals reporting		95 (91, 97)	96 (93, 98)	<0.001
HQA CHF score (median, IQR), 3,362 hospitals reporting		87 (79, 92)	88 (80, 94)	0.03
HQA pneumonia score (median, IQR), 3,655 hospitals reporting		89 (84, 93)	92 (88, 95)	<0.001
Length of stay, AMI (median, IQR)		5 (3, 8)	4 (3, 8)	<0.001†
Length of stay, CHF (median, IQR)		4 (3, 7)	4 (3, 6)	<0.001†
Length of stay, pneumonia (median, IQR)		5 (3, 8)	5 (3, 7)	<0.001†

*=excludes Critical Access Hospitals, for which this information is not available.

†=length of stay was longer for minority-serving hospitals for all three conditions.

AMI=acute myocardial infarction; CHF=congestive heart failure; HQA=Hospital Quality Alliance; IQR=interquartile range. P values were generated using chi-square tests for categorical variables, and using Wilcoxon tests for continuous variables.

Table 3

Risk-adjusted odds of 30-day all-cause readmission, by race and site of care

		Acute Myocardial Infarction			Congestive Heart Failure			Pneumonia		
		N	**Readmission Rate**	**Odds Ratio (95% CI)**	**N**	**Readmission Rate**	**Odds Ratio (95% CI)**	**N**	**Readmission Rate**	**Odds Ratio (95% CI)**
Race	**Black**	42,401	24.8%	**1.13** (1.10, 1.16)	149,758	27.9%	**1.04** (1.03, 1.06)	84,522	23.7%	**1.15** (1.12, 1.17)
	White	537,091	22.6%	Reference	1,197,010	27.1%	Reference	1,152,229	21.3%	Reference
Site of care	**Minority-serving hospital**	50,107	25.5%	**1.22** (1.17, 1.27)	138,386	28.8%	**1.14** (1.11, 1.17)	95,930	24.0%	**1.18** (1.14, 1.22)
	Non-minority- serving hospital	529,385	22.0%	**Reference**	1,208,382	26.2%	**Reference**	1,140,821	21.1%	**Reference**

Table displays risk-adjusted odds of all-cause 30-day readmission, in a single model for each condition. Odds of readmission are examined as a function of both race and site of care. P<0.001 for all comparisons.

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Table 4

Risk-adjusted odds of 30-day all-cause readmission, grouped by race and site of care

		N	Readmission rate†	Model 1 Odds Ratio (95% CI)	Model 2 Odds Ratio (95% CI)	Model 3 Odds Ratio (95% CI)	Model 4 Odds Ratio (95% CI)	Model 5 Odds Ratio (95% CI)
AMI	**Black patients, minority-serving hospital**	17,212	26.4%	**1.46** (1.38, 1.54)	**1.35** (1.28, 1.42)	**1.30** (1.24, 1.37)	**1.28** (1.21, 1.35)	**1.22** (1.16, 1.29)
	White patients, minority-serving hospital	32,895	24.6%	**1.22** (1.17, 1.28)	**1.23** (1.18, 1.29)	**1.21** (1.16, 1.26)	**1.18** (1.13, 1.24)	**1.14** (1.09, 1.19)
	Black patients, non-minority-serving hospital	25,189	23.3%	**1.25** (1.21, 1.29)	**1.20** (1.16, 1.23)	**1.12** (1.08, 1.16)	**1.12** (1.08, 1.15)	**1.11** (1.08, 1.15)
	White patients, non-minority-serving hospital	504,196	20.9%	**Reference**	**Reference**	**Reference**	**Reference**	**Reference**
CHF	**Black patients, minority-serving hospital**	65,596	29.0%	**1.20** (1.16, 1.23)	**1.20** (1.16, 1.23)	**1.18** (1.15, 1.21)	**1.15** (1.12, 1.19)	**1.10** (1.06, 1.13)
	White patients, minority-serving hospital	72,790	27.8%	**1.11** (1.08, 1.15)	**1.13** (1.10, 1.17)	**1.12** (1.09, 1.16)	**1.09** (1.06, 1.13)	**1.05** (1.01, 1.08)**
	Black patients, non-minority-serving hospital	84,162	26.1%	**1.06** (1.04, 1.08)	**1.04** (1.02, 1.06)	**1.01** (1.00, 1.04)*	**1.02** (1.00, 1.04)*	**1.02** (1.00, 1.04)*
	White patients, non-minority-serving hospital	1,124,220	25.3%	**Reference**	**Reference**	**Reference**	**Reference**	**Reference**
PNA	**Black patients, minority-serving hospital**	34,703	25.2%	**1.36** (1.31, 1.42)	**1.35** (1.30, 1.41)	**1.30** (1.26, 1.35)	**1.28** (1.23, 1.33)	**1.22** (1.18, 1.28)
	White patients, minority-serving hospital	61,227	22.8%	**1.16** (1.12, 1.21)	**1.18** (1.14, 1.17)	**1.16** (1.11, 1.20)	**1.13** (1.09, 1.18)	**1.09** (1.05, 1.13)
	Black patients, non-minority-serving hospital	49,819	22.8%	**1.19** (1.16, 1.21)	**1.15** (1.12, 1.17)	**1.12** (1.09, 1.14)	**1.13** (1.10, 1.15)	**1.12** (1.09, 1.15)
	White patients, non-minority-serving hospital	1,091,002	20.0%	**Reference**	**Reference**	**Reference**	**Reference**	**Reference**

Model 1 = age alone

Model 2 = Model 1 plus patient comorbidities

Model 3 = Model 2 plus discharge destination (home, nursing home or rehabilitation facility, hospice, or other) and length of stay

Model 4 = Model 3 plus hospital characteristics (size, membership in a system, teaching status, ownership, location, and region)

Model 5 = Model 4 plus percent Medicaid at each hospital and each hospital's Disproportionate Share Index

Table displays risk-adjusted odds of all-cause 30-day readmission, in a single model for each condition. Odds of readmission are examined as a function of both race and site of care, broken into four categories. AMI=acute myocardial infarction; CHF=congestive heart failure; HQA=Hospital Quality Alliance; LOS=length of stay; PNA=pneumonia.

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† =readmission rates are based on Model 2, the fully risk-adjusted model.

* =p value is nonsignificant at the 0.008 level.

** =p<0.008. All other p values <0.001.