Racial Differences in Admissions to High-Quality Hospitals for Coronary Heart Disease

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Background: Research increasingly shows that blacks with coronary heart disease (CHD) are treated at lower-quality hospitals. Little is known about racial differences in admission to high-quality hospitals.

Methods: We identified all black and white Medicare patients with acute myocardial infarction and coronary artery bypass grafting (CABG) admitted during 2002 through 2005 to hospitals located in markets with top-ranked cardiac hospitals, as ascertained from the US News and World Report “America’s Best Hospitals” annual rankings. The relationship between race and admission to top-ranked hospitals was estimated using multinomial conditional logit models to account for distance from patient residence to all available hospitals.

Results: In unadjusted analyses, blacks with AMI or undergoing CABG, compared with whites, were more likely to be admitted to top-ranked hospitals (18.3% vs 10.5% and 34.4% vs 22.7% \(P<.001\)) but also more likely to bypass top-ranked hospitals (25.8% vs 14.7% and 37.5% vs 26.3% \(P<.001\)). In models accounting for distance, blacks with acute myocardial infarction were more likely (odds ratio [OR], 1.12; 95% confidence interval [CI], 1.08-1.16 \(P<.001\)), whereas blacks undergoing CABG were equally likely (OR, 1.05; 95% CI, 0.97-1.13; \(P=.27\)) to be admitted to top-ranked hospitals compared with whites. However, within socially disadvantaged zip codes, blacks undergoing CABG were less likely (OR, 0.75; 95% CI, 0.64-0.86 \(P<.001\)) to be admitted to top-ranked hospitals compared with whites and more likely to bypass top-ranked hospitals located closer to their residence (OR, 1.16; 95% CI, 1.02-1.30 \(P=.03\)).

Conclusion: Black Medicare patients with acute myocardial infarction or undergoing CABG were equally or more likely to be admitted to top-ranked hospitals, except for socially disadvantaged black patients undergoing CABG.

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Racial disparities in the management of coronary heart disease (CHD) are widely documented,1,6 yet the reasons behind persistent gaps in quality of care are not fully understood. Recent studies have suggested that differential access to high-quality hospitals may play an important role. In particular, these analyses have shown that hospitals treating large proportions of black patients have lower adherence to guideline-recommended treatments and higher mortality than hospitals treating larger proportions of white patients.7,10

See Invited Commentary at end of article

The finding that black patients are more likely to receive care from lower-quality hospitals would seem somewhat disconcerting, since major academic medical centers have prided themselves as delivering exceptional quality11,12 in a culturally sensitive environment.13-15 Indeed, a number of prior analyses have shown that blacks are actually more likely to receive care in teaching hospitals and, in turn, teaching hospitals are generally considered to deliver higher quality of care.16,17 That said, we are unaware of any published analyses that have directly examined racial differences in access to the nation’s most prestigious medical centers. Such analyses are especially important, since high-quality hospitals are typically located in close proximity to urban environments with relatively large black populations.

Thus, our objective was to compare the likelihood of admission to top-ranked cardiac hospitals for black and white patients living in markets with at least 1 top-ranked hospital. We chose the highly influential US News & World Report “America’s Best Hospitals” annual rank-
ings to identify top-ranked hospitals because prior literature has shown that hospital reputation significantly influences hospital selection. We hypothesized that because black populations are concentrated in metropolitan areas, black patients with CHD will be equally or more likely to be admitted to these top-ranked cardiac hospitals. Moreover, because hospital selection may vary according to the urgency of a particular medical condition, we examined 2 separate CHD diagnoses of varying acuity: acute myocardial infarction (AMI) and coronary artery bypass grafting (CABG). We selected patients with AMI or undergoing CABG because we envisioned that hospital choice might differ for an emergent condition for which patients might be expected to choose the nearest hospital (AMI) when compared with a more elective procedure for which patients might have more discretion in where to seek admission (CABG).

In addition, we explored how residential socioeconomic factors may influence the likelihood of admission to top-ranked cardiac hospitals for black and white patients. In light of prior research showing a strong association between socioeconomic constraints and cardiovascular health, we hypothesized that residential social disadvantage has an independent negative impact on access to top-ranked cardiac hospitals for black compared with white patients.

DATA SOURCES AND PATIENT SAMPLES

The present study used 5 primary data sources: (1) the US News & World Report “America’s Best Hospitals” annual rankings for 2002 through 2005; (2) Medicare Part A (MedPAR) files for 2002 through 2005; (3) the Dartmouth Atlas of Healthcare; (4) the American Hospital Association (AHA) annual survey for 2005; and (5) 2000 US Census files.

We identified top-ranked cardiac care hospitals using lists published by the US News & World Report for years 2002 through 2005. Top-ranked hospitals were defined as all hospitals included on “America’s Best Cardiac Programs” by the US News & World Report at least twice during 2002 through 2005. The yearly rankings draw from secondary sources such as physician surveys, AHA annual surveys, and the Centers for Medicare & Medicaid Services (CMS) MedPAR files and take into account 3 dimensions of quality measured along the following multiple domains: (1) structure (e.g., technology, volume, staffing, presence of certain specialized physicians); (2) process (measured indirectly, through nominations for “best hospital” collected during annual surveys of board-certified physicians); and (3) outcome (risk-standardized hospital mortality rates). Prior empirical analyses have demonstrated that the reputation of top-ranked hospitals may indeed be justified based on their excellent clinical outcomes.

We then developed 2 separate cohorts of patients by identifying all Medicare beneficiaries admitted for either AMI (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 410) or CABG (ICD-9-CM codes 36.10-36.19) in health care markets (hospital referral regions [HRRs]), with 1 or more top-ranked cardiac hospitals during 2002 through 2005. Hospital referral regions represent distinct geographical markets that were developed by examining the delivery of specialized cardiovascular care in Medicare beneficiaries. Markets were assigned using hospital zip code–based algorithms available from the Dartmouth Atlas of Health Care. All analyses were conducted separately for the AMI and CABG cohorts. For the AMI cohort, patients who were admitted for AMI, percutaneous coronary intervention (PCI), or CABG within the previous 3 years were excluded to limit the sample to patients with initial episodes of myocardial infarction. For the CABG cohort, we also conducted analyses on the subset of CABG patients without AMI to better evaluate the effect of elective vs emergent admission on hospital selection. Approximately 20% of patients undergoing CABG had a primary diagnosis of AMI.

We excluded markets with fewer than 100 blacks admitted per year for AMI (269 markets) or CABG (281 markets) during 2002 through 2005 to ensure adequate samples for comparisons of outcomes, leaving 37 HRRs for AMI admissions and 25 HRRs for CABG admissions in the analysis. Seven AMI markets were located in the Northeast, 14 in the South, 12 in the Midwest, and 4 in the West; 4 CABG markets were located in the Northeast, 11 in the South, 9 in the Midwest, and 1 in the West. We excluded patients residing outside of the treatment HRR (11% for the AMI and 21% for the CABG cohort) to define a market-based set of choices for each patient. We also excluded patients who were admitted after transfer from another hospital (8% for the AMI and 17% for the CABG cohort), since the selection of a transfer hospital was likely influenced by factors beyond patients’ choice. Final analyses focused on comparisons between black and white patients, excluding patients of other racial groups or for whom race information was missing (4.1% of the combined samples).

STUDY VARIABLES

We linked study hospitals to the AHA survey to obtain data on hospitals’ teaching status and classified study hospitals into 3 mutually exclusive groups: (1) top-ranked cardiac hospitals (all of which had teaching programs); (2) non–top-ranked teaching hospitals; and (3) nonteaching hospitals. Other hospital characteristics, including number of hospital beds, Medicaid case load (used to identify safety net status), and for-profit status, were also obtained from the 2005 AHA survey. Hospital AMI admission volumes as well as CABG volumes were calculated using Medicare Part A data from 2002 through 2005. Hospitals that performed at least 2 CABG procedures in Medicare beneficiaries during the year of patient discharge were considered to provide full revascularization services. We identified each hospital’s location as urban or rural based on each hospital’s zip code using rural-urban commuting area codes.

Patient race was identified within the MedPAR files and was categorized as either black or white. Other patient-level variables included demographic characteristics (age and sex), comorbid illnesses, and AMI location, identified using ICD-9–CM diagnostic codes and following algorithms developed by Elixhauser et al and Quan et al.

We used Census Tract data (publicly available at http://factfinder.census.gov) aggregated at the zip code level to obtain measures of poverty (percentage of population living below poverty level), family disruption (percentage of households with women as head of household), male joblessness (percentage of unemployed men ≥16 years), and occupational composition (percentage of population in professional and managerial occupations). Individual measures were first standardized and then summed up to calculate a zip code social disadvantage index. Based on the index distribution, zip codes were categorized as low (index in the lowest tertile), intermediate (index in the middle tertile), and high (index in the highest tertile) disadvantage areas.

Zip code–based centroids were used to calculate straight-line distances from a patient’s residence to all hospitals available within the patient’s respective HRR.
We compared the characteristics of the 3 groups of study hospitals (top-ranked teaching, non–top-ranked teaching, and nonteaching) and characteristics of black and white patients admitted to these hospitals using χ² statistics for dichotomous measures and unpaired t tests or Wilcoxon rank sum tests for continuous measures. We used similar methods to compare median distances from patients’ residence to HRR hospitals and proportions of admission to top-ranked hospitals and of top-ranked hospital bypass for black and white patients in the study sample. “Bypass” was defined as occurring when patients were admitted to non–top-ranked hospitals that were at least as distant or 3.2 km (2 miles) farther from their residence than the closest top-ranked hospital.

We used conditional logit (McFadden) models²⁷ to examine patients’ choice of one hospital over other hospitals available within the patient’s market area. Conditional logit analysis represents the standard approach for evaluating determinants of hospital choice.²⁸²⁹ It has the distinct advantage that it explicitly accounts for distance to all available hospitals and for the characteristics of hospitals chosen as well as those of hospitals not chosen by patients. This is achieved by creating a file that includes each combination of patient admission and hospitals that could be used by the patient (ie, hospitals within the patient’s hospital market), to which the model is then fitted. Differences in choice between specific patient populations (eg, black and white patients) are investigated as interactions between patient characteristics and hospital characteristics. In this study, we were particularly interested in estimating the relative likelihood of a top-ranked cardiac hospital being selected over other hospitals for black compared with white patients; thus, we estimated the relative odds using an interaction term between black and white race and the top-ranked hospital indicator variable.

To assess the robustness of our findings, we conducted several sensitivity analyses. To determine whether severity of illness influenced hospital choice, we conducted analyses stratified by patient risk of death. Predicted 30-day mortality was estimated using hierarchical models adjusting for demographic, comorbidities, and AMI location and introducing hospital random effects to account for clustering of patients within hospitals. Patients were stratified into low, intermediate, and high risk of death, based on the predicted mortality being in the lowest, middle two, and highest quartiles of the distribution. Analyses of hospital choice were conducted for each of the risk strata.

To evaluate the effect of socioeconomic environment on racial differences in hospital choice, we conducted analyses stratified by patients’ zip code social disadvantage index, as described in the “Study Variables” subsection (ie, low, intermediate, and high disadvantage level).

Finally, we used hierarchical models that adjusted for severity and zip code social disadvantage index and accounted for clustering of patients within zip codes to evaluate the relationship between race and top-ranked hospital bypass. Race was entered in these models as an indicator variable (1 if black and 0 if white).

P values were 2-sided, and statistical significance was defined as P < .01. All analyses were performed using SAS statistical software version 9.1 (SAS Institute Inc, Cary, North Carolina). This project was approved by the University of Iowa institutional review board.

In aggregate, we identified 44 top-ranked hospitals for AMI and 30 for CABG (eTable; http://www.archinternmed.com), 98 non–top-ranked teaching hospitals for AMI and 62 for CABG, and 821 nonteaching hospitals for AMI and 178 for CABG (Table 1). Top-ranked hospitals were more likely urban and had a larger bed size and higher AMI volumes compared with non–top-ranked teaching and nonteaching hospitals. Within the AMI cohort, all top-ranked hospitals provided revascularization services, as did most of the teaching non–top-ranked hospitals (n=75 [77%]), whereas only 24% of nonteaching hospitals did provide these services (Table 1). Top-ranked hospitals and non–top-ranked teaching hospitals were more likely to be safety net providers compared with nonteaching hospitals and were less likely to have for-profit status (Table 1).

Compared with white patients, black patients living in markets with top-ranked cardiac hospitals and admitted for AMI or CABG were younger, more likely to be female, and lived in zip code areas with lower median household income and higher social disadvantage (Table 2). Blacks in the study markets were also more likely to have congestive heart failure and renal failure but less likely to have chronic obstructive pulmonary disease or arrhythmias compared with whites (Table 2). Observed 30-day mortality rates for blacks were lower compared with whites in the AMI cohort (17.0 vs 17.9; P < .001) but were similar in the CABG cohort (4.6 vs 4.4; P = .39).

In bivariate comparisons, black patients lived closer to both top-ranked hospitals and non–top-ranked teaching hospitals and were more likely to be admitted to both top-ranked hospitals and non–top-ranked teaching hospitals for both AMI and CABG (Table 3).
In analyses using conditional logit models and accounting for distance between patient residence and hospitals within the patients' HRR, black patients with AMI appeared more likely to be admitted to top-ranked hospitals and non–top-ranked teaching hospitals compared with white patients (Table 4). Black patients undergoing CABG were equally likely to receive care at top-ranked hospitals and more likely to receive care at other teaching hospitals compared with white patients undergoing CABG (Table 4). These findings did not differ in the subsample of patients undergoing CABG without a primary AMI diagnosis and in analyses conducted across the 3 risk strata.

In additional analyses stratified by social disadvantage level, there were no significant black-white disparities for patients with AMI or undergoing CABG living in zip code areas with low and intermediate social disadvantage levels (Table 4). However, blacks living in areas with high social disadvantage were significantly less likely than whites living in similar areas to be admitted to top-ranked hospitals for CABG (Table 4).

In unadjusted analyses, black patients also appeared significantly more likely to bypass the closest top-ranked hospital (Table 5). After adjusting for disease severity using the predicted risk of death at 30 days and for zip code social disadvantage index and accounting for clustering of patients in zip codes, black patients with AMI were equally likely to bypass top-ranked hospitals compared with white patients (Table 5). However, black patients undergoing CABG remained significantly more likely to bypass top-ranked hospitals and be admitted to other hospitals located at least 3.2 km farther away from their residence; this difference was more marked for the CABG cohort restricted to patients without AMI (Table 6).
We used choice models to evaluate differences in admissions to top-ranked cardiac hospitals for black and white patients with CHD in markets with at least 1 top-ranked hospital. We found that, even after accounting for distance to available hospitals, black patients with CHD were equally or more likely to be admitted at top-ranked hospitals compared with whites. We also found that, consistent with prior research, black patients were more likely to be admitted to teaching hospitals in general. However, in stratified analyses, we found that blacks undergoing CABG and residing within zip codes with high levels of social disadvantage were significantly less likely to receive care at top-ranked cardiac hospitals compared with white patients residing within zip codes with similar levels of disadvantage, while no such difference was seen in zip codes with lesser degrees of disadvantage. Lastly, we also found that, consistent with prior research, black patients were more likely to be admitted to teaching hospitals in general.

### Table 4. Adjusted Odds of Admission to Top-Ranked Cardiac Hospitals for Black and White Medicare Patients Admitted for AMI or CABG During 2002 Through 2005, Overall and Stratified by Zip Code Social Disadvantage Index

<table>
<thead>
<tr>
<th>Variable</th>
<th>AMI Cohort (n=215,216)</th>
<th>CABG Cohort (All Patients) (n=71,731)</th>
<th>CABG Cohort (No AMI) (n=58,862)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>P Value</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>Top-ranked hospital</td>
<td>1.12 (1.08-1.16)</td>
<td>&lt;.001</td>
<td>1.05 (0.97-1.13)</td>
</tr>
<tr>
<td>Non–top-ranked teaching hospital</td>
<td>1.14 (1.10-1.18)</td>
<td>&lt;.001</td>
<td>1.28 (1.19-1.37)</td>
</tr>
<tr>
<td>Stratified by zip code social disadvantage index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest tertile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top-ranked hospital</td>
<td>0.94 (0.80-1.08)</td>
<td>.40</td>
<td>1.32 (1.07-1.57)</td>
</tr>
<tr>
<td>Non–top-ranked teaching hospital</td>
<td>1.15 (0.00-1.30)</td>
<td>.95</td>
<td>1.75 (1.45-2.05)</td>
</tr>
<tr>
<td>Middle tertile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top-ranked hospital</td>
<td>1.05 (0.93-1.17)</td>
<td>.44</td>
<td>1.13 (0.91-1.29)</td>
</tr>
<tr>
<td>Non–top-ranked teaching hospital</td>
<td>1.16 (1.05-1.27)</td>
<td>.998</td>
<td>0.88 (0.68-1.08)</td>
</tr>
<tr>
<td>Upper tertile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top-ranked hospital</td>
<td>1.06 (1.00-1.12)</td>
<td>.04</td>
<td>0.76 (0.66-0.86)</td>
</tr>
<tr>
<td>Non–top-ranked teaching hospital</td>
<td>1.05 (1.00-1.10)</td>
<td>.06</td>
<td>0.93 (0.82-1.04)</td>
</tr>
</tbody>
</table>

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; CI, confidence interval; OR, odds ratio.

### Table 5. Unadjusted Rates of Top-Ranked Hospital Bypass for Black and White Patients With Coronary Heart Disease in Markets With Top-Ranked Hospitals

<table>
<thead>
<tr>
<th>Location of Top-Ranked Hospital</th>
<th>AMI Cohort (n=215,216)</th>
<th>CABG Cohort (All Patients) (n=71,731)</th>
<th>CABG Cohort (No AMI) (n=58,862)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Black Patients, No. (%)</td>
<td>White Patients, No. (%)</td>
<td>P Value</td>
</tr>
<tr>
<td>Located at the same distance or closer than the admitting hospital</td>
<td>6761 (25.8)</td>
<td>27 704 (14.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Located at least 3.2 km (2 miles) closer than the admitting hospital</td>
<td>2250 (8.6)</td>
<td>9277 (4.9)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting.

### Table 6. Adjusted Odds of Top-Ranked Hospital Bypass for Black and White Patients With Coronary Heart Disease in Markets With Top-Ranked Hospitals

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<th>Location of Top-Ranked Hospital</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>P Value</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>Located at the same distance or closer than the admitting hospital</td>
<td>1.00 (0.94-1.06)</td>
<td>.90</td>
<td>1.02 (0.91-1.13)</td>
</tr>
<tr>
<td>Located at least 3.2 km (2 miles) closer than the admitting hospital</td>
<td>0.99 (0.91-1.07)</td>
<td>.08</td>
<td>1.16 (1.02-1.30)</td>
</tr>
</tbody>
</table>

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; CI, confidence interval; OR, odds ratio.

* Odds of top-ranked hospital bypass for black patients, relative to white patients, adjusted for predicted risk of death at 30 days and zip code social disadvantage index.
black patients undergoing CABG in markets with top-ranked hospitals appeared more likely to bypass nearby top-ranked hospitals, while instead undergoing CABG in lower-ranked, more distant hospitals.

Our finding that black patients were equally if not more likely to be admitted to top-ranked hospitals stands in contrast to an increasing body of research demonstrating the segregation of black patients into lower-quality hospitals. In an analysis of Medicare patients with AMI, Skinner et al found that hospitals that disproportionately serve blacks had significantly worse mortality compared with hospitals serving whites. In another study using Medicare data, Konety et al found that black patients were more likely to undergo CABG in hospitals with higher risk-adjusted mortality rates. Similarly, in analyses of data from the Hospital Quality Alliance, which provides information on inpatient quality of care, Hasnain-Wynia et al found that disparities in processes of care for AMI were largely the result of minorities seeking care at lower-quality facilities.

However, a number of analyses have found that black patients are more likely to be admitted to teaching hospitals, which, in turn, have been shown to have better quality of care. This seeming contradiction that blacks appear more likely to receive treatment in major teaching hospitals as well as in poor-quality hospitals could be explained by study design. First, prior analyses showing the segregation of blacks in poor-quality hospitals used national data and failed to account for distance. Therefore, findings represent average effects across US regions, which are difficult to interpret within specific geographic environments. This is particularly important in light of recent research showing large regional variations in both quality of care and racial disparities in health care delivery.

In contrast, studies showing higher rates of admission to teaching hospitals for blacks have largely been limited to studies of particular geographic areas. For example, Iwashyna et al evaluated the use of teaching hospitals for patients who actually had the option to choose such hospitals, although this was loosely defined as those patients living in counties in which at least 10 people from the study went to teaching hospitals.

Our study adds to this prior body of research in that it anchors hospital selection within the specific context of health care markets by limiting the study sample to HRRs with top-ranked hospitals (less than 12% of HRRs) and to patients residing within those markets. Thus, by explicitly taking into account local market conditions (eg, distances to facilities and rankings of available hospitals), this study suggests that in markets where top-ranked hospitals are available and geographically accessible, black patients with CHD are no less likely than white patients to be admitted to such hospitals.

A secondary albeit important finding of this analysis is the isolated disparity in admission to top-ranked hospitals observed for black patients undergoing CABG residing in heavily disadvantaged neighborhoods, although these patients lived on average closer to such hospitals. Our finding that such a disparity existed for CABG (a high-risk and often elective procedure) but not for AMI (more often an emergent condition) suggests that perhaps blacks are more likely to choose more distant hospitals when issues of urgency are less important (CABG). Because differences were isolated to patients residing in zip codes with high social disadvantage levels, perceived discrimination and distrust of the health care system—perhaps more prominent in these communities—could influence where black and white patients seek care for CABG. Furthermore, the racial differences in rates of bypassing top-ranked hospitals for CABG also suggest that blacks in need of CABG might select hospitals based on factors including cultural competency or familiarity with a particular facility.

However, prior work has shown that patients’ hospital choice can be significantly influenced by physician referral. Indeed, a prior study by Mukamel et al found that racial disparities in cardiac surgeon quality in New York State were partially attributable to referral patterns from physicians providing the majority of cardiac care before CABG. Future studies are needed to evaluate the relative contributions of patient and health care system factors to this observed disparity in access to quality care for black and white patients undergoing CABG.

This study has several limitations that need to be acknowledged. Most important, the use of the term hospital choice was merely methodological, since we did not collect stated patient preferences. However, the model asserts that patients choose from available hospitals based on the attractiveness of particular hospitals. In that sense, it examines preference revealed by patients’ choice behavior. Second, distance to hospitals was calculated as straight-line (Euclidian) distance between zip code centroids. Although other studies have used this method to approximate actual travel distance, local travel conditions may have a significant impact on hospital choice, especially in large urban areas. Third, we were not able to measure several important factors that may affect the hospital selection process, including health care provider characteristics and referral patterns and the use of emergency medical services. Lastly, the study sample comprised black and white Medicare patients. As a consequence, findings may not be generalizable to other age groups and other types of insurance.

Despite these limitations, the present study provides important evidence that black patients are equally or more likely to be admitted to high-quality cardiac hospitals compared with white patients with similar geographic access to these facilities, with the notable exception of patient undergoing CABG who reside in communities with marked social disadvantage. Given the proximity of high-quality hospitals to this segment of the black population, our study suggests an inequity in the use of such hospitals by underprivileged black patients undergoing CABG. Future research should focus on the complexity of geographical and social factors driving hospital choices for vulnerable populations in order to develop effective local interventions aimed at reducing racial disparities in health care delivery.

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Author Contributions: Dr Popescu had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Popescu, Nallamothu, and Cram. Acquisition of data: Vaughan-Sarrazin and Cram. Analysis and interpretation of data: Popescu, Nallamothu, Vaughan-Sarrazin, and Cram. Drafting of the manuscript: Popescu, Vaughan-Sarrazin, and Cram. Critical revision of the manuscript for important intellectual content: Popescu, Nallamothu, Vaughan-Sarrazin, and Cram. Statistical analysis: Popescu and Vaughan-Sarrazin. Obtained funding: Popescu and Cram. Administrative, technical, and material support: Cram.

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Online-Only Material: The eTable is available at http://www.archinternmed.com.

REFERENCES


