HHS Public Access

Author manuscript

Health Aff (Millwood). Author manuscript; available in PMC 2016 March 13.

Published in final edited form as:

Health Aff (Millwood). 2013 June ; 32(6): 1046–1053. doi:10.1377/hlthaff.2011.1365.

Black Patients Are More Likely to Undergo Surgery at Low Quality Hospitals in Segregated Regions

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Abstract

Previous research has shown that, compared to white patients, black patients more frequently undergo surgery at low-quality hospitals. In this paper, we assess the extent to which racial segregation and geographic proximity to low–quality hospitals contributes to this disparity. To determine the role of proximity, we used national Medicare data to measure distances between patient residence and high- and low-quality surgical hospitals. To examine the role of racial segregation, we evaluated the likelihood that blacks living in regions with low, medium, and high degrees of residential segregation would undergo surgery in lower quality hospitals. Despite living closer to higher-quality hospitals, black patients were 25% to 58% more likely to undergo surgery at low-quality hospitals. We found a strong relationship between racial segregation and the likelihood that blacks underwent surgery at low quality hospitals. Policy efforts aimed at helping referring physicians overcome these entrenched referral patterns and programs to improve care at the low quality hospitals are needed.

Racial disparities in outcomes after major surgery are well documented[1–3]. With most procedures, black patients are much more likely to die than are white patients. Although some of the differences in mortality may be explained by patient factors—including illness severity, comorbid conditions, and patient preferences for specific hospitals—there is growing evidence that much of these disparities are explained by blacks receiving care at high mortality hospitals[2,4]. Previous studies in major surgery show that more than half of the black/white disparities in mortality are attributable to differences in hospital quality.

Reasons why black patients disproportionately receive surgical care in lower-quality hospitals are not well understood. Differences in geographic proximity to high quality hospitals may be one factor underlying these disparities[5,6]. In other words, black patients may be more likely to have surgery at low-quality hospitals because they live closer to them. Patient choice and/or entrenched referral patterns may be additional reasons why blacks disproportionately receive surgical care in lower-quality hospitals[2,4]. Separate and unequal referral patterns may be a particular problem in areas with high degrees of racial segregation[7].

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In this context, we sought to understand racial disparities in the use of hospitals for major surgery in the national Medicare population. We first evaluated racial differences in the proportion of patients having surgery in low- and high-quality hospitals, as defined based on a previously validated composite measure for major surgery[8,9]. We then established the extent to which disparities can be explained by geographic proximity. Finally, we explored the impact of racial segregation on the use of low quality hospitals by separately examining health care markets with low, medium, and high degrees of segregation.

Study Data and Methods

Data source and study population

We used data from the Medicare Analysis Provider and Review (MEDPAR) files for 2005–08 to create our main analysis datasets. This dataset contains hospital discharge abstracts for all fee-for-service acute care hospitalizations of US Medicare recipients, which accounts for approximately 70 percent of such admissions in the Medicare population. The Medicare denominator file was used to assess patient vital status at thirty days. The study protocol was approved by the Institutional Review Board at the University of Michigan.

Using appropriate procedure codes from the International Classification of Diseases, version 9 (ICD-9), we identified all patients aged 65–99 undergoing any of three high-risk surgical procedures: coronary artery bypass grafting, abdominal aortic aneurysm repair, and resection for lung cancer[8]. We chose these procedures because they are all common, high-risk, and represent surgical specialties with different groups of referring physicians. To enhance the homogeneity of hospital case mix, we excluded small patient subgroups with much higher baseline risks, including those with procedure codes indicating that other operations were simultaneously performed (e.g., coronary artery bypass and heart valve surgery) or were performed for emergent indications (e.g., ruptured abdominal aortic aneurysm)[10].

Hospital quality measures

To assess hospital quality, we use a previously validated composite measure that optimally predicts procedure-specific mortality[8,9]. These composite measures incorporate all relevant information about hospital quality, including hospital volume, risk-adjusted mortality, and risk-adjusted morbidity, as well as procedure volume and risk-adjusted outcomes for other, potentially related procedures. Each input measure is empirically weighted based on its ability to predict future risk-adjusted mortality with each procedure. We then use empirical Bayes techniques to “filter” out measurement error, which is a particular problem when assessing surgical quality because many individual hospitals have very small caseloads. For each procedure, we rank hospitals based on their composite measure and divide them into five equal size groups (patient quintiles). Finally, we classified the lowest scoring 20 percent of hospitals (bottom quintile) as low quality. Higher quality hospitals were defined as non-low quality hospitals, i.e., not ranked in the bottom 20 percent of the composite mortality measure.

Evaluating geographic proximity

We assessed the geographic proximity of black and white patients to higher quality hospitals by calculating distance in miles. Distances were calculated, using standard techniques, as the linear arc distance between the exact longitude and latitude of the hospital to the latitude and longitude of the ZIP code centroid corresponding to the patient's residence[7]. Straight line distance has been shown to be highly correlated with patient driving time, especially when using ZIP code centroid to assess patient and hospital locations[11].

We next evaluated the role of geographic proximity using two approaches. First, we calculated the median distance to an average or high-quality hospital for both blacks and whites. We then evaluated the proportion of blacks and whites who live within five miles, five to ten miles, and more than 20 miles of the nearest higher quality hospital. Finally, we performed a stratified analysis investigating the likelihood of having surgery at a low quality hospital for black and white patients living within five miles, five to 10 miles, and more than 20 miles from the nearest higher quality hospital.

Assessing Racial Segregation

Segregation was measured using the Dissimilarity Index, which reflects the evenness with which two groups (e.g., blacks and whites) are distributed across units (such as hospitals or neighborhoods)[7]. The index varies between 0 (no segregation) and 1 (complete segregation) and represents the proportion of blacks who would have to relocate to a different unit (that is, to reside in a different neighborhood) to achieve an even distribution across all areas. For our analysis, we defined regional markets for tertiary care using Hospital Referral Regions (HRRs) from Dartmouth Atlas of Healthcare[12]. Using data from the 2000 Census, we calculated the residential Dissimilarity Index for all hospital referral regions. In our sample, the region with the highest Dissimilarity Index was Detroit (0.853) and the Santa Cruz region had the lowest (0.165). In other words, the black and white populations were most unevenly distributed across its component zip codes in the Detroit region, and were most evenly distributed in the Santa Cruz region. After calculating the dissimilarity index for each hospital referral region, we classified regions into one of three equal sized groups (low, medium and high) based on their level of segregation.

We first evaluated whether black patients were more likely to be admitted to low-quality hospitals compared to white patients. For this analysis, we used logistic regression with admission to a low-quality hospital as the dependent variable. In these analyses, we adjusted for patient demographics (age, gender), urgency of admission, and comorbid diseases by including them as independent variables. Comorbid diseases were ascertained from secondary diagnostic codes using the approach described by Elixhauser.

We then evaluated the impact of residential racial segregation, as defined by the Dissimilarity Index for the hospital referral region, on the likelihood of admission to a low-quality hospital. For this analysis, we evaluated the likelihood of blacks vs. whites being admitted to a low quality hospital within each category of residential segregation (low, medium, high). If more highly segregated areas show a disparity in use of low quality hospitals—that is, blacks living in highly segregated areas are likely to use low-quality

hospitals—and areas with low segregation do not show such a disparity, it is likely that these differences in access represent entrenched referral patterns. To adjust for patient clustering within hospitals (i.e., patients similar to one another will likely seek care at the similar hospitals), we generated robust confidence intervals for all analyses. We also performed random effects models to further ensure that our point estimates were not confounded by clustering of patients within hospitals, which yielded nearly identical results. All statistical analyses were conducted using STATA 11.0 (College Station, TX).

Sensitivity Analyses

We performed several sensitivity analyses to test the robustness of our findings. Because most high-risk surgery is performed in urban settings, it is possible that our analysis of proximity is confounded by rural/urban residence. We therefore repeated our analysis excluding patients who lived in rural areas. To ensure that our results were not driven by hospital referral regions with a very low proportion of black patients, we conducted a secondary analysis restricted to only those regions with a black population above the United States average (14.8%).

Study Limitations

Because we used Medicare data, our findings may not accurately reflect referral patterns in younger populations. However, for these surgical procedures, the majority of patients (approximately two-thirds) are over the age of sixty-five and therefore eligible for Medicare. In fact, the use of Medicare data may actually underestimate the magnitude of the disparities because all patients in this population have health insurance. In younger populations, there may be more uninsured and underinsured patients, which could exacerbate the lack of access to higher-quality hospitals. Another limitation of this study is its reliance on straight line distance as a measure of geographic proximity. However, previous studies show very high correlations between driving time and straight line distance.[11] We also performed a sensitivity analysis excluding patients living in rural areas, which did not change the results. Nonetheless, our findings regarding proximity should be considered in the context of well-known differences in population density in different types of neighborhoods (inner city vs. suburbs) and how these relate to barriers to travel (e.g., lower percentage of car owners in inner cities).

Study Results

Compared to white patients, black patients were more likely to undergo surgery in low-quality hospitals for all three procedures: coronary artery bypass (22.9 percent vs. 19.1 percent, P<.001), abdominal aortic aneurysm repair (27.2 percent vs. 18.7 percent, P<.001), and lung cancer resection (24.6 percent vs. 19.7 percent, P<.001). After adjusting for patient characteristics, blacks were still much more likely to undergo surgery at low-quality hospitals for all three procedures (Exhibit 1).

Black patients were also less likely to undergo surgery at high-quality hospitals for all three operations: 23 percent lower odds (OR 0.77; 95 percent CI, 0.73 to 0.82) for coronary artery bypass, 24 percent lower odds (OR, 0.76; 95 percent CI, 0.68 to 0.85) for abdominal aortic

aneurysm repair, and 22 percent lower odds for lung cancer resection (OR, 0.78; 95 percent CI, 0.69 to 0.89) (Exhibit 1). Black and white patients were equally likely to have surgery at average quality hospitals.

These disparities could not be explained by a lack of geographic proximity to higher-quality hospitals. In fact, black patients lived closer to average or high-quality hospitals for all three procedures. For example, with coronary artery bypass surgery, black patients lived about half the average distance of white patients (5.7 vs. 12.3 miles) to an average or high-quality hospital and were twice as likely to live within 5 miles of one (45.3% vs. 26.2%). Findings were similar for lung cancer resection and abdominal aortic aneurysm repair. Moreover, when examining only those patients who lived within five miles of a non-low quality hospital (high or average quality), we found that black patients were still more likely to go to low-quality hospitals compared to white patients: 33% higher odds (OR, 1.33; 95% CI, 1.21 to 1.46) for coronary artery bypass, 44% higher odds (OR, 1.44; 95% CI, 1.22 to 1.70) for lung cancer resection, and 110% higher odds (OR, 2.10; 95% CI, 1.83 to 2.42) for abdominal aortic aneurysm repair (Exhibit 2).

In contrast, there was a strong relationship between residential racial segregation and the use of low quality hospitals (Exhibit 3). Black patients living in regions with high degrees of racial segregation were even more likely (compared to the analysis above with all regions) to undergo surgery in low quality hospitals: 48 percent higher odds (OR 1.48; 95 percent CI, 1.37 to 1.59) for coronary artery bypass, 41 percent higher odds for lung cancer resection (OR, 1.41; 95 percent CI, 1.22 to 1.62), and 96 percent higher odds (OR, 1.96; 95 percent CI, 1.73 to 2.22) for abdominal aortic aneurysm repair (Exhibit 3). In contrast, blacks living in regions with low degrees of residential racial segregation were no more likely to receive care in low quality hospitals than whites (Exhibit 3).

Exhibit 4 shows the patients demographics and hospital characteristics for low-quality hospitals in regions with low, medium, and high degrees of segregation. Low-quality hospitals in regions with high degrees of segregation had a higher proportion of black patients for all three operations. With regard to hospital characteristics, the low-quality hospitals in highly segregated regions tended to be larger with more inpatient days, but there was little consistent difference in the availability of resources (e.g., bed size, accredited cancer program, cardiac catheterization, and trauma center) between these hospitals (Exhibit 4).

These findings were replicated in several sensitivity analyses, including excluding patients living in rural settings and limiting the analysis to those hospital referral regions with a black population at or above the national average.

Discussion and Policy Implications

In this study, we found that blacks were consistently more likely to undergo major surgery at low-quality hospitals when compared to white patients. This disparity could not be attributed to geographic proximity. In fact, black patients actually lived closer to higher-quality hospitals than did white patients. However, there was a strong relationship between residential segregation and the use of low-quality hospitals. In highly segregated regions,

blacks were even more likely (compared to the analysis including all regions) to have surgery in low-quality hospitals. In contrast, in regions with low degrees of segregation, blacks and whites were equally likely to undergo surgery in low-quality hospitals.

These results confirm previous studies demonstrating that black patients are more likely to undergo surgery in lower-quality hospitals. Specifically, numerous studies evaluating the volume-outcome effect in surgery demonstrate that lower-volume hospitals treat a higher proportion of blacks than higher volume hospitals[10,13]. For example, Lui et al found that blacks were significantly more likely to receive care in low volume hospitals for nine of ten complex operations in California[13]. Other studies evaluate the extent to which hospital quality explains racial disparities in outcomes between black and white patients. For example, Lucas et al found that the site of care explains most of the disparity in risk-adjusted mortality rates for major surgery in Medicare patients[1]. Our study goes beyond this work to explore potential mechanisms underlying racial differences in the use of lower quality hospitals.

Although no previous studies have evaluated the mechanisms underlying these disparities in surgical populations, there is previous evidence from Medicare patients hospitalized for acute myocardial infarction. Sarrazin et al found that black patients were 12 percent more likely than white patients to go to high-mortality hospitals[7]. Similar to our study, Sarrazin demonstrated that these differences were much larger in areas with a high degree of residential segregation. Blacks who lived in highly-segregated regions were 35 percent more likely than whites to go to high mortality hospitals. In contrast, in unsegregated region, blacks and whites were equally likely to go to high mortality hospitals for acute myocardial infarction.

The findings from this study, and prior work in medical populations, suggest separate and unequal hospitalization patterns for a broad range of medical services[7,14,15]. These disparities in the use of low-quality hospitals may be due to patient preferences for site or care. Black patients in need of major surgery may feel unwelcome in hospitals that treat a majority of white patients. Previous studies have found that racial concordance is more important for blacks making health care decisions than it is for whites[16–18].

Our findings may also represent race-related differences in physician referral patterns. Until the 1960s, health care delivery was segregated by race, with separate hospitals for blacks and whites. Bach and colleagues recently conducted a study showing that there is still a high degree of segregation in primary care, with most black patients served by a relatively small number of lower quality physicians[19]. Bach's findings provide an explanation for our paper's main result – i.e., that disparities in access to high-quality specialists are present in segregated areas. In Bach's study, physicians who take care of a disproportionate share of black patients also reported less access to specialty resources, which suggests that they may also have trouble accessing specialist surgeons at high-quality hospitals.

There are two potential policy solutions for addressing these disparities. First, policy makers could focus on strategies that redirect black patients to higher quality hospitals[2]. Because blacks already live closer to higher quality hospitals, such policies would not result in any

additional travel burden. At the present time, however, information on comparative hospital quality is not widely available. Providing such information about the relative quality of nearby hospitals could potentially influence referral patterns. It is naïve to assume that providing patients with such information would result in meaningful changes in referral patterns. Most decisions about where to go for major surgery are made by the referring physicians and not patients and their families. In fact, evidence from numerous studies demonstrates the limited power of public reporting alone to redirect patients to better hospitals[20]. Deployment of care navigators and other strategies used in other health care contexts could be used by patients, families, and referring physicians to help them make more informed decisions about where to go for surgery[21,22].

A second policy solution is to improve care in low-quality hospitals that disproportionately treat black patients. Unfortunately, however, many existing policies designed to incentivize improvement could actually exacerbate differences in hospital quality.[23–25] For example, pay-for-performance directs financial bonuses to high-quality providers and often reduces payment to lower quality hospitals[26]. Such policies could exacerbate rather than improve quality problems at resource-constrained hospitals[27]. Policies aimed at improving quality broadly, including pay-for-performance and bundled payments should be constructed carefully so they include strategies to avoid exacerbating these resource disparities.

Further research into the root causes of the differences in outcomes is needed. If the poor performance of these hospitals is due to a lack of financial resources, as some evidence suggests, then additional resources may be needed to make necessary capital investments to improve care. These include information technology, quality measurement infrastructure, or recruitment of well-trained specialty surgeons and other staff[26,28]. If the poor performance is due to problematic health system culture or organizational factors, surgical checklists, medical team training, and more targeted quality improvement interventions would need to be implemented[29,30].

Acknowledgments

Funding: This study was supported by a career development award to Dr. Dimick from the Agency for Healthcare Research and Quality (K08 HS017765) and an established investigator award to Dr. Birkmeyer from the National Cancer Institute (K05CA115571). The views expressed herein do not necessarily represent the views of Center for Medicare and Medicaid Services or the United States Government.

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Exhibit 1

Admission to low, average, and high quality hospitals for black and white Medicare Patients undergoing major surgery.

Surgical Procedure	**Proportion admitted to each type of hospital**		**Adjusted odds ratio for having surgery at each type of hospital,(95% CI)**
Coronary artery bypass grafting	**White**	**Black**	**Black vs. White**
Quality rating (Mortality rate)	N=150,744	N=9,161	
Low quality hospital (4.6%)	19.1%	22.9%	1.25 (1.19 to 1.32)
Average hospital (3.5%)	60.1%	60.1%	1.10 (0.97 to 1.06)
High quality hospital (2.7%)	20.9%	17.0%	0.77 (0.73 to 0.82)
Abdominal aortic aneurysm repair	**White**	**Black**	**Black vs. White**
Quality rating (Mortality rate)	N=52,239	N=2,394	
Low quality hospital (4.1%)	18.7%	27.2%	1.58 (1.44 to 1.74)
Average hospital (3.3%)	60.7%	56.5%	0.85 (0.78 to 0.93)
High quality hospital (3.0%)	20.6%	16.3%	0.76 (0.69 to 0.85)
Lung cancer resection	**White**	**Black**	**Black vs. White**
Quality rating (Mortality rate)	N=32,000	N=2,033	
Low quality hospital (6.0%)	19.7%	24.6%	1.30 (1.17 to 1.44)
Average hospital (4.9%)	59.8%	59.4%	0.96 (0.88 to 1.05)
High quality hospital (3.4%)	20.5%	16.0%	0.78 (0.69 to 0.89)

National Medicare population, 2005–2008.

Exhibit 2

Geographic proximity and admission to low quality hospitals for major surgery.

Surgical Procedure	Proportion admitted to a low quality hospital		Adjusted odds ratio for admission to a low quality hospital (95% CI)
Coronary artery bypass grafting	**White**	**Black**	**Black vs. White**
Proximity to an average or high quality hospital < 5 miles	11.4%	14.8%	1.33 (1.21 to 1.46)
5–20 miles	18.1%	28.2%	1.76 (1.61 to 1.91)
> 20 miles	25.8%	31.6%	1.35 (1.22 to 1.48)
Abdominal aortic aneurysm repair	**White**	**Black**	**Black vs. White**
Proximity to an average or high quality hospital < 5 miles	13.2%	25.1%	2.10 (1.83 to 2.42)
5–20 miles	21.3%	30.1%	1.59 (1.34 to 1.87)
> 20 miles	22.1%	28.9%	1.39 (1.11 to 1.75)
Lung cancer resection	**White**	**Black**	**Black vs. White**
Proximity to an average or high quality hospital < 5 miles	11.9%	16.9%	1.44 (1.22 to 1.70)
5–20 miles	21.2%	32.5%	1.76 (1.45 to 2.13)
> 20 miles	30.1%	42.4%	1.70 (1.34 to 2.16)

National Medicare population, 2005–2008.

Exhibit 3

Residential segregation and admission to a low quality hospital for major surgery.

Surgical Procedure	Proportion admitted to a low quality hospital		Adjusted odds ratio for admission to a low quality hospital (95% CI)
Coronary artery bypass grafting	**White**	**Black**	**Black vs. White**
Low segregation	21.3%	19.5%	0.93 (0.82 to 1.05)
Medium segregation	22.6%	27.8%	1.28 (1.16 to 1.40)
High segregation	15.7%	21.7%	1.48 (1.37 to 1.59)
Abdominal aortic aneurysm repair	**White**	**Black**	**Black vs. White**
Low segregation	25.5%	26.7%	1.03 (0.83 to 1.29)
Medium segregation	15.6%	19.8%	1.29 (1.05 to 1.58)
High segregation	18.3%	31.0%	1.96 (1.73 to 2.22)
Lung cancer resection	**White**	**Black**	**Black vs. White**
Low segregation	25.4%	29.2%	1.24 (0.97 to 1.58)
Medium segregation	20.8%	25.6%	1.25 (1.01 to 1.54)
High segregation	17.1%	23.0%	1.41 (1.22 to 1.62)

National Medicare population, 2005–2008.

Exhibit 4

Patient demographics and hospital characteristics of low-quality hospitals in segregated versus non-segregated hospital referral regions (HRRs).

	Hospital Referral Region (HRR) Segregation		
Procedure	**Low**	**Medium**	**High**
Coronary artery bypass grafting			
Patient demographics			
N	6,657	11,842	12,357
Black	5.4%	5.7%	8.6%
Low socioeconomic position	29%	30%	27%
Urban location	65.3%	67.2%	67.8%
Hospital characteristics			
Total Staffed Beds	314	402	436
Inpatient Days	77,405	104,797	112,259
ACS Approved Cancer Program	62%	69%	66%
Cardiac catheterization	83%	91%	92%
Trauma Center	63%	65%	60%
Abdominal aortic aneurysm repair			
Patient demographics			
N	2,571	2,779	5,093
Black	4.7%	4.5%	8.0%
Low socioeconomic position	25%	25%	13.9%
Urban location	71%	69%	82%
Hospital characteristics			
Total Staffed Beds	332	265	333
Inpatient Days	90,067	64,917	87,297
ACS Approved Cancer Program	67%	53%	69%
Cardiac catheterization	84%	84%	78%
Trauma Center	63%	58%	50 %
Lung cancer resection			
Patient demographics			
N	1,561	2,218	3,037
Black (%)	6.3%	5.7%	9.1%
Low socioeconomic position	32%	25%	22%
Urban location	64%	68%	73%
Hospital characteristics			
Total Staffed Beds	409	490	449
Inpatient Days	108,022	127,727	118,513
ACS Approved Cancer Program	74%	75%	71%
Cardiac catheterization	86%	89%	81%

Procedure	Hospital Referral Region (HRR) Segregation		
	Low	Medium	High
Trauma Center	67%	52%	53%

National Medicare population, 2005–2008.