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Differences in admitting hospital characteristics for black and white Medicare beneficiaries with AMI

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Abstract

Background—Racial disparities in acute myocardial infarction (AMI) treatment may be due to differences in admitting hospitals. Little is known about factors associated with hospital selection for black and white AMI patients.

Methods and Results—We identified black and white Medicare beneficiaries with AMI in 63 hospital referral regions (HRRs) with at least 50 black admissions during 2005 (N=65,633). We calculated distance from patient home to HRR hospitals using zip code centroids. We assessed hospital quality using a composite score comprised of hospital risk-adjusted 30-day mortality and AMI performance measures. Hospitals with a score in the top 20% were categorized as high-quality and lowest 20% as low-quality. We used conditional multinomial logit models to examine differences in hospital selection for blacks and whites.

On average, blacks lived closer to revascularization hospitals (mean 3.8 vs. 6.8 miles, p<.001) and to high-quality hospitals (mean 5.6 vs. 9.7 miles, p<.001). After accounting for distance, blacks were relatively less likely (p<.001) to be admitted to revascularization hospitals (RR 0.87, 95%CI 0.80-0.95), and to high-quality hospitals (RR 0.88, 95%CI 0.801-0.95), but more likely (p<.001) to be admitted to low-quality hospitals (RR 1.17, 95%CI 1.05-1.29). In analyses matched by home zip code, differences in admissions to revascularization (RR 0.92, 95%CI 0.80-1.05), high- (RR 0.94, 95%CI 0.81-1.07) and low-quality (RR 1.15, 95%CI 0.94-1.35) hospitals were not significant.

Conclusions—Differences in admissions to revascularization and high-quality hospitals may contribute to disparites in AMI care. These differences may be due in part to residential zip code characteristics.

Keywords

acces to care; disparities; hospital; myocardial infarction

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Background

Over the past two decades, numerous studies have demonstrated large disparities in the management of acute myocardial infarction (AMI).[1-7] Most notably, black patients with AMI are less likely to receive guideline-recommended treatments, even after accounting for patient characteristics[1-7] and appropriateness of care.[5,6]

A number of recent studies have suggested that differences in characteristics of admitting hospitals may play an important, perhaps primary role in racial disparities in AMI treatment[8-10]. These studies have found that the care of black patients is concentrated in a relatively small number of hospitals[8] with lower volumes[9], lower adherence to process measures[10], and higher risk-adjusted mortality[11]. Yet little is known about why blacks and whites tend to receive care from hospitals of varying quality.

Prior research has established that where a patient is admitted for hospital care is determined primarily by distance[12-13] and by an array of hospital and patient characteristics.[12-15] However, no study specifically addressed the relationship between patient race and admitting hospital, and its impact on health care disparities. Yet, examining differences in hospital admission for black and white AMI patients in their given geographic context could help us better understand local, regional, and national disparities in coronary care.

The main objective of this study was to examine the association between patient race, distance, and institutional characteristics that might influence admission to particular hospitals for black and white AMI patients. The study framework is adapted from the traditional hospital choice model[12-13], which assumes that admission to a particular hospital given a set of alternatives (i.e. hospitals within a health care market for cardiac tertiary care) is dependent upon characteristics of available hospitals (i.e., location, scope of service and quality), individual patient characteristics (i.e., race, socioeconomic status, and acuity of illness), and distance to available hospitals. Specifically, we hypothesized that characteristics of admitting hospitals will differ significantly for blacks and whites and that differences will persist after accounting for distance from patient residence to available hospitals. In secondary analyses, we also sought to explore the role of residence in the final admitting hospital choice, matching black and white patients by the zip code areas where they live.

Methods

Data sources

The study used four primary data sources: 1) Medicare Provider Analysis and Review (MedPAR) Part A data to identify AMI patients and to calculate hospital-level revascularization volumes and mortality rates; 2) the Dartmouth Atlas to define regional health care markets; 3) the CMS Hospital Compare website to obtain hospital process performance measures; and 4) the American Hospital Association (AHA) 2005 survey to obtain additional hospital characteristics.

Study sample

We identified all Medicare patients admitted to US hospitals with a primary diagnosis of AMI (*International Classification of Diseases, Ninth revision, Clinical Modification* [ICD-9-CM] code 410) during 2005. Since hospital choices for patients with a prior AMI are likely to be influenced by a different set of factors (e.g., experience with illness and treating hospital) we excluded patients with a primary diagnosis of AMI within the previous three years, and patients younger than 68 in order to have three years of Medicare data.

The MedPAR files contain data on all Medicare fee-for-service hospitalizations, including patient zip code and demographics, primary and secondary diagnoses and procedures as defined by ICD-9-CM codes; admission source (e.g., transfer from another hospital); discharge disposition; and a six-digit unique identifier for the admitting hospital.

We assigned patients and admitting hospitals to distinct health care markets represented by 2005 Hospital Referral Regions (HRRs). Patients and hospitals were allocated using home and hospital zip codes, following Dartmouth Atlas algorithms (http://www.dartmouthatlas.org). We excluded patients who lived in zip codes outside the market area where they were admitted (N=25,393 [13%]), since these patients might have been traveling at the time of the AMI, thus rendering distance from home to available hospitals inaccurate. We also excluded patients who were transferred in from another hospital (N= 15,007 [8%]), since these patients' selection of hospitals would likely be influenced by a different set of factors from those determining the initial admission for treatment. We excluded patients for whom race was missing or defined as other than black or white (N=2,093 [4.2%]), limiting our comparisons to black and white patients with a first episode of AMI.

Finally, we excluded HRRs with fewer than 50 blacks admitted with AMI during 2005 (N=243), to allow for meaningful statistical comparisons. Characteristics of study HRRs are provided in the Supplemental Material section.

Characteristics of hospitals within selected markets

Based on prior literature on hospital choice[12-15], we primarily focused on two hospital characteristics expected to influence hospital choice: 1) availability of revascularization services (scope of service); and 2) hospital quality of care (defined below).

We categorized hospitals as having revascularization programs if they performed at least two coronary artery bypass graft (CABG) surgeries during 2005, based on calculated MedPAR volumes.

We assessed hospital quality using process performance measures and hospital-specific, risk-adjusted mortality rates. For both types of measures, we assumed that hospital selection is influenced by how patients perceive hospital quality of care prior to admission; hence, we used data collected prior to 2005 (i.e., 2004 data for process measures and 2002-2004 data for mortality rates).

We downloaded 2004 hospital AMI performance measures from the Hospital Compare website (www.hospitalcompare.hhs.gov). We selected 5 core AMI process measures for our analyses: 1) use of aspirin within 24 hours of arrival; 2) use of aspirin at discharge; 3) use of beta-blockers within 24 hours of arrival; 4) use of beta-blockers at discharge; and 5) the use of an angiotensin-converting-enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB) for left ventricular systolic dysfunction. We excluded three additional AMI measures available from the Hospital Compare database (time-to-reperfusion with either thrombolytics or percutaneous coronary intervention (PCI), and smoking cessation counseling) because they were reported by relatively few hospitals. For each measure, a hospital's score is calculated as the number of patients who received a given treatment divided by the number of patients eligible for the treatment. We used the five measures to create a single AMI process performance score for each hospital as the total number of treatments in a given hospital divided by the total number of treatments eligible in each hospital (i.e., the sum of individual measure numerators divided by the sum of individual measure denominators).[16] We excluded 110 hospitals (1,044 patients) that either had not reported measures for 2004, or reported less than a combined 25 eligible patients for these measures, thus rendering the scores less reliable.[16]

We calculated risk-adjusted mortality rates using data from Medicare beneficiaries admitted with AMI during 2002-2004. Hospital-specific risk-adjusted 30-day mortality rates were constructed as the ratio of predicted to expected mortality at each hospital, multiplied by the mean 30-day mortality rate for the population, using a methodology similar to the one employed by CMS.[17] Patient-level variables drawn from MedPAR records included demographics, comorbidities identified from ICD-9-CM diagnostic codes using well-established algorithms,[18-19] and AMI location, defined as anterior and lateral, inferior and posterior, subendocardial and other unspecified site based on ICD-9CM codes. Predicted and expected 30-day mortality were estimated using multivariable mixed models that included hospital random effects. Covariates included in the mortality model are displayed in Appendix 1.

For each hospital, we created a composite quality score comprised of the process performance score and the 30-day hospital-level survival rate (i.e., 1 minus standardized 30-day mortality rate). The quality score was calculated using a methodology similar to the one proposed by CMS's Hospital Quality Incentive Demonstration (HQID) project,[20] which weighs each of the process measures and standardized mortality equally. Thus, global scores for each hospital were calculated according to the following formula: (5/6*process performance score) + (1/6*30-day hospital survival rate). We defined high-quality hospitals as all hospitals ranking in the top 20% on the composite score (N=248); we defined low-quality hospitals as hospitals ranking in the bottom 20% on the composite score (N=249). All other hospitals (N=747) were defined as intermediate-quality hospitals.

We obtained other hospital characteristics from the 2005 AHA annual survey. We further excluded 8 hospitals (202 patients) that we were unable to link to the 2005 AHA survey. The survey provided data on hospitals' structural and operational characteristics including teaching status, ownership (e.g., for-profit status), and Medicaid caseload. We categorized hospitals as safety-net providers if the hospital's 2005 Medicaid caseload (based on AHA data) exceeded the mean for all hospitals within the state by one standard deviation.

We estimated travel distance as straight-line distance from patients' home residence to all hospitals within the patients' home HRR, using home and hospital 5 digit zip code based centroids.

Data analysis

For black and white patients we compared patient characteristics, distance to and characteristics of admitting hospitals using chi square statistics for dichotomous measures and t-tests or Wilcoxon rank sum tests for continuous measures.

We used conditional logit (McFadden) models[21] to examine the likelihood of admission to particular hospitals, given the characteristics of available hospitals within the patient's market. Conditional logit models, which assume that the selection of a particular hospital is conditional on the characteristics of other hospitals in the market, have been widely employed in research evaluating determinants of hospital choice.[12,14-15, 22]. In this case, we estimated the impact of hospital distance, presence of revascularization services, quality, teaching status, safety net status, and for profit status on the likelihood of admission to a given hospital. For each hospital characteristic, models incorporated separate effects for black and white patients that provided race-specific odds of admission to specific hospitals. Race-specific model estimates associated with each hospital characteristic were exponentiated to obtain the odds of admission to a hospital with a particular characteristic;

race-specific probabilities of admission to a hospital with a particular characteristic were calculated using the formula Odds / (1 + Odds). Risk ratios for black relative to white patients were calculated as the ratios of the race-specific probabilities of admission to a hospital with a given characteristic, with confidence intervals based on the pooled variance of the race-specific coefficients.

To evaluate the robustness of our findings, we performed several secondary analyses. To determine whether severity of illness influenced hospital choice, we conducted analyses stratified by AMI location. Furthermore, we calculated patient-level expected 30-day mortality rates (i.e., the rate of death that would be expected if the patients had been treated at an "average" hospital, given the "average" hospital's quality of care effect on mortality) based on the mortality risk adjustment model described above. Patients were stratified into low, intermediate and high risk of death, based on the expected mortality being in the lowest, middle two, and highest quartiles of the distribution. Analyses were conducted for each risk stratum.

To control for the impact of unmeasured differences in the characteristics of the environment where blacks and whites live on differences in admitting hospital characteristics, we repeated analyses on a subset of blacks and whites pair-matched by home zip code (N=10,422). Thus, if a zip code had 5 black and 3 white AMI patients, the matched sample would contain 3 black and 3 white patients; 2 white patients would be excluded randomly.

P-values were two-sided. Statistical significance was defined using a criterion of P<.01. All analyses were performed using SAS statistical software version 9.2 (Cary, NC).

Results

There were 57,342 (87.4%) whites and 8,291 (12.6%) blacks admitted during 2005 with a primary diagnosis of AMI to 1,244 US hospitals, in markets with at least 50 black AMI admissions for the study year. In unadjusted analyses, blacks were younger, more likely female, and more likely to reside in urban areas with lower zip code income (Table 1). Further characteristics of the study population are provided in Table 1.

Blacks lived substantially closer to hospitals with revascularization programs and to both high- and low-quality hospitals relative to whites, and traveled on average less for admission (Table 2). The closest hospital was also a revascularization hospital for 49% blacks and 47% whites, high quality hospital for 18% blacks and 23% whites, low quality hospital for 15% blacks and 12% whites, teaching hospital for 22% blacks and 10% whites and safety net hospital for 12% blacks and 74 whites (p<.001 for all comparisons).

In unadjusted analyses, proportions of admissions to hospitals with revascularization programs were only slightly higher for blacks relative to whites with AMI (Table 3). A lower proportion of blacks were admitted to high-quality hospitals, whereas a higher proportion of blacks were admitted to low-quality hospitals. Although statistically significant, these differences were small. Blacks were also more likely to be admitted to safety net hospitals and to teaching hospitals relative to whites (Table 3).

Table 4 shows how the likelihood of being admitted to a particular hospital is impacted by specific characteristics of available hospital, and distance from home to hospitals within patients' markets. The impact of each hospital characteristic on the likelihood of admission to a particular hospital type is shown separately for blacks and whites (columns 1 and 2), and for blacks relative to whites (i.e., the ratio of black and white probabilities of admission to hospitals with particular characteristics, column 3).

For both blacks and whites, the two most influential hospital characteristics were proximity to patient's residence and availability of revascularization services (Table 4). Thus, whites were nearly 4 times more likely to select the closest hospital over hospitals located farther from home, whereas blacks were 2.6 times more likely to select the closest hospital, controlling for distance to hospitals and other hospital characteristics. Similarly, whites and blacks were 3.5 times and 2.6 times more likely, respectively, to select a revascularization hospital over other hospitals without revascularization services.

Measures of hospital quality of care were somewhat less influential on the admitting hospital selection, although the relationship was statistically significant (Table 4). Sensitivity analyses using 15% and 25% cutoffs for quality definitions yielded similar results.

Lastly, blacks were more likely, while whites were less likely to select teaching hospitals; both blacks and whites were less likely to select safety net hospitals and for-profit hospitals as compared to hospitals without those characteristics (Table 4).

However, black patients with AMI were *relatively less* likely to select the closest hospital, hospitals providing coronary revascularization and high-quality hospitals, but *relatively more* likely to select low-quality hospitals, teaching hospitals, and safety net hospitals *as compared to white patients* (Table 4, Black: White Relative Risks).

Secondary analyses stratified by predicted risk of death or AMI location yielded similar results. For example, blacks with low, intermediate, or high risk of death were 13%, 12%, and 13% less likely to be admitted to high quality hospitals compared to whites with similar death risk.

To evaluate the effect of where patients live on hospital admission, we matched 63% (N=5,211 [63%]) blacks and 9% (N=5,211 [9%]) whites by home zip code. These patients were younger (mean age 80.2 vs. 80.7, p<.001), more likely to live in urban areas (73.0% vs. 68.9%, p<.001) and in zip codes with lower median household income ($ 36,900 vs. 54,100, p<.001) relative to unmatched patients.

In matched sample analyses (Table 5), racial differences in the likelihood of admission to closest hospitals, to revascularization hospitals, and to high-and low-quality hospitals were smaller and not statistically significant, but The statistical power was somewhat reduced (e.g., the power to detect a 10% black-white difference in likelihood of admission was 0.83 for high-quality hospitals, and 0.39 for low-quality hospitals). Blacks were still more likely than whites to be admitted to teaching and safety net hospitals.

Comment

Despite living substantially closer to hospitals with revascularization programs and to high quality hospitals, after adjusting for distance black patients with AMI were overall 13% and 12% less likely to be admitted to these hospitals relative to white patients treated for AMI in the same markets. On the other hand, black patients were 17% relatively more likely to be admitted to low quality hospitals, and 30% more likely to be admitted to teaching and safety net hospitals. In additional analyses restricted to black and white patients living in similar zip codes, hospital choices based on revascularization services and quality did not differ significantly, but black patients were still more likely to be admitted to teaching and safety net hospitals as compared to whites. Several of the study findings have potentially important implications and will be discussed below.

The finding that black patients were relatively less likely than white patients to be admitted to the closest hospital may be significant in light of strong evidence that , at least in the case of ST elevation AMI (STEMI), prompt coronary reperfusion improves survival after AMI.[23-24] Although we were not able to identify STEMI within administrative data, black patients were consistently less likely to select the closest hospital in analyses stratified by AMI location (i.e. anterior and lateral, inferior and posterior, and subendocardial). However, given that the absolute difference in proportions of blacks and whites admitted to the closest hospital was very low, the finding is unlikely to have a detectable impact on clinical outcomes for blacks and whites in this patient sample.

Second, although black patients live closer to revascularization hospitals, this geographic proximity did not translate into higher likelihood of admission to such hospitals. Several other studies have evaluated access to hospitals providing high technology cardiac services as a primary source of racial disparity in AMI treatment. An earlier study by Blustein et al[25] examined the association between race and admission to hospitals offering coronary revascularization services for patients admitted with AMI in the state of New York during 1986. The study found that black and white AMI patients presented equally to hospitals offering coronary revascularization services, but, after adjusting for distance to the nearest high-technology hospital, the white-to-black odds ratio for likelihood of admission to such a hospital was 1.68. This apparent discrepancy was attributed to racial differences in travel patterns (e.g., blacks being less likely to travel beyond the closest hospital, when the closest hospital was not a revascularization hospital). However, these analyses did not examine other hospital characteristics that may significantly influence hospital choice (e.g., hospital quality, teaching status), and were limited to New York state. Thus, results may not be generalizable to different hospital characteristics and to other US geographic areas. Indeed, the racial difference in likelihood of admission to revascularization hospitals in our study was considerably smaller.

As compared to this prior analysis, our study has several distinct advantages. The choice of a particular hospital over alternative hospitals in the market is explicitly modeled, based on hospitals available within a patient's market. Moreover, analyses are rooted in a theoretical framework for hospital choice, and control for distance and an array of hospital characteristics known to influence choice beyond hospitals' technological capabilities.

In fact, our study found racial differences in admitting hospital choice for multiple hospital characteristics. Notably, black patients with AMI were less likely to use high-quality hospitals and more likely to use low-quality hospitals relative to white patients, even though black patients lived substantially closer to high-quality hospitals than white patients.

This finding stands in contrast to our recently published study evaluating racial differences in admission to high quality hospitals for coronary heart disease.[26] The study, which identified high quality hospitals as hospitals consistently ranking on the *US News and World Report's* "Best Hospitals" list for cardiac care, found that black AMI patients were more likely to be admitted to these high quality hospitals relative to white patients. The apparently incongruent findings are likely explained by the use of different definitions for high quality hospitals in the two studies. In the first study, high-quality hospitals were represented by a relatively unique group of highly reputable, large teaching institutions. For the current study, we defined high-quality hospitals based on self reported process measures and risk-adjusted mortality; this definition captured hospitals with varied characteristics, located in a larger number of markets that do not necessarily overlap with the *US News and World Report's* top ranked hospital markets. Importantly, the discrepant results of these two studies once again highlight the role of location, as well as the choice of quality indicators, in evaluating racial disparities. The role of location is further strengthened by the finding that racial differences in admission to high-and low-quality hospitals in the current study did not persist when analyzing black and white patients in the same residential areas.

Perhaps the most informative finding of the study is the fact that racial differences in hospital admission persisted after accounting for distance to available hospitals, but were generally smaller and not statistically significant in analyses restricted to patients matched by home zip code. Prior to matching, racial differences might be explained by a number of unmeasured factors, including differences in mode of transportation to the hospital[27], differences in patient preferences for particular hospitals based on institutional factors[28] (e.g., patient and staff demographics), physician referral[29], or perceived discrimination.[30] While the lack of statistical significance in matched samples might be related to the diminished statistical power due to small sample size, it more likely indicates that racial differences in access to high quality hospitals are primarily driven not by race but by characteristics of neighborhoods where black and white patients live, including socioeconomic and cultural factors, and local health care networks. Indeed, geography is increasingly recognized as a source of racial disparities in health care,[31] leading the Institute of Medicine to conclude that ”minorities access to better quality facilities is often limited by the geographic distribution of care facilities and patterns of residential segregation, which results in higher quality facilities being less accessible”.[32]

Several study limitations merit further discussion. First, analyses do not reveal true patient preferences, but rather observed hospital admission patterns. Thus, results should be interpreted cautiously, in light of potential racial differences in hospital preference based on social factors (e.g., segregation) acting within geographic boundaries, and generating distrust in medical institutions and providers. Second, the study sample was limited to black and white Medicare beneficiaries. Prior research has shown that hospital choice is influenced by other factors, including age, disease type and severity and insurance status. Thus, findings may not be applicable to other age groups, private insurance or indigent patients, and other disease settings. Third, the study did not differentiate between STEMI and NSTEMI yet patterns of admission might differ significantly between these two conditions due to disease acuity. Although blacks tend to be diagnosed slightly less often with STEMI,[33] it is unlikely that these differences would fully explain the results of our study. Moreover, analyses stratified by AMI location showed consistent findings. Lastly, we calculated travel distance as straight line distance between patient home zip code and hospital zip code. Although this method has been validated in prior studies,[34] it is possible that, especially in urban markets, straight-line distance significantly underestimates actual road travel distance and time.

Despite these limitations, the current study sheds an important light on factors contributing to racial disparities in AMI treatment. The study confirms the role of differential access to hospitals with revascularization services and high quality of care as a plausible source of disparity. However, racial differences in access to high quality hospitals appear to be primarily driven not by race in itself, but by differences in where the majority of blacks and whites live and seek care. Effective policy recommendations aimed at reducing disparities need to take local socioeconomic and health care system factors into consideration.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Recent research has identified differential access to high quality hospitals care as an important, perhaps primary factor associated with racial disparities in treatment of acute myocardial infarction. However, the reasons why minorities are more often treated at hospitals with relatively lower quality of care are not fully understood. We examined the relationship between patient race, distance and admissions to hospitals with particular characteristics (e.g., provision of revascularization services, quality ranks) available to patients within defined hospital markets. We found that, after accounting for distance from home to available hospitals, black patients were overall less likely to be admitted to closest hospitals, to hospitals with revascularization programs, and to high quality hospitals. In secondary analyses limited to black and white patients living in similar zip codes, these differences were attenuated and not statistically significant. Our findings suggest that differences in admissions to hospitals with particular characteristics are not exclusively driven by race but also by characteristics of the environment where patients live. Such local context factors may include economic factors, community culture (e.g., perceived discrimination, high levels of distrust in the health care system), and physician referral practices. Practicing physicians need to be aware of and sensitive to such potential local barriers in access to high quality care.

Table 1

Characteristics of black and white patients treated for AMI during 2005 at hospitals within study HRRs

Patient Characteristics	**Black (N=8,291)**	**White (N=57,342)**	**P-value**
Age (mean, SD)	79.6 (7.7)	80.8 (7.5)	<.001
Female sex (%)	60.6 (5,028)	53.2 (30,500)	<.001
Census region (%)			
Northeast	16.3 (1,348)	24.4 (14,011)	
South	59.7 (4,949)	50.8 (29,122)	
Midwest	22.4 (1,859)	22.3 (12,767)	
West	1.6 (135)	2.5 (1,442)	
Urban residence (%)	80.0 (6,549)	69.0 (39,591)	<.001
Zip median household income ($, mean, SD)	33,620 (12,660)	45,300 (16,100)	<.001
Comorbidities (%)			
Heart failure	46.4 (3,848)	44.3 (25,405)	<.001
Arrhythmia	24.6 (2,040)	33.7 (19,301)	<.001
Chronic obstructive lung disease	19.8 (1,646)	24.3 (13939)	<.001
Fluid and electrolyte imbalance	25.4 (2,109)	20.8 (11,924)	<.001
Renal insufficiency	14.4 (1,195)	9.3 (5,316)	<.001
Dementia	5.9 (491)	4.6 (2,607)	<.001
Neurological disorder	7.5 (619)	5.3 (3,027)	<.001
Metastatic cancer	1.5 (126)	1.1 (657)	.003
Weight loss	3.2 (269)	1.7 (994)	.<001
AMI location			
Anterior and lateral	10.0 (829)	11.6 (6,647)	<.001
Inferior and posterior	8.8 (732)	12.3 (7,047)	<.001
Subendocardial	69.7 (5,778)	64.2 (36,821)	<.001
Other site	11.5 (952)	11.9 (6,827)	0.26

Table 2

Distances from the home residence of black and white AMI patients admitted during 2005 to hospitals available within the study HRRs

Distance, in miles (median, [IQR])	**Black (N=8,291)**	**White (N=57,342)**	**P-value**
Closest hospital	**2.2** (0-2.3)	**2.9** (0-6.5)	<.001
Closest hospital with revascularization	**3.8** (2.0-10.9)	**6.8** (2.9-17.1)	<.001
Closest high quality hospital	**5.6** (2.8-16.5)	**9.7** (4.0-25.4)	<.001
Closest low quality hospital	**25.5** (9.0-54.7)	**36.9** (17.4-62.0)	<.001
Admitting hospital	**3.4** (1.4 – 7.0)	**4.7** (1.7-10.3)	<.001

Table 3

Unadjusted proportions of black and white patients admitted during 2005 with AMI to hospitals available within the study HRRs

Admitting hospital characteristic (%)	Black (N=8,291)	White (N=57,342)	P-value
Closest hospital	55.5 (4,248)	56.1 (32,177)	<.001
Revascularization hospital	60.9 (5,048)	59.0 (33,850)	.0013
Top 20% quality hospital	21.1 (1,753)	25.0 (14,345)	<.001
Bottom 20% quality hospital	10.8 (898)	9.0 (5,161)	<.001
Safety net	15.3 (1,267)	5.4 (3,094)	<.001
Teaching hospital	33.2 (2,754)	17.2 (9,845)	<.001
For profit hospital	12.8 (1,060)	13.3 (7,633)	0.19

Table 4

Distance-adjusted odds and relative risk (RR) of admission to hospitals with particular characteristics for black and white AMI patients in study HRRs

Hospital characteristic	Black Odds (95% CI)	P-value	White Odds (95% CI)	P-value	Black: White Relative Risk* (95% CI)	P-value
Closest hospital	2.60 (2.54-2.67)	<.001	3.98 (3.95-4.01)	<.001	0.90 (0.83-0.98)	0.005
Revascularization center	2.10 (2.03-2.17)	<.001	3.48 (3.45-3.51)	<.001	0.87 (0.80-0.95)	<.001
High quality	0.75 (0. 68-0.82)	<.001	0.95 (0.92-0.97)	<.001	0.88 (0.81-0.95)	<.001
Low quality	0.63 (0.52-0.74)	<.001	0.49 (0.45-0.54)	<.001	1.17 (1.05-1.29)	0.003
Teaching	1.47 (1.40-1.54)	<.001	0.87 (0.84-0.90)	<.001	1.28 (1.20-1.35)	<.001
Safety net	0.84 (0.77-0.92)	<.001	0.54 (0.49-0.58)	<.001	1.31 (1.22-1.40)	<.001

* The probability of admission to a hospital with a particular characteristic is given by the following formula: Odds / (1 + Odds). Thus, the Relative Risk Ratios are calculated as the ratio of probabilities (rather than the ratio of odds) as follows: $[Odds_{black} / (1 + Odds_{black})] / [Odds_{white} / (1+Odds_{white})]$.

Table 5

Distance-adjusted relative risk (RR) of admission to hospitals with particular characteristics for black and white AMI patients matched by zip code of residence

Hospital characteristic	Black Odds (95% CI)	P-value	White Odds (95% CI)	P-value	Black: White Relative Risk* (95% CI)	P-value
Closest hospital	2.82 (2.72-2.90)	<.001	3.03 (2.95-3.13)	<.001	0.98 (0. 85-1.10)	0.36
Revascularization center	2.18 (2.08-2.16)	<.001	2.86 (2.77-2 .95)	<.001	0.92 (0.80-1.05)	0.11
High quality	0.81 (0.72-0.90)	<.001	0.91 (0.83-0.99)	.03	0.94 (0. 81-1.07)	0.17
Low quality	0.59 (0.44-0.73)	<.001	0.48 (0.33-0.63)	<.001	1.15 (0.94-1.35)	0.09
Teaching	1.37 (1.28-1.46)	<.001	0.90 (0.82-0.99)	.009	1.23 (1.10-1.36)	<.001
For profit	0.70 (0.58-0.81)	<.001	0.61 (0.50-0.72)	<.001	1.09 (0.93-1.25)	.17

*The probability of admission to a hospital with a particular characteristic is given by the following formula: Odds / (1 + Odds). Thus, the Relative Risk Ratios are calculated as the ratio of probabilities (rather than the ratio of odds) as follows: $[Odds_{black} / (1 + Odds_{black})] / [Odds_{white} / (1+Odds_{white})]$.