Hospital Characteristics and Racial Disparities in Hospital Mortality from Common Medical Conditions

Jennifer R. Pippins, MD; Garrett M. Fitzmaurice, ScD; and Jennifer S. Haas, MD, MSPH

Objectives: Less is known about racial disparities in mortality from medical conditions than for procedures. We determined whether black–white disparities in risk-adjusted hospital mortality exist for five common conditions (myocardial infarction, congestive heart failure, cerebral vascular accident, gastrointestinal hemorrhage and pneumonia), and to determine the role of hospital characteristics.

Methods: We used the 2003 Nationwide Inpatient Sample. Where a mortality disadvantage for black patients was demonstrated, additional analyses assessed whether the degree of disparity varied by hospital characteristics.

Results: Mortality for black patients was equivalent to or lower than that for white patients for four of the five conditions. Black patients were more likely than white patients to die from gastrointestinal hemorrhage (1.5% vs. 1.1%, p<0.001). In multivariate analysis, hospital racial composition was the only characteristic associated with degree of disparity for gastrointestinal hemorrhage, with hospitals discharging fewer black patients demonstrating greater disparity.

Conclusions: In a large, multistate sample, there was no evidence of disparities in mortality for four of five common conditions. Black–white racial disparities in mortality from gastrointestinal hemorrhage, however, may be associated with hospital racial composition.

Key words: race/ethnicity ■ health disparities ■ mortality

 From the Division of General Medicine and Primary Care, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA. Send correspondence and reprint requests for *J Natl Med Assoc.* 2007;99:1030–1036 to: Dr. Jennifer Haas, Division of General Medicine and Primary Care, Brigham and Women's Hospital, 1620 Tremont St., Boston, MA 02120-1613; phone: (617) 732-7063; fax: (617) 732-7072; e-mail: jhaas@partners.org

INTRODUCTION

Racial disparities in hospital mortality from surgical procedures are well documented.[1] Among medical conditions, disparities in outcomes from acute myocardial infarction (MI) have received particular attention. A recent study examined the care received by black patients and white patients with acute coronary syndrome after having been admitted to 400 U.S. hospitals.[2] While black patients were less likely to receive newer treatments for acute coronary syndrome, there were no racial disparities in the receipt of older treatments, nor was there any difference in hospital mortality. Similarly, in a study of black veterans and white veterans presenting with acute MI, black patients were less likely than white patients to receive thrombolytic therapy or bypass surgery, but there was no difference in all-cause mortality at 30 days, one year or three years.[3]

Less is known about racial disparities in hospital mortality from other common medical conditions such as congestive heart failure (CHF), cerebral vascular accident (CVA), gastrointestinal hemorrhage (GIH) and pneumonia. While some studies on mortality show a black–white disparity, most studies show either no difference or a survival advantage for black patients. A study focused on hospital mortality among black patients and white patients admitted to one of 30 hospitals in northeast Ohio with one of six medical conditions (acute MI, CHF, obstructive airways disease, GIH, pneumonia or CVA) found a survival advantage for black patients admitted with either CHF or obstructive airways, and found no black-white differences for the other four conditions.[4] A study of black veterans and white veterans admitted to 147 Veterans Affairs (VA) hospitals with pneumonia, angina, CHF, chronic obstructive pulmonary disease, diabetes mellitus and chronic renal failure found a survival advantage for black patients when compared to white patients, with black patients having lower overall hospital, 30-day and six-month mortality rates.[5] Black patients hospitalized for CVA have been shown to have a higher three-year mortality than white patients, but other studies on CHF, GIH and pneumonia have demonstrated either no black–white difference in mortality or a black survival advantage.[6-9]

These findings indicate that for some of the most common medical conditions, including acute MI, CHF,

GIH and pneumonia, there is no black–white disparity in mortality—instead, in some cases, there may be a survival advantage for black patients. These prior studies have been limited by a focus on specific populations (e.g., veterans, Medicare population). The objective of this study is to determine whether black–white disparities (i.e., mortality for black patients exceeding mortality for white patients) in risk-adjusted hospital mortality exist for five common medical conditions (acute MI, CHF, CVA, GIH and pneumonia) using a large, multistate sample of a broad variety of patients, and to determine whether degree of black–white disparity, if it exists, varies with hospital characteristics.

METHODS

Data

The source of data for this project was the 2003 Nationwide Inpatient Sample (NIS).[10] NIS is a database of hospital inpatient stays and is a part of the Healthcare Cost and Utilization Project (HCUP), which is sponsored by the Agency for Healthcare Research and Quality (AHRQ). The 2003 NIS contains information on 7,977,728 discharges from 994 hospitals from 37 states across the nation. The NIS contains information regarding the hospital inpatient stay, including admission diagnosis, secondary diagnoses, age, gender, race (for 26 of the 37 states), disposition (including death), as well as information regarding the hospitals themselves (e.g., location, teaching status, etc.). All the data, including those for race, are obtained from hospitals and reflect the type of information typically included in a discharge abstract.[10]

Given the interest in whether hospital characteristics impact the degree of black–white disparity, a hospital-level analysis was performed. In order to be eligible for inclusion, a hospital had to be from one of the 26 states that report race data, had to have ≥730 discharges a year. In addition, hospitals had to have ≥3 discharges with the principle diagnosis of interest for both black patients and white patients; this is in keeping with the inpatient quality indicator software available from AHRQ which will calculate risk-adjusted rates only for cells having equal or greater than three discharges.[11] Separate samples were used for each of the five medical conditions of interest.

Measures

The outcome measure was risk-adjusted hospital mortality for each medical condition. This is an aggregate measure occurring at the level of the hospital (i.e., the unit of analysis is the hospital and not the individual). Mortality rates were risk adjusted for age, gender and comorbid illness using an automated procedure based on APR-DRG software provided by AHRQ.[13] This risk-adjustment package assesses mortality risk based on a patient's secondary diagnoses.

The hospital characteristics that were examined included hospital location and teaching status (rural, urban nonteaching and urban teaching; the rural hospitals were not further categorized by teaching status because of the small number of rural teaching hospitals), hospital bed size (small, medium, large; based on number of hospital beds, and taking into account both hospital location and teaching status[10]), hospital racial composition (categorized as <6% of patients discharged of black race, 6–30% of black race or >30% of black race, similar to prior work[12]), hospital insurance composition (percentage of patients on Medicaid, percentage of patients uninsured) and hospital volume for the medical condition of interest (each categorized as quartiles).

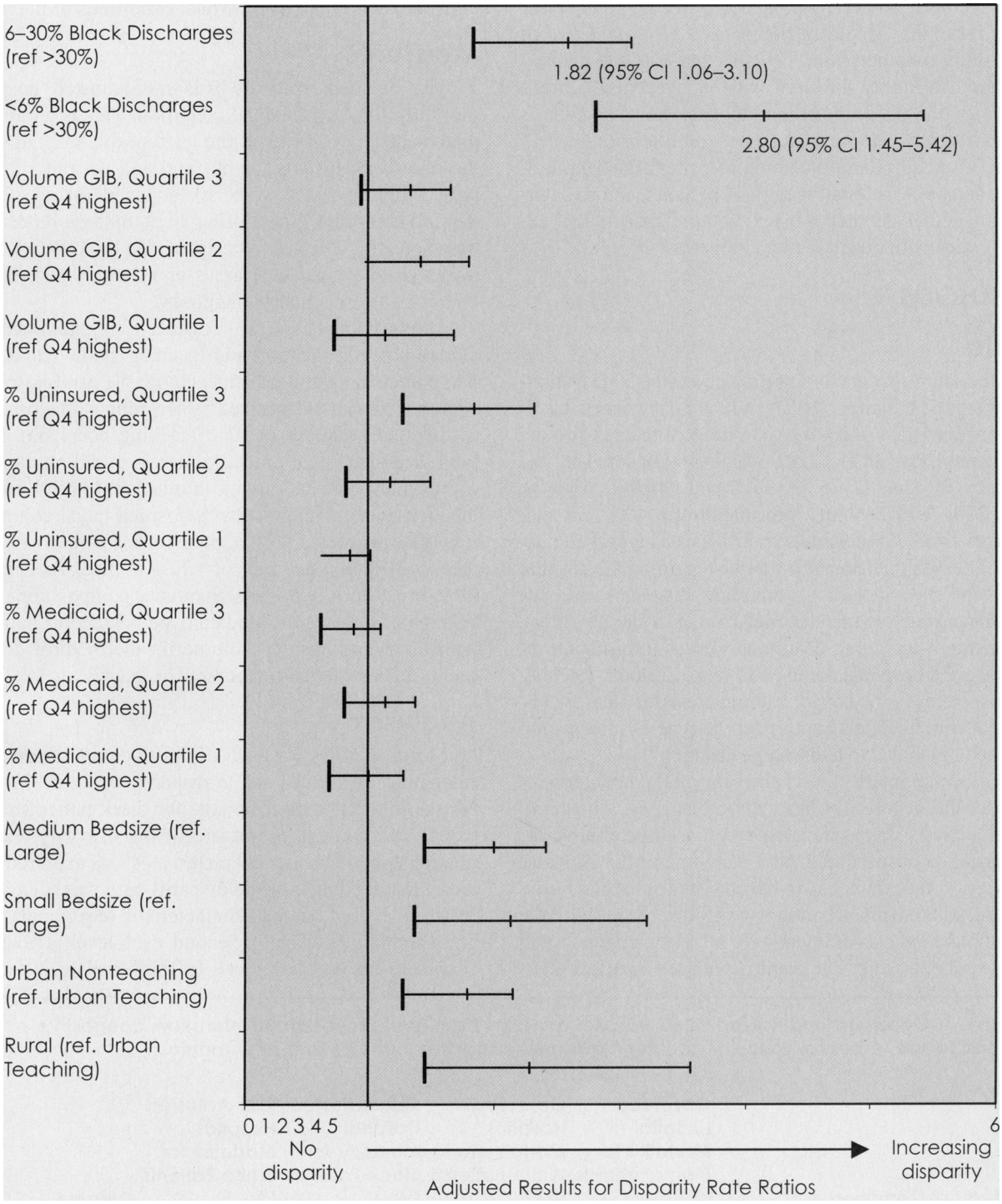
Analyses

Mortality rates for each of the five conditions were calculated. If a black–white disparity was demonstrated (i.e., mortality disadvantage for black patients compared with whites), the nature of the disparity and its relationship to hospital characteristics was explored further. First, the black–white disparity rate was calculated for each level of hospital characteristic (e.g., small, medium and large bed size). Second, each level of hospital characteristic was compared to a referent level (small

Table 1. Observed and risk-adjusted hospital mortality from acute myocardial infarction, congestive heart failure, cerebral vascular accident, gastrointestinal hemorrhage and pneumonia

Medical Condition	Observed Hospital Mortality for Black Patients (%)	Observed Hospital Mortality for White Patients (%)	Risk-Adjusted Hospital Mortality for Black Patients (%)	Risk-Adjusted Hospital Mortality for White Patients (%)	P Value
Acute myocardial infarction	9.2	8.9	11.6	11.7	0.79
Congestive heart failure	2.4	5.0	4.2	5.0	<0.001
Cerebral vascular accident	10.7	12.1	12.1	13.1	0.05
Gastrointestinal hemorrhage	3.2	3.3	1.5	1.1	<0.001
Pneumonia	6.8	8.4	10.2	10.8	0.01

Figure 1. Relationship between hospital characteristics and disparity in risk-adjusted mortality from gastrointestinal hemorrhage



Rural: Rural location; Urban nonteaching: Urban nonteaching location/teaching status; Small: Small bed size; Medium: Medium bed size; % Medicaid, Q1: Quartile 1 (lowest) for number of patients in hospital on Medicaid; % Medicaid, Q2: Quartile 2 for number of patients in hospital on Medicaid; % Medicaid, Q3: Quartile 3 for number of patients in hospital on Medicaid; % Uninsured, Q1: Quartile 1 (lowest) for number of patients in hospital without insurance; % Uninsured, Q2: Quartile 2 for number of patients in hospital without insurance; % Uninsured, Q3: Quartile 3 for number of patients in hospital without insurance; Volume GIH, Q1: Quartile 1 (lowest) for volume of gastrointestinal hemorrhage cases; Volume GIH, Q2: Quartile 2 for volume of gastrointestinal hemorrhage cases; Volume GIH, Q3: Quartile 3 for volume of gastrointestinal hemorrhage cases; <6% Black discharges: Hospital racial composition of <6% discharges for black patients; 6–30% Black discharges: Hospital racial composition of 6–30% discharges for black patients

compared to large bed size) to determine whether or not there was an association between that hospital characteristic and the black–white disparity rate. Finally, all of the hospital characteristics were entered into a multivariate model to determine, after full adjustment, which associations persisted between hospital characteristics and black–white disparity in mortality.

Analyses of mortality rates were based on a loglinear (i.e., Poisson) regression model that appropriately adjusted for the complex survey design; analyses were implemented in SUDAAN version 9.0 (Research Triangle Institute, Research Triangle Park, NC). This analysis was reviewed and approved by the Partners HealthCare institutional review board.

RESULTS

There were 252 hospitals included in the acute MI sample (6,875 black patients and 46,089 white patients), 376 in the CHF sample (31,342 black patients and 97,242 white patients), 308 in the CVA sample (12,551 black patients and 42,326 white patients), 324 in the GIH sample (10,851 black patients and 42,509 white patients), and 391 in the pneumonia sample (21,654 black patients and 119,225 white patients).

Observed and risk-adjusted mortality rates for blacks and whites for each of the five medical conditions are presented in Table 1 (the p values in Table 1 refer to the difference in the risk-adjusted mortality rates). The hospital risk-adjusted mortality for black patients was either equivalent to or lower than that for whites for four of the five conditions studied (acute MI, CHF, CVA and pneumonia). Black patients were more likely than whites to die from GIH, with hospital mortality rates of 1.5% and 1.1%, respectively ($p<0.001$).

Table 2 presents the next step of our analysis, which was conducted only for mortality from GIH given that this was the only condition for which a black–white disparity was demonstrated. In this table, the black–white

Table 2. APR–DRG adjusted black–white hospital mortality disparity rate from gastrointestinal hemorrhage, by hospital characteristics (n=324 hospitals)

	Number of Hospitals (%)	Disparity Rate (Black–White)	95% Confidence Interval	P Value
Percent Discharges for Black Patients				
>30% Black	41 (13)	0.94	0.60–1.46	0.78
6–30% Black	192 (59)	1.51	1.19–1.92	0.001
<6% Black	91 (28)	2.18	1.52–3.16	<0.001
Volume of Gastrointestinal Hemorrhage Cases				
Quartile 4	82 (25)	1.34	0.94–1.90	0.10
Quartile 3	80 (25)	1.52	0.95–2.44	0.08
Quartile 2	82 (25)	1.72	1.12–2.66	0.01
Quartile 1 (lowest)	80 (25)	1.51	0.99–2.27	0.05
Percent of Discharges Uninsured				
Quartile 4	81 (25)	1.67	1.17–2.34	0.004
Quartile 3	81 (25)	2.03	1.12–3.67	0.02
Quartile 2	81 (25)	1.57	0.94–2.64	0.08
Quartile 1 (lowest)	81 (25)	1.05	0.77–1.45	0.75
Percent of Discharges on Medicaid				
Quartile 4	81 (25)	1.49	1.03–2.16	0.03
Quartile 3	81 (25)	1.09	0.68–1.73	0.71
Quartile 2	88 (27)	1.52	1.04–2.23	0.03
Quartile 1 (lowest)	74 (23)	1.45	0.90–2.36	0.13
Hospital Bed Size				
Large	156 (48)	1.34	1–1.79	0.05
Medium	110 (34)	1.82	1.22–2.72	0.003
Small	58 (18)	1.42	0.79–2.56	0.25
Hospital Location/Teaching Status				
Urban/teaching	99 (31)	1.22	0.85–1.73	0.28
Urban/nonteaching	170 (52)	1.68	1.27–2.25	<0.001
Rural	55 (17)	1.67	0.94–2.91	0.08

disparity rates are presented, stratified by each level of the covariates for hospital characteristics (e.g., a disparity rate is presented for small, medium and large hospitals). The 95% confidence interval gives the range for the disparity rates, and the p value indicates whether the black–white comparison was statistically significant for that level for each covariate. Black–white disparity in hospital mortality was demonstrated for urban nonteaching hospitals, medium-sized hospitals, hospitals with a larger percentage of uninsured discharges, and for hospitals having ≤30% discharges of black patients. There was no consistent association with the volume of Medicaid discharges or the volume of discharges with GIH.

To determine whether hospital characteristics are associated with the degree of black–white disparity (disparity rate ratio) of hospital mortality from GIH, we examined the interaction between each characteristic and disparity. The test for interaction was significant for only one hospital characteristic: hospital racial composition ($p<0.02$).

The next and final step of our analysis is presented in Table 3 and Figure 1. This multivariate model simultaneously adjusted for all of the hospital characteristics. In this model, hospital racial composition was the only hospital characteristic associated with the degree of black–white disparity (disparity rate ratio) in hospital mortality from GIH. Hospitals having <6% discharges of black patients demonstrated greater disparity than the reference group of hospitals with >30% discharges of black patients (adjusted disparity rate ratio 2.80, 95% CI 1.45–5.42); in addition, in the adjusted analysis hospitals having 6–30% discharges for black patients also demonstrated greater disparity than the reference group (adjusted disparity rate ratio 1.82, 95% CI 1.06–3.10). The hospital mortality for black patients exceeded that for white patients, with <6% and 6–30% discharges for black patients; however, the rate for black patients was less than that for white patients in hospitals with >30% discharges for black patients (Figure 2).

DISCUSSION

The absence of a black–white disparity in hospital mortality in a broad population of patients with four common medical conditions is in keeping with prior studies, which have generally demonstrated either no black–

Table 3. Multivariate results for disparity rate ratio from log-linear regression

	Disparity Rate Ratio	95% Confidence Interval	P Value
Percent Discharges for Black Patients			
>30% Black	Ref.	Ref.	Ref.
6–30% Black	1.82	1.06–3.10	0.03
<6% Black	2.80	1.45–5.42	0.002
Volume of Gastrointestinal Hemorrhage Cases			
Quartile 4	Ref.	Ref.	Ref.
Quartile 3	0.93	0.53–1.65	0.81
Quartile 2	0.96	0.51–1.79	0.89
Quartile 1 (lowest)	0.72	0.30–1.68	0.45
Percent of Discharges Uninsured			
Quartile 4	Ref.	Ref.	Ref.
Quartile 3	1.26	0.69–2.32	0.45
Quartile 2	0.81	0.45–1.48	0.49
Quartile 1 (lowest)	0.61	0.37–1.01	0.05
Percent of Discharges on Medicaid			
Quartile 4	Ref.	Ref.	Ref.
Quartile 3	0.60	0.33–1.08	0.09
Quartile 2	0.79	0.45–1.36	0.39
Quartile 1 (lowest)	0.67	0.35–1.27	0.22
Hospital bed size			
Large	Ref.	Ref.	Ref.
Medium	1.43	0.86–2.41	0.16
Small	1.35	0.57–3.22	0.50
Hospital Location/Teaching Status			
Urban/teaching	Ref.	Ref.	Ref.
Urban/nonteaching	1.26	0.74–2.14	0.39
Rural	1.43	0.58–3.56	0.44

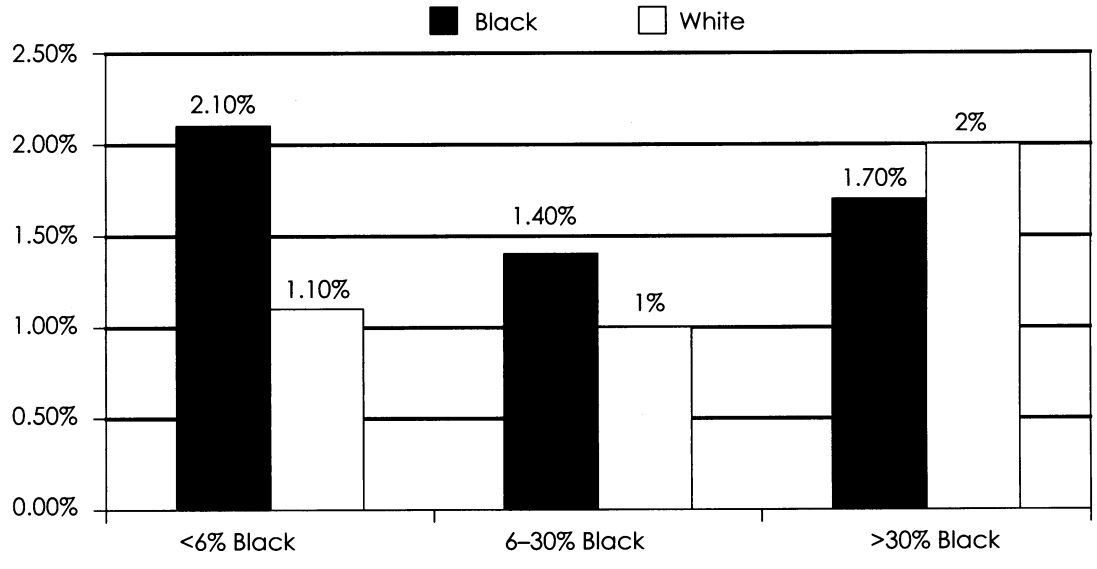
white difference in mortality or, in some cases, a survival advantage for black patients.[2-6,8-9] This finding, however, remains somewhat counterintuitive given that national death certificate data from 2002 demonstrate that blacks have greater age-adjusted mortality from ischemic heart disease (203.0 per 100,000 compared to 169.8 per 100,000 for whites), cerebrovascular disease (76.3 per 100,000 compared to 54.2 per 100,000 for whites) and influenza and pneumonia (24.0 per 100,000 compared to 22.4 per 100,000 for whites).[14] A number of explanations for the absence of black–white disparity in mortality have been suggested. These include the idea that disparities in access to invasive cardiac procedures may be more likely to impact long-term outcomes than outcomes in the acute inpatient setting,[2] the argument that more-equal access to care (such as that in the VA setting) may eliminate black–white disparities,[4] and the suggestion that black patients may be more likely to die from these illnesses prior to hospitalization than whites.[5,9]

The finding of a black–white disparity in hospital mortality from GIH represents a departure from prior studies. There is a limited body of work addressing the issues of racial disparities in mortality from GIH; one of the largest studies found no black–white difference in 30-day mortality from GIH; however, the study was limited to Medicare patients with GIH only from peptic ulcer disease—a population notably different from ours.[7] Another study, which examined hospital mortality in northeast Ohio from a number of medical conditions, found no black–white disparity in mortality from GIH.[9]

In our study, the only hospital characteristic that was associated with degree of black–white disparity in hospital mortality from GIH was the racial composition of hospital discharges, with hospitals having a lower prevalence of black patients demonstrating greater black–white disparity. While there is a smaller gap in hospital mortality rates for black and white patients in hospitals with >30% discharges for black patients, this is largely due to a substantial increase in white mortality in these "more minority" hospitals. Smaller black–white disparity may therefore be reflective of worse overall quality of care for GIH in these hospitals. It is unclear why hospitals with a higher proportion of black patients may have worse outcomes than their counterparts. One possibility is that these results reflect the impact of low levels of insurance coverage among the populations served by these hospitals. While black individuals are known to have higher levels of uninsurance (19.7% compared to 11.3% for non-Hispanic whites in 2004),[15] the pattern seen in this study persisted even after controlling for the percentage of patients in the hospital who were uninsured or on Medicaid. Insurance reimbursement, however, is only one of a multitude of resources needed for a hospital to function. Hospital racial composition, therefore, may be a marker for any number of a hospital's resources (i.e., access to specialty care, number and quality of hospital staff, etc.); variation in the availability of such resources could impact the quality of care and, in turn, hospital mortality. There is evidence for this in the realm of primary care, with 80% of visits by black Medicare beneficiaries accounted for by only 22% of physicians; the group of physicians taking care of the majority of black patients, moreover, is less likely to be board certified and more likely to report barriers to providing high-quality care.[16]

The relationship between hospital racial composition and racial disparities in care has been looked at in several other studies. In contrast to our results, a study focused on racial disparities in the use of emerging technologies among Medicare beneficiaries in the 1990s

Figure 2. Risk-adjusted mortality from gastrointestinal hemorrhage, by hospital racial composition



found that disparities were greater among hospitals with higher proportions of black patients. Similar to our results, however, was the finding that hospitals with larger proportions of black patients demonstrated lower overall use of emerging technologies among all patients—both black and white—a result akin to our finding of higher hospital mortality from GIH for both black and white patients cared for in hospitals with the highest proportion of black patients.[12] Another study, which was focused on racial disparities in the treatment of and outcomes from acute MI, found that black patients were less likely than whites to receive various medical treatments in the hospital, but that they had better 30-day and one-year morality rates than whites.[17] In this study, 85% of black patients were cared for at <25% of the hospitals in the sample, while only 40% of white patients were cared for at these same hospitals—leading the authors to the conclusion that race impacts where patients receive care, and that differences among hospitals are an important mediator of racial disparities in care.

Our study has a number of limitations. The data on race are obtained from hospitals and reflect the type of information typically included in discharge abstracts;[10] to that extent, it is subject to the limitations of administrative data. While we used an established risk-adjustment method (APR-DRG), any risk-adjustment process has limitations.[18] The APR-DRG method is limited in that it is only able to adjust to the extent that clinical information about the individual is captured by administrative data. Prior work, however, has established APR-DRG as a valid risk-adjustment method for acute MI.[19] These data do not include patient-level data on socioeconomic characteristics. In addition, we do not have additional data about other hospital characteristics—such as operating budget, number and types of hospital staff, and availability of specialty care—which may differ among hospitals with different racial compositions and thereby mediate the observed differences in hospital mortality for GIH. The data for our study are drawn from the 26 states in the NIS reporting race data and include only black and white individuals, thereby limiting generalizabilty. Our sample size is nevertheless substantial (>50,000 discharges taking place in 324 hospitals for the GIH analysis).

In conclusion, in this large, multistate sample of hospital discharges, we did not demonstrate black–white disparity in hospital mortality was found for four of five common medical conditions (acute MI, CHF, CVA and pneumonia). Black patients had a higher rate of hospital mortality from GIH compared to white patients, and the degree of black–white disparity was related to hospital racial composition, with hospitals having ≤30% discharges of black patients demonstrating more black–white disparity compared with hospitals having >30% discharges. This difference in black–white disparity, however, was largely due to a substantial increase in white hospital mortality from GIH in hospitals with >30% discharges of black patients when compared to hospitals having a smaller proportion of black patients, suggesting that these hospitals may provide poorer quality of care for both black patients and white patients.

REFERENCES

1. Lucas FL, Stukel TA, Morris AM, et al. Race and Surgical Mortality in the United States. *Ann Surg.* 2006;243:281-286.

2. Sonel AF, Good CB, Mulgund J, et al. Racial variations in treatment and outcomes of black and white patients with high-risk non-ST-elevation acute coronary syndromes: insights from CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC/AHA Guidelines?) *Circulation.* 2005;111:1225-1232.

3. Petersen LA, Wright SM, Peterson ED, et al. Impact of race on cardiac care and outcomes in veterans with acute myocardial infarction. *Med Care.* 2002;40:186-196.

4. Gordon HS, Harper DL, Rosenthal GE. Racial variation in predicted and observed hospital death. A regional analysis. *JAMA.* 1996;276:1639-1644.

5. Jha AK, Shilpak MG, Hosmer W, et al. Racial differences in mortality among men hospitalized in the Veterans Affairs health care system. *JAMA.* 2001;285:297-303.

6. Bian J, Oddone EZ, Samsa GP, et al. Racial differences in survival post cerebral infarction among the elderly. *Neurology.* 2003;60:285-290.

7. Rathore SS, Foody JM, Wang Y, et al. Race, quality of care, and outcomes of elderly patients hospitalized with heart failure. *JAMA.* 2003:289:2517-2524.

8. Cooper GS, Yuan Z, Rosenthal GE, et al. Lack of gender and racial differences in surgery and mortality in hospitalized Medicare beneficiaries with bleeding peptic ulcer. *J Gen Intern Med.* 1997;12:485-490.

9. Haas JS, Dean ML, Hung Y, et al. Differences in mortality among patients with community-acquired pneumonia in California by ethnicity and hospital characteristics. *Am J Med.* 2003;114:660-664.

10. HCUP Databases. Healthcare Cost and Utilization Project (HCUP). 2003 Nationwide Inpatient Sample (NIS). www.hcup-us.ahrq.gov/nisoverview.jsp. Accessed 09/16/2006.

11. AHRQ Quality Indicators—Inpatient Quality Indicators: Software Documentation, Version 2.1, SAS. Rockville, MD: Agency for Healthcare Research and Quality, 2002. Revision 4 (December 22, 2004). AHRQ Pub. No 02-R0205.

12. Groeneveld PW, Laufer SB, Garber AM. Technology diffusion, hospital variation, and racial disparities among elderly medicare beneficiaries 1989–2000. *Med Care.* 2005;43:320-329.

13. Inpatient Quality Indicators Overview. AHRQ Quality Indicators, February 2006. Rockville, MD: Agency for Healthcare Research and Quality. www.qualityindicators.ahrq.gov/iqi_overview.htm. Accessed 07/17/06.

14. www.cdc.gov/nchs/data/hus/hus04trend.pdf. Accessed 06/26/2006.

15. www.census.gov/prod/2005pubs/p60-229.pdf. Accessed 06/26/06.

16. Bach PB, Pham HH, Schrag D, et al. Primary care physicians who treat blacks and whites. *N Engl J Med.* 2004; 351:575-584.

17. Barnato AE, Lucas FL, Staiger D, et al. Hospital-level racial disparities in acute myocardial infarction treatment and outcomes. *Med Care.* 2005;43:308-319.

18. Iezzoni LI, Ash AS, Shwartz M, et al. Judging hospitals by severity-adjusted mortality rates: the influence of severity-adjustment method. *Am J Public Health.* 1996;86;1379-1387.

19. Romano PS, Chan BK. Risk-adjusting acute myocardial infarction mortality: are APR-DRGs the right tool? *Health Serv Res.* 2000;34:1469-1489. ■