Differential Association of Race With Treatment and Outcomes in Medicare Patients Undergoing Diverticulitis Surgery

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Background: Observed racial disparities in diverticulitis surgery have been attributed to differences in health insurance status and medical comorbidity.

Objective: To examine disparities in procedure type (elective vs urgent/emergency) and mortality in patients with surgically treated diverticulitis insured by Medicare, accounting for comorbidities.

Design: Retrospective analysis of Medicare Provider Analysis and Review inpatient data.

Patients: All blacks and whites 65 years and older undergoing surgical treatment for primary diverticulitis with complete admission and outcome data were eligible.

Main Outcome Measures: In-hospital mortality was examined across procedure categories (elective vs urgent/emergency). Multivariable regression controlled for age, sex, and medical comorbidity (Charlson Comorbidity Index).

Results: A total of 49,937 whites and 2,283 blacks met the study criteria. Blacks were slightly younger (74.7 vs 75.5 years, \(P<.001\)) and more likely to be female (75.2% vs 69.8%, \(P<.001\)). Blacks carried greater comorbidity than did whites (mean Charlson Comorbidity Index score: 0.98 vs 0.87, \(P<.001\); 67.8% of blacks vs 54.7% of whites \(P<.001\) were urgent/emergency. After adjustment, blacks demonstrated 26% greater risk of urgent/emergency admission (relative risk, 1.26; 95% CI, 1.22-1.30). Black race was also associated with a 28% greater risk of mortality (relative risk, 1.28; 95% CI, 1.10-1.51).

Conclusions: Blacks underwent urgent/emergency surgery more often than did whites. Blacks demonstrated significantly increased mortality risk after controlling for age, sex, and comorbidities. These findings suggest that observed racial disparities encompass more than just insurance status and medical comorbidity. Mechanisms leading to worse outcomes for blacks must be elucidated.

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DIVERTICULAR DISEASE imposes a substantial clinical burden on the US population and accounts for approximately 300,000 hospital admissions and estimated direct health care costs of $2.4 billion annually.1-3 Diverticular disease is a common gastrointestinal tract condition, particularly in the elderly population, and up to 25% of the population can be expected to develop signs and symptoms of acute diverticulitis.4 Treatment is straightforward for patients who present in extremis with acute, complicated diverticulitis: these individuals require emergency surgery, and outcomes are known to be poor.5 Patients who are treated nonoperatively (antibiotic drug therapy with or without percutaneous drainage) during an acute diverticulitis episode can go on to experience recurrent episodes and may be offered prophylactic colectomy to prevent future catastrophes.

Lack of health insurance is a powerful predictor of disease severity, suboptimal surgical treatment, and mortality in patients treated surgically for diverticulitis.6 Individuals with a lower socioeconomic status are less likely to be covered by health insurance, and blacks have a disproportionately lower socioeconomic status compared with whites. Blacks younger than 65 years are less likely to be insured than are whites.7 A previous study8 demonstrated higher rates of mortality, complication, and readmission comparing black surgical patients with whites undergoing similar surgical interventions. It has been suggested that the poorer health care outcomes seen in blacks can largely be accounted for by differences in socioeconomic status, including health insurance coverage, and greater underlying medical comorbidity.9
This study explores the hypothesis that race affects mortality independent of insurance status and comorbidities in an older population with diverticulitis. To accomplish this, mortality and treatment type (emergency/urgent vs elective surgical intervention) are compared in blacks and whites undergoing surgical treatment of diverticulitis in a cohort in which all the patients are insured under Medicare and undergoing medical comorbidity has been documented and can be controlled for.

### METHODS

After obtaining approval from the institutional review board at The Johns Hopkins School of Medicine, Baltimore, Maryland, data derived from the longitudinal Medicare Provider Analysis and Review inpatient file were examined. For this analysis, all records related to inpatient claims occurring between January 1, 2004, and December 31, 2007, were examined.

We isolated patients 65 years and older who were categorized as being either black or white by the Center for Medicare and Medicaid Services and who had a primary diagnosis of diverticulitis (defined by International Classification of Diseases, Ninth Revision [ICD-9] coding as follows: 562.12, diverticulitis without hemorrhage, or 562.13, diverticulitis with hemorrhage). Patients meeting these criteria who underwent diverticulitis surgery (left colon resection: ICD-9 procedure codes 45.71, 45.75, 45.76, 45.79, 45.8, 48.62, and 48.63; colostomy: ICD-9 procedure codes 46.03, 46.1x, and 48.62; or ileostomy: ICD-9 procedure codes 46.01 and 46.2x) were eligible. To prevent bias attributable to substantially differing outcomes with malignant conditions, we excluded patients with a concurrent diagnosis of colorectal cancer (ICD-9 diagnosis codes 153.2, 153.3, 154.0, 154.1, 154.2, 154.3, and 154.8). Patients were categorized for comparison into 2 groups based on admission status. Surgical patients admitted on an emergency or urgent basis were classed as “emergency,” and surgical patients admitted electively were classified as “elective.” Differences in underlying medical comorbidity were cataloged using the Charlson Comorbidity Index. The ICD-9 diagnosis codes were examined to determine the presence of known contributors to the risk of mortality (eg, history of myocardial infarction, heart disease, vascular disease, diabetes, renal disorder, liver disease, and cancer). The presence of these disorders was used to generate a weighted Charlson Comorbidity Index score for each individual, which provides a means of comparing comorbidity-related mortality risk across groups and enables adjustment for overall comorbidity.

Surgery admission type, intestinal diversion (ileostomy and colostomy), 30-day readmission, and in-hospital mortality during the index hospitalization were captured from the data set and were examined for race. Underlying differences in patient characteristics between blacks and whites were examined using t, Mann-Whitney, and χ² tests. Proportions of emergency vs elective surgery and mortality were examined using χ² tests. Race-based risks associated with admission for emergency surgery and in-hospital mortality were examined using regression models adjusted for age, sex, and medical comorbidity (Charlson Comorbidity Index). Because outcomes were not rare (>10%), approximate relative risks (RRs) rather than odds ratios are reported. A modified Poisson approach using robust standard errors was used to calculate approximate RRs. A sensitivity analysis was performed to examine whether provider-related variability accounted for a significant portion of observed variance. Multivariable models clustered on Medicare provider were examined. Because no significant difference was observed between clustered and nonclustered models, all reported regression results are based on the more parsimonious nonclustered models. Analyses were completed using a commercially available software program (STATA 8.0; StataCorp LP, College Station, Texas).

### RESULTS

A total of 53,675 patients with a primary diagnosis of diverticulitis who underwent left colectomy, an ostomy procedure, or both were initially identified; 204 individuals were excluded because of comorbid colorectal cancer. Of the remaining 53,471 individuals, 52,220 were categorized as being either black or white and had complete data on admission type. Among these, 49,937 (95.6%) were white and 2283 (4.4%) were black. On average, blacks were slightly younger (74.7 vs 75.5 years) and more likely to be female (75.2% vs 69.8%) than were whites (P < .001 for both). Compared with whites, blacks carried greater overall comorbidity, as described by the Charlson Comorbidity Index (mean Charlson Comorbidity Index score: 0.98 vs 0.87, P < .001). Blacks had statistically significantly higher rates of congestive heart failure, diabetes mellitus, and renal disease but were similar to whites in terms of myocardial infarction, peripheral vascular disease, cerebrovascular disease, dementia, rheumatic disorder, peptic ulcer, liver disease, paralysis, and cancer, including metastatic disease (Table 1).

Compared with whites, blacks had higher rates of emergency admission for diverticulitis surgery (67.8% vs 54.7%, P < .001) and in-hospital mortality (6.8% vs 5.0%, P < .001) (Table 2). The mean length of hospital stay was greater for blacks vs whites (15.2 vs 11.4 days, P < .001), and mean total hospital charges were also greater for blacks vs whites ($93,494 vs $65,973, P < .001).

After adjusting for age, sex, and medical comorbidity using the Charlson Comorbidity Index, black race was associated with a 26% increase in the risk of having diverticulitis surgery on an emergency basis (RR, 1.26; 95% CI, 1.22-1.30). In adjusted models, black race was also associated with a 28% increase in the risk of in-hospital mortality (RR, 1.28; 95% CI, 1.10-1.51), regardless of admission type. In analyses stratified by admission type, it was noted that the risk of mortality in blacks treated elec-

### Table 1. Characteristics of 52,220 Medicare Patients Undergoing Surgical Treatment for Primary Diverticulitis

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Whites (n=49,937)</th>
<th>Blacks (n=2283)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex, No. (%)</td>
<td>34,859 (69.8)</td>
<td>1716 (75.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>75.5 (6.8)</td>
<td>74.7 (7.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Congestive heart failure, No. (%)</td>
<td>5646 (11.3)</td>
<td>335 (14.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Diabetes, No. (%)</td>
<td>6021 (12.1)</td>
<td>484 (21.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Renal disease, No. (%)</td>
<td>161 (0.3)</td>
<td>15 (0.7)</td>
<td>.007</td>
</tr>
<tr>
<td>Charlson Comorbidity Index score, mean (SD)</td>
<td>0.87 (1.33)</td>
<td>0.98 (1.33)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Blacks and whites demonstrated similar rates of myocardial infarction, peripheral vascular disease, cerebrovascular disease, dementia, rheumatic disorder, peptic ulcer, liver disease, paralysis, and cancer.
Eligible black Medicare beneficiaries undergoing surgical treatment for diverticulitis had a significantly increased risk of being treated on an emergency basis and a higher overall risk of mortality. Although a portion of the increased mortality risk can be attributed to the greater rate of emergency surgery in blacks, there was a similarly strong, but not statistically significant, trend toward increased mortality risk in blacks treated electively. These findings are especially important because previous studies have demonstrated that any racial disparities in diverticulitis outcomes may be modulated by access or lack of insurance in minority populations. This study, however, demonstrates that even in an insured population, race-based differences in outcomes persist.

In these exploratory analyses, we found that the risk of intestinal diversion was lower in blacks than in whites. However, blacks undergoing elective procedures were at increased risk for ostomy compared with electively treated whites. In a previous work by our group, blacks were no more likely than whites to require intestinal diversion during surgery for diverticulitis. Race was found to be a significant variable on patient presentation, however, and these racial differences in outcome were thought to be attributed to differences in patient presentation and not to differences in treatment received. For all the patients, risk of readmission was higher in blacks than in whites; however, there was no difference in risk of readmission comparing blacks and whites treated electively. It is conceivable that the higher risks associated with black race may be a function of poorer general medical supervision in blacks compared with in whites. Use of medical services, including preventive procedures such as vaccination, is demonstrably lower in blacks than in whites, even in the population covered by Medicare. Reporting on the results of a national health survey, Shavers et al indicated that after adjustment for demographic factors, blacks are significantly less likely than are whites to have ever undergone a screening colonoscopy. The finding that the adverse outcomes seen in emergently treated blacks are not present in those undergoing elective procedures suggests that systematic underuse of health care resources may be a significant factor leading to greater comorbidity and increased risk of emergency surgery in blacks. Elective treatment is, in and of itself, suggestive of a higher level of presurgery medical involvement in patient care than might be the case for patients undergoing emergency surgery.

Blacks remained in the hospital significantly longer than did whites and incurred much higher total charges. It is possible that some of this difference is also a function of underlying medical comorbidity and may also be related to the higher risk of emergency treatment in blacks. However, other possibilities cannot be excluded based on this analysis. For example, despite controlling for comorbidity using the Charlson Comorbidity Index, it is possible that blacks may be generally sicker and have less physiologic reserve. Blacks may also carry more undiagnosed illness than whites as evidenced by research suggesting that blacks are less likely to undergo diagnostic evaluations, even after positive screening test results, than are whites.

Other factors that may cause older blacks to differ from similarly aged whites include possible differences in so-

### Table 2. Admission Type and Mortality Rates in 52,220 Medicare Patients Undergoing Surgical Treatment for Primary Diverticulitis

<table>
<thead>
<tr>
<th>Variable</th>
<th>White, No. (%)</th>
<th>Black, No. (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency</td>
<td>27,332 (54.7)</td>
<td>15,488 (67.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any admission</td>
<td>2,471 (5.0)</td>
<td>1,556 (6.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Elective admission</td>
<td>311 (1.4)</td>
<td>11 (1.5)</td>
<td>.78</td>
</tr>
<tr>
<td>Emergency admission</td>
<td>2,160 (7.9)</td>
<td>144 (9.3)</td>
<td>.48</td>
</tr>
</tbody>
</table>

### Table 3. Admission and Mortality Risks for Black Patients Compared With White Patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Relative Risk (95% CI)</th>
<th>Unadjusted</th>
<th>Adjusteda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency</td>
<td>1.23 (1.20-1.26)</td>
<td>1.26 (1.22-1.30)</td>
<td></td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any admission</td>
<td>1.37 (1.17-1.60)</td>
<td>1.28 (1.10-1.51)</td>
<td></td>
</tr>
<tr>
<td>Elective admission</td>
<td>1.09 (0.90-1.98)</td>
<td>1.20 (0.66-2.18)</td>
<td></td>
</tr>
<tr>
<td>Emergency admission</td>
<td>1.18 (1.00-1.38)</td>
<td>1.28 (1.09-1.51)</td>
<td></td>
</tr>
</tbody>
</table>

a All the analyses were adjusted for age, sex, and medical comorbidity via the Charlson Comorbidity Index.

Black Medicare beneficiaries undergoing surgical treatment for diverticulitis had a significantly increased risk of being treated on an emergency basis and had a higher overall risk of mortality. Although a portion of the increased mortality risk can be attributed to the greater rate of emergency surgery in blacks, there was a similarly strong, but not statistically significant, trend toward increased mortality risk in blacks treated electively. These findings are especially important because previous studies have demonstrated that any racial disparities in diverticulitis outcomes may be modulated by access or lack of insurance in minority populations. This study, however, demonstrates that even in an insured population, race-based differences in outcomes persist.
cial norms for the use of medical care, less healthy environ-mental conditions, and, despite insurance coverage in the study group, lower socioeconomic status. The exploration of these possibilities is beyond the scope of this study.

It seems especially likely that some portion of the racial differences seen in this study result from different levels of access to the health care system. For a variety of reasons, whether insured or not, blacks may not enjoy the same level of medical care experienced by whites. This has been demonstrated in terms of continuity of care, with just 63.5% of blacks reporting a physician’s office as their point of primary care compared with 75.4% of whites. Musa et al report that underuse of health care resources by blacks may be related to a higher level of distrust of the medical establishment.

Although one would hope it unlikely in 2011, it remains possible that racial bias may affect care in the hospital setting such that blacks may not always receive the same level of care as whites. It has also been reported that perceptions of health care quality differ between blacks and whites, with blacks reporting less satisfaction with the care provided. Another factor that may differentially affect blacks is that black patients are more likely than whites to present at smaller, less well-staffed hospitals, where outcomes tend to be worse, and as a group, blacks may tend to be treated by surgeons with less experience or training. Further research is warranted into these factors and how they relate to treatment and outcomes in patients undergoing surgery.

Some limitations of this study include those associated with any analysis of data collected for billing or administrative purposes. Granularity is lacking in diagnoses, and the clinical history of individual patients is limited to concurrent diagnostic coding. Also, no detailed clinical history, laboratory values, or information on physical disabilities, which would have been useful for comparison across groups, were available in this administrative data set. In addition, no information on co-insurance was available, although the data did exclude individuals who were members of a health maintenance organization. For various reasons, blacks are underrepresented in Medicare compared with whites, and it is possible that this underrepresentation and issues related to unmeasured differences between black and white Medicare patients may confound the results. However, by examining models clustered by Medicare provider and by including a measure of underlying comorbidity (the Charlson Comorbidity Index), we attempted to account for possible race-related differences in treatment facility choice and overall health. Finally, the classification of race was based on the Center for Medicare and Medicaid Services indicator for race, which is typically taken from Social Security Administration records.

This study of a large group of older Medicare beneficiaries with known medical comorbidities, all of whom underwent surgical treatment for diverticulitis, found that black race was associated with increased risk of emergency admission and in-hospital mortality and substantially higher total treatment charges. Because all the patients studied carried the same basic insurance coverage and the analysis controlled for differences in reported underlying medical comorbidity, this finding contradicts the hypothesis that black race serves merely as a surrogate for either reduced likelihood of having health insurance coverage or an increased likelihood of carrying substantial medical comorbidity in blacks. The underlying mechanisms that lead to higher rates of emergency vs elective admission, greater risk of in-hospital mortality, and substantially greater hospital expenses for blacks need to be elucidated so that interventions can be developed to eliminate the premature mortality and greater costs experienced by blacks.

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Author Contributions: Study concept and design: Schneider, Haider, Chang, Segal, Wu, and Lidor. Acquisition of data: Sheer and Wu. Analysis and Interpretation of data: Schneider, Haider, Hambridge, Segal, Wu, and Lidor. Drafting of the manuscript: Schneider, Haider, and Lidor. Critical revision of the manuscript for important intellectual content: Schneider, Haider, Sheer, Hambridge, Chang, Segal, Wu, and Lidor. Statistical analysis: Schneider, Haider, Hambridge, Chang, and Segal. Obtained funding: Lidor. Administrative, technical, and material support: Haider, Sheer, Hambridge, and Wu. Study supervision: Haider, Wu, and Lidor.

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REFERENCES