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Black Patients More Likely Than Whites To Undergo Surgery At Low-Quality Hospitals In Segregated Regions

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ABSTRACT Research has shown that black patients more frequently undergo surgery at low-quality hospitals than do white patients. We assessed the extent to which living in racially segregated areas and living in geographic proximity to low-quality hospitals contribute to this disparity. Using national Medicare data for all patients who underwent one of three high-risk surgical procedures in 2005–08, we found that black patients actually tended to live closer to higher-quality hospitals than white patients did but were 25–58 percent more likely than whites to receive surgery at low-quality hospitals. Racial segregation was also a factor, with black patients in the most segregated areas 41–96 percent more likely than white patients to undergo surgery at low-quality hospitals. To address these disparities, care navigators and public reporting of comparative quality could steer patients and their referring physicians to higher-quality hospitals, while quality improvement efforts could focus on improving outcomes for high-risk surgery at hospitals that disproportionately serve black patients. Unfortunately, existing policies such as pay-for-performance, bundled payments, and nonpayment for adverse events may divert resources and exacerbate these disparities.

Racial disparities in outcomes after major surgery are well documented.^{1–3} Research shows that after undergoing most operations, black patients are much more likely to die than are white patients. Some of the differences in mortality may be explained by patient factors such as illness severity, comorbid conditions, and preferences for specific hospitals. However, there is growing evidence that much of the imbalance stems from blacks' receiving care at hospitals that have high rates of surgical mortality.^{2,4} Previous studies show that more than half of the black-white disparities in mortality are attributable to differences in hospital quality.

The reasons why black patients disproportionately receive surgical care in low-quality

hospitals are not well understood. Differences in geographic proximity to high-quality hospitals may be one factor.^{5,6} In other words, black patients may be more likely than whites to have surgery at low-quality hospitals because blacks live closer than whites to such hospitals. Patient choice and entrenched physician referral patterns may be additional reasons why blacks disproportionately receive surgical care in low-quality hospitals.^{2,4} Separate and unequal referral patterns may be a particular problem in areas with high degrees of racial segregation.⁷

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 by a previously validated quality

measure for major surgery.^{8,9} We then established the extent to which disparities could be explained by geographic proximity to high- and low-quality hospitals. 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 Provider Analysis and Review files for 2005–08 to create the main data sets for our analysis. These files contain hospital discharge abstracts for all fee-for-service acute care hospitalizations of Medicare recipients, accounting for approximately 70 percent of such admissions in the Medicare population. The Medicare denominator file was used to assess whether the patient was alive or deceased thirty days after surgery. 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*, Ninth Revision (ICD-9), we identified all patients ages 65–99 undergoing any of the following 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 and high risk, and they represent surgical specialties whose patients are typically referred by different groups of physicians (for example, cardiologists, pulmonologists, and internists). To ensure that our patients were clinically similar, we excluded small patient subgroups with much higher baseline risks, including those with procedure codes indicating that other operations (such as coronary artery bypass and heart valve surgery) were simultaneously performed or were performed for emergency indications (for example, a ruptured abdominal aortic aneurysm).¹⁰

HOSPITAL QUALITY MEASURES To assess hospital quality we used previously validated composite measures that optimally predict 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 by its ability to predict each procedure's risk-adjusted mortality.

We then used empirical Bayes techniques to “filter” out measurement error, which is a particular problem when assessing surgical quality

because many hospitals have very small case-loads. For each procedure, we ranked hospitals on the basis of their composite measures and divided them into five groups of equal size (patient quintiles). Finally, we classified the lowest-scoring 20 percent of hospitals (the bottom quintile) as low-quality hospitals, the highest-scoring 20 percent of hospitals (the top quintile) as high-quality hospitals, and the middle 60 percent of hospitals as average hospitals. For some analyses we combined the high-quality and average hospitals into a single group called higher-quality hospitals.

EVALUATING GEOGRAPHIC PROXIMITY We assessed the geographic proximity of black and white patients to higher-quality hospitals by calculating distances in miles. Distances were calculated, using standard techniques, as the distance between the exact longitude and latitude of the hospital and the latitude and longitude of the ZIP code centroid—the estimated geographic center of the population in the ZIP code—corresponding to the patient's residence.⁷ Straight-line distance has been shown to be highly correlated with patients' driving time, especially when the ZIP code centroid is used 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 (the upper 80 percent of hospitals) for both blacks and whites. We then evaluated the proportion of blacks and whites who lived within five miles, five to ten miles, and more than twenty miles of the nearest higher-quality hospital. Finally, we performed a stratified analysis to investigate the likelihood of having surgery at a low-quality hospital for black and white patients who lived within five miles, five to ten miles, and more than twenty miles of the nearest higher-quality hospital.

ASSESSING RACIAL SEGREGATION We measured segregation using the Dissimilarity Index, which reflects the evenness with which two groups (in this case, 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 one group (in this case, 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 from the *Dartmouth Atlas of Health Care*.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, Michigan (0.853), and the region with the lowest was Santa Cruz, California (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 the regions into three equal-size groups based on their level of segregation (low, medium, and high).

We first evaluated whether black patients were more likely than white patients to be admitted to low-quality hospitals. For this analysis, we used logistic regression with admission to a low-quality hospital as the dependent variable. We adjusted for patients' demographic characteristics (age and sex), urgency of admission, and comorbid diseases by including these items as independent variables. Comorbid diseases were ascertained from secondary diagnostic codes using the approach described by Anne Elixhauser and coauthors.¹³

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 that blacks versus whites would be admitted to a low-quality hospital within each category of residential segregation (low, medium, and high). If more highly segregated areas show a disparity in the use of low-quality hospitals—that is, if 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 probable that these differences in usage patterns represent entrenched referral patterns.

To adjust for patient clustering within hospitals—which occurs when patients similar to one another are likely to seek care at 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 patient clustering within hospitals. The models yielded nearly identical results. All statistical analyses were conducted using the statistical software Stata, version 11.0.

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 was confounded by differences between rural and 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 those regions with a black population above the US average, which is 14.8 percent.

LIMITATIONS Because we used Medicare data, our findings may not have accurately reflected referral patterns in younger populations. For the surgical procedures we studied, however, approximately two-thirds of patients were older than age sixty-five and therefore eligible for Medicare. In fact, the use of Medicare data may underestimate the magnitude of the racial disparities because all patients in this population have health insurance. In younger populations there may be larger shares of uninsured and underinsured patients, which could exacerbate the lack of access to higher-quality hospitals.

Another limitation of this study was its reliance on straight-line distance as a measure of geographic proximity. However, previous studies showed 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 (an inner city versus a suburb) and how these relate to barriers to travel, such as the lower percentage of car owners in inner cities.

Study Results

Black patients were more likely than white patients to undergo surgery in low-quality hospitals for all three surgical procedures (Exhibit 1). Blacks were also less likely than whites to undergo surgery at high-quality hospitals for all three operations. This was still the case after adjustment for patient characteristics. Black and white patients were equally likely to have surgery at hospitals of average quality.

These disparities could not be explained by a lack of geographic proximity to higher-quality hospitals. In fact, black patients lived closer than whites to average or high-quality hospitals performing all three procedures. For example, black patients undergoing coronary artery bypass surgery lived about half the average distance of white patients undergoing the same surgery to an average or high-quality hospital (5.7 versus 12.3 miles). Blacks were almost twice as likely as whites to live within five miles of such a hospital (45.3 percent versus 26.2 percent). The findings were similar for lung cancer resection and abdominal aortic aneurysm repair.

Moreover, when we examined only those patients who lived within five miles of a non-low-quality hospital (one of high or average quality),

EXHIBIT 1
Black And White Medicare Patients Undergoing Major Surgery In Hospitals Of Low, Average, And High Quality, 2005–08

Surgical procedure	Number or percent admitted		Adjusted odds ratio for having surgery at each type of hospital, black versus white
	White	Black	
CORONARY ARTERY BYPASS GRAFTING			
Patients	150,744	9,161	— ^a
Hospital quality (mortality rate)			
Low (4.6%)	19.1%	22.9%	1.25**
Average (3.5%)	60.1%	60.1%	1.10
High (2.7%)	20.9%	17.0%	0.77**
ABDOMINAL AORTIC ANEURYSM REPAIR			
Patients	52,239	2,394	— ^a
Hospital quality (mortality rate)			
Low (4.1%)	18.7%	27.2%	1.58**
Average (3.3%)	60.7%	56.5%	0.85**
High (3.0%)	20.6%	16.3%	0.76 ^b
LUNG CANCER RESECTION			
Patients	2,000	2,033	— ^a
Hospital quality (mortality rate)			
Low (6.0%)	19.7%	24.6%	1.30**
Average (4.9%)	59.8%	59.4%	0.96
High (3.4%)	20.5%	16.0%	0.78**

SOURCE Authors' analysis of Medicare Provider Analysis and Review files, 2005–08. **NOTE** Significance refers to the odds ratio's being higher or lower than 1.0. ^aNot applicable. ***p* < 0.05

we found that black patients were still more likely than white patients to go to low-quality hospitals. For coronary artery bypass, the odds were 33 percent higher (95% confidence interval: 1.21, 1.46); for lung cancer resection, 44 percent higher (95% CI: 1.22, 1.70); and for abdominal aortic aneurysm repair, 110 percent higher (95% CI: 1.83, 2.42) (Exhibit 2).

In contrast, there was a strong relationship between residential racial segregation and the use of low-quality hospitals. 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. For coronary artery bypass, the odds were 48 percent higher (95%

EXHIBIT 2
Black And White Medicare Patients' Proximity And Admission To Low-Quality Hospitals For Major Surgery, 2005–08

Proximity to average or high-quality hospital	Percent admitted to a low-quality hospital		Adjusted odds ratio for admission to a low-quality hospital, black versus white
	White	Black	
CORONARY ARTERY BYPASS GRAFTING			
<5 miles	11.4	14.8	1.33**
5–20 miles	18.1	28.2	1.76**
>20 miles	25.8	31.6	1.35**
ABDOMINAL AORTIC ANEURYSM REPAIR			
<5 miles	13.2	25.1	2.10**
5–20 miles	21.3	30.1	1.59**
>20 miles	22.1	28.9	1.39**
LUNG CANCER RESECTION			
<5 miles	11.9	16.9	1.44**
5–20 miles	21.2	32.5	1.76**
>20 miles	30.1	42.4	1.70**

SOURCE Authors' analysis of Medicare Provider Analysis and Review files, 2005–08. **NOTE** Significance refers to the odds ratio's being higher or lower than 1.0. ***p* < 0.05

EXHIBIT 3

Black And White Medicare Patients' Residential Segregation And Admission To A Low-Quality Hospital For Major Surgery, 2005–08

Level of segregation	Percent admitted to a low-quality hospital		Adjusted odds ratio for admission to a low-quality hospital, black versus white
	White	Black	
CORONARY ARTERY BYPASS GRAFTING			
Low	21.3	19.5	0.93
Medium	22.6	27.8	1.28**
High	15.7	21.7	1.48**
ABDOMINAL AORTIC ANEURYSM REPAIR			
Low	25.5	26.7	1.03
Medium	15.6	19.8	1.29**
High	18.3	31.0	1.96**
LUNG CANCER RESECTION			
Low	25.4	29.2	1.24
Medium	20.8	25.6	1.25**
High	17.1	23.0	1.41**

SOURCE Authors' analysis of Medicare Provider Analysis and Review files, 2005–08. **NOTE** Significance refers to the odds ratio's being higher or lower than 1.0. ** $p < 0.05$

CI: 1.37, 1.59); for lung cancer resection, 41 percent higher (95% CI: 1.22, 1.62); and for abdominal aortic aneurysm repair, 96 percent higher (95% CI: 1.73, 2.22) (Exhibit 3). Blacks living in regions with low degrees of residential racial segregation were no more likely than whites to receive care in low-quality hospitals.

Low-quality hospitals in regions with high degrees of segregation had a higher proportion of black patients undergoing all three operations and tended to have more inpatient days, compared to similar hospitals in less segregated regions (Exhibit 4). However, there was little consistent difference between the two groups of hospitals in the availability of resources such as number of beds, presence of an accredited cancer program or trauma center, and availability of cardiac catheterization.

These findings were replicated in sensitivity analyses, including ones that excluded patients living in rural settings and limited the analysis to Hospital Referral Regions with black populations at or above the national average.

Discussion And Policy Implications

We found that black patients were consistently more likely than white patients to undergo major surgery at low-quality hospitals. This disparity cannot be attributed to geographic proximity. In fact, black patients 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 than whites to have surgery in low-quality hospitals than they were in the comparison that included all regions. 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 effect of provider volume on outcomes in surgery have demonstrated that lower-volume hospitals treat a higher proportion of blacks than higher-volume hospitals do.^{10,14} For example, Jerome Liu and coauthors found that blacks were significantly more likely than whites to receive care in low-volume hospitals for nine of ten complex operations in California.¹⁴

Other studies have evaluated the extent to which hospital quality explains racial disparities in outcomes between black and white patients. For example, F. Lee Lucas and coauthors 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 the 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. Mary Vaughan Sarrazin and coauthors found that black patients were 12 percent more likely than white patients to go to hospitals with high mortality rates.⁷ Similar to our study, the work of Vaughan Sarrazin and her colleagues demonstrated that these differences were much larger in areas with high degrees of residential segregation. Blacks who lived in highly segregated regions were 35 percent more likely than whites to go to hospitals with high mortality rates. In contrast, in unsegregated regions, blacks and whites with acute myocardial infarction were equally likely to go to such hospitals.

The findings from this and earlier studies suggest that separate and unequal hospitalization patterns exist for a broad range of medical services.^{7,15,16} These disparities in the use of low-quality hospitals may be due to patient preferences for site of 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 than for whites in making health care decisions.^{17–19}

Our findings may also indicate race-related differences in physician referral patterns. Until

the 1960s, health care delivery was segregated by race, with separate hospitals for blacks and whites. Peter Bach and colleagues found 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.²⁰ These findings provide an explanation for our study's main result: Blacks living in segregated regions may have less access to high-quality specialists. In the study by Bach and co-authors, physicians who took care of a disproportionate share of black patients also reported that their patients had reduced access to specialty resources, which suggests that these patients may also have trouble accessing specialist surgeons at high-quality hospitals.

There are two potential policy solutions to these disparities. First, policy makers could focus on strategies that would redirect black patients to higher-quality hospitals.² Because blacks already live closer to these hospitals, such policies would not result in any additional travel burden. However, information on comparative hospital quality is not widely available. Moreover, even if it were available, it is naïve to assume that simply providing it to patients would result in meaningful changes in referral to higher-quality hospitals. In fact, evidence from numerous studies demonstrates the limited power of public reporting alone to redirect patients to better hospitals.²¹

Engaging referring physicians and providing them with reports about hospital quality may be more effective. Most decisions about where to go for major surgery are made by referring physicians, not by patients and their families. The deployment of care navigators—that is, people with expertise in referral processes and sensitivity to cultural barriers—could help patients, families, and referring physicians make more informed decisions about where to have surgery.^{22,23}

A second policy solution would be to improve care in low-quality hospitals that disproportionately treat black patients. Unfortunately, many existing policies designed to incentivize improvements could actually exacerbate differences in hospital quality.^{24–26} For example, pay-for-performance directs financial bonuses to high-quality providers and often reduces payments to lower-quality hospitals.²⁷ Such policies could heighten quality problems at resource-constrained hospitals.²⁸ Policies aimed at improving quality broadly, including pay-for-performance, bundled payments, and nonpayment for adverse events, should be constructed carefully so that they include strategies to avoid the unintended consequence of exacerbating existing disparities in resources.

EXHIBIT 4

Characteristics Of Medicare Patients And Low-Quality Hospitals, By Level Of Segregation In Hospital Referral Regions, 2005–08

Characteristic	Level of segregation		
	Low	Medium	High
CORONARY ARTERY BYPASS GRAFTING			
Patient			
Number	6,657	11,842	12,357
Black	5.4%	5.7%	8.6%
Low socioeconomic position	29%	30%	27%
Urban location	65%	67%	68%
Hospital			
Staffed beds	314	402	436
Inpatient days per year	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			
Number	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			
Staffed beds	332	265	333
Inpatient days per year	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			
Number	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			
Staffed beds	409	490	449
Inpatient days per year	108,022	127,727	118,513
ACS-approved cancer program	74%	75%	71%
Cardiac catheterization	86%	89%	81%
Trauma center	67%	52%	53%

SOURCE Authors' analysis of Medicare Provider Analysis and Review files, 2005–08. **NOTES** Low socioeconomic position is defined as the bottom third in terms of median ZIP code income. ACS is American College of Surgeons.

Further research into the root causes of disparities in outcomes is needed. If the poor performance of low-quality hospitals is due to a lack of financial resources, as some evidence suggests, then additional resources may be needed for the capital investments that are necessary to improve care. These include information technology, quality measurement infrastructure, and the recruitment of well-trained specialty surgeons and other staff.^{27,29} If the poor performance is due to a health system culture or organizational factors, then surgical checklists, medical team training, and more targeted quality improvement interventions would need to be implemented.^{30,31} ■

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government. Birkmeyer and Dimick have equity interests in ArborMetrix, which provides software and services for profiling hospital quality and episode cost efficiency. The company was not involved with this article in any way.

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In this month's *Health Affairs*, Justin Dimick and coauthors assess the extent to which living in racially segregated areas and living in geographic proximity to low-quality hospitals may contribute to black patients' undergoing surgery at low-quality hospitals more frequently than white patients.

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