Effect of Race and Insurance Status on Presentation, Treatment, and Mortality in Patients Undergoing Surgery for Diverticulitis

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Objective: To determine the effect of race and insurance status on patient presentation, treatment, and mortality in individuals who underwent surgery for diverticulitis.

Design: Retrospective analysis of the Nationwide Inpatient Sample file from 1999 to 2003.

Setting: A 20% representative sample of all hospitals in 37 states in the United States.

Patients: Patients admitted with a primary diagnosis of diverticulitis who subsequently underwent either colectomy and/or colostomy (n=45,528).

Main Outcome Measures: Odds ratios (ORs) for association of race (black vs white) and insurance status (Medicaid or self-pay [inadequate insurance] vs other insurance) with (1) complicated presentation, (2) colostomy, and (3) in-hospital mortality.

Results: On multivariate analysis, black race was significantly associated with complicated presentation (OR, 1.16; 95% confidence interval [CI], 1.04-1.30) and mortality (OR, 1.41; 95% CI, 1.06-1.86) but not with receiving a colostomy. In contrast, insurance status was significantly associated with complicated presentation (OR, 1.21; 95% CI, 1.08-1.36), receiving a colostomy (OR, 2.10; 95% CI, 1.89-2.32), and mortality (OR, 2.64; 95% CI, 1.82-3.82).

Conclusions: Black patients were no more likely than white patients to undergo colostomy; however, race was a significant variable on patient presentation. Therefore, racial differences in outcome can be attributed to differences in patient presentation and not to differences in treatment received. Lack of adequate health insurance is a more powerful predictor of disease severity, suboptimal surgical treatment, and mortality.

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DIVERTICULAR DISEASE IS A very common condition, with increasing prevalence in the Western population. Less than 5% of individuals younger than 40 years are affected by diverticular disease, while 65% of people older than 85 years can be expected to be affected. Diverticula of the colon (diverticulosis) can lead to diverticulitis, which refers to the presence of infection and inflammation with subsequent perforation of the colonic diverticulum. Diverticulitis accounts for more than 200,000 hospitalizations annually and more than $300 million in health care costs. There are no known differences in prevalence or characteristics of the disease by race in the United States.

Uncomplicated diverticulitis is a localized infection that usually does not require hospitalization and can be treated with oral antibiotics. Complicated diverticulitis refers to associated obstruction, hemorrhage, free perforation, and/or fistula or abscess formation. Complicated diverticulitis is managed by hospital admission, bowel rest, intravenous antibiotics, and, depending on the patient’s condition, either emergency surgery or conservative management with or without the addition of percutaneous drainage of any abscess that may be present. Surgical intervention consists of a segmental colonic resection with primary anastomosis or a 2-staged operation with colonic resection and colostomy followed by reanastomosis at a later date. The need for a colostomy usually relates to higher disease severity at presentation and is difficult for patients from a functional as well as emotional standpoint. From a health care cost view, colostomy is in it-
self associated with further use, including the need for a second operation if the colostomy is to be reversed at a later date.

Racial and ethnic disparities in medical care have been extensively documented, with multiple studies reporting higher mortality, re-admission, and complication rates in black patients than in white patients after surgical interventions.4 Racial disparities in complications and outcomes have been attributed to unmeasured differences in baseline patient morbidity or disease severity as well as to an inequality of access to high-quality health care. Moreover, several studies have demonstrated a correlation between worse health outcomes and uninsured or inadequately insured patient status.5,8 Although this could potentially be due to barriers to high-quality care, worse overall health, or presentation at more advanced stages of disease, it is also possible that such patients are receiving substandard medical care based solely on their insurance status. Approximately 30% of adults in the United States either lack health insurance completely or rely on Medicaid as their only form of health insurance. Black and Hispanic patients are represented disproportionately within this group of the inadequately insured,9 indicating a serious public health issue with significant societal ramifications. As such, it is essential that we scrutinize the causes for poor health outcomes so that we can focus public policy on correcting any remediable causes of these inequalities.

We performed an analysis of a national database to explore racial disparities in clinical presentation, surgical procedure received, and mortality after surgery for patients admitted to the hospital for diverticular disease in the United States. This inquiry attempts to explore the relative contributions of race and insurance status in determining differential outcomes and thereby to better understand the complex associations among race, access to health care, individual patient characteristics, and overall quality of care.

**METHODS**

Data were derived from the National Inpatient Sample file (1999-2003),10 which includes a 20% representative sample of hospitals from 37 states. Inclusion criteria for the analysis were a primary International Classification of Diseases, Ninth Revision (ICD-9), diagnosis code of diverticulitis (562.11 or 562.13) with a coincident procedure code for colectomy (457, 457.1, 457.2, 457.3, 457.4, 457.6, 457.9, or 459.4) or colostomy (461, 461.0, 461.1, or 461.3). Patients with a diagnosis of diverticulitis but without the associated procedure code were excluded.

There were 3 principal outcome variables: patients' clinical status at presentation (complicated vs uncomplicated diverticulitis), treatment received (colostomy vs no colostomy), and in-hospital mortality. For patient presentation status, indicator variables were created for patients presenting with obstruction (ICD-9 code 560 in any of 15 record positions), hemorrhage (ICD-9 codes 578, 578.9, or 569.3), or perforation (ICD-9 code 569.83). These are the most common clinical presentations for patients with complicated diverticulitis; these 3 conditions were further combined in a variable that indicated the presence of any of these 3 conditions for a patient. For treatment received, we created a categorical variable to indicate whether or not the patient received a colostomy, with or without colectomy. For in-hospital outcome, we also used the colostomy variable in addition to the variable in the data set that indicated whether the patient died in the hospital. Other outcome variables included one to indicate whether or not the patient received a blood transfusion, as another way to measure treatment received, and the patient's length of stay and total hospital charges, as additional variables for in-hospital outcomes. Hospital charges were adjusted for inflation to reflect 2005 US dollars.11

A categorical variable was created for white vs black race. Patients of other races were not included in the analysis. Insurance status was coded as Medicaid and self-pay (underinsured) vs all other types of insurance (insured).

Additional variables included age, sex, race, academic status of the hospital, and disease severity as measured by the Charlson Comorbidity Index, which is based on the presence or absence of a number of diagnoses in the patient, combined in a weighted formula.12 The ICD-9 diagnosis codes for these conditions were derived using the method of Romano et al.13

The Pearson χ2 test was used for between-group comparisons for categorical outcomes and t tests were used for continuous variable outcomes. Multiple logistic regression was used to calculate the odds ratio (OR) and 95% confidence intervals (CIs) for the association between the 2 primary independent variables (white or black race, and inadequate or adequate insurance) and the outcomes of interest (presentation status, receiving colostomy, and in-hospital mortality). Three multiple regression analyses were performed, each one subsumed within the next. The first model used symptomatic status as a dependent variable and included age, sex, race, Charlson Comorbidity Index score, and insurance category as covariates. The second model used receipt of colostomy as the dependent variable and included the same set of covariates used previously plus hospital teaching status and the dependent variable from the first regression (complicated diverticulitis on presentation) as an additional independent variable in this subsequent analysis. The final model included the same set of covariates as in the second regression and included colectomy as an additional independent variable. C statistics were calculated for all models, which represent the ability of the models to predict a positive vs negative outcome, with 0.50 representing a prediction that is no different from chance and 1.0 representing a perfect prediction. All analyses were conducted using Stata, version 9.1 (Stata Corp, College Station, Texas).

**RESULTS**

We initially identified 185 587 patients who were admitted with a primary diagnosis of diverticulitis. Of these, 140 059 patients did not receive colectomy or colostomy, leaving 45 528 for the analysis.

The characteristics of the study population are presented in Table 1. The median age was 59 years (interquartile range, 48-72 years); 53.0% of patients were women. Among all patients, 32.7% had missing race data. Of the remaining 67.3% of patients with known race data, 85.3% of patients were white and 5.3% of patients were black. Overall, 21.5% presented with obstruction, 0.29% presented with hemorrhage, and 3.7% presented with perforation. Altogether, 24.7% presented with at least 1 of these 3 conditions. Most patients were treated at nonacademic hospitals (62.4%), and 30.5% of patients received colectomy as part of their treatment. The overall in-hospital mortality rate was 2.9%. The median length
of stay was 8 days (interquartile range, 6-11 days). The median total hospital charge, adjusting for inflation to reflect 2005 values, was $28,200 (interquartile range, $18,913-$46,686).

An unadjusted bivariate analysis comparing black patients with white patients is presented in Table 2. Black patients were younger, more likely to be female and underinsured, and less likely to be treated at a teaching hospital. They were also more likely to present with complicated diverticulitis, receive a blood transfusion, and have longer lengths of stay and higher total hospital charges. Nevertheless, their rates of colostomy and in-hospital mortality were no different from those of white patients.

An unadjusted bivariate analysis comparing insured with underinsured patients is also presented in Table 2. Underinsured patients were younger, less likely to be female, and more likely to be black and treated at a teaching hospital. They were less likely to have complicated diverticulitis on presentation and less likely to die, but were more likely to receive a colostomy, have longer lengths of stay, and have higher total hospital charges.

Table 3 presents results from the multiple logistic regression analysis. As expected, on multivariate analysis, older age was associated with complicated diverticulitis status on presentation, receiving a colostomy, and mortality. In contrast, female sex was not associated with presentation status or mortality and had a negative association with receiving a colostomy. Additionally, patient comorbidities, as measured by the Charlson Comorbidity Index in this study, were not associated with presentation status but with colostomy and mortality. Patients presenting to teaching hospitals were more likely to receive a colostomy and to die. In contrast, patients presenting with complicated diverticulitis were more likely to receive a colostomy but not more likely to die; however, patients who received a colostomy were more likely to die.

Black race (OR, 1.18; 95% CI, 1.03-1.32) and underinsured status (OR, 1.22; 95% CI, 1.08-1.38) were found to have a positive association with complicated diverticulitis on presentation after adjusting for age, sex, and Charlson Comorbidity Index score. This model has a C statistic of 0.580. Black race was found to have no association with receiving a colostomy (OR, 0.99; 95% CI, 0.88-1.11), while inadequate insurance status had a strong positive association with receiving a colostomy (OR, 2.11; 95% CI, 1.89-2.36) after adjusting for age, sex, teaching status of hospital, and Charlson Comorbidity Index score. This model has a C statistic of 0.623. Again adjusting for age, sex, teaching status of hospital, Charlson Comorbidity Index score, and receiving a colostomy, black patients had a higher odds of in-hospital mortality (OR, 1.45; 95% CI, 1.08-1.94), while inadequate insurance status had an even stronger positive association with mortality (OR, 2.74; 95% CI, 1.84-4.09) in contrast to results from the unadjusted bivariate analysis. This model had the strongest C statistic, 0.871. The interaction between race and insurance was examined for all 3 dependent variables, but was nonsignificant in all instances.

These results are summarized in the Figure. There were racial differences in outcomes and in presentation status but not in treatment. This suggests that racial differences in outcomes were more likely attributable to differences in presentation rather than differences in treatment received. In contrast, there were significant differences between insured and underinsured patients for all of the outcomes examined.

### Table 1. Characteristics of Study Population Undergoing Surgery for Diverticulitis

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (median) y</td>
<td>59.5 (59)</td>
</tr>
<tr>
<td>Female sex</td>
<td>24,102/45,504 (53.0)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>28,825/33,812 (85.3)</td>
</tr>
<tr>
<td>Black</td>
<td>1805/33,812 (5.3)</td>
</tr>
<tr>
<td>Underinsured</td>
<td>30,493/45,558 (6.7)</td>
</tr>
<tr>
<td>Care at a teaching hospital</td>
<td>17,129/45,513 (37.6)</td>
</tr>
<tr>
<td>Complicated presentation</td>
<td>11,224/45,528 (24.6)</td>
</tr>
<tr>
<td>Obstruction</td>
<td>9792/45,528 (21.5)</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>130/45,528 (0.3)</td>
</tr>
<tr>
<td>Perforation</td>
<td>1685/45,528 (3.7)</td>
</tr>
<tr>
<td>Received colostomy</td>
<td>13,888/45,528 (30.5)</td>
</tr>
<tr>
<td>Death</td>
<td>13,300/45,476 (2.9)</td>
</tr>
<tr>
<td>Received a blood transfusion</td>
<td>3823/45,528 (8.4)</td>
</tr>
<tr>
<td>Length of stay, mean (median), d</td>
<td>9.75 (9)</td>
</tr>
<tr>
<td>Total charges, mean (median), $</td>
<td>42,338 (29,200)</td>
</tr>
</tbody>
</table>

*In 2005 US dollars.

Following the landmark report by the Institute of Medicine,11 many authors have examined the influence of race and ethnicity on a variety of health care issues. Numerous studies have cited increased rates of surgical complications for black patients compared with white patients.15,16 These disparities have largely been explained by higher comorbidity at baseline as well as lack of access to high-quality health care. Insurance status, adjusted for race, has also been shown to be an independent predictor of postoperative outcomes, likely owing to many of the same mechanisms.17 However, the interaction between race and insurance has been less explored, and it is unclear whether racial disparity in health care may simply be a manifestation of differences in access to insurance. Our study finds that this was not the case. Race, in fact, had an independent effect on treatment and outcomes. Moreover, insurance also has an independent effect and seems to play a bigger role than race.

Diverticulitis is a common condition that is associated with high morbidity and high health care costs in the United States. One of the more serious sources of morbidity that can occur as a result of surgical intervention for diverticular disease is a colostomy. A colostomy is difficult for a patient to deal with from a functional as well as an emotional standpoint and is in itself associated with further morbidity, including the need for another surgical procedure if the connection is to be reversed.

In our study, we found that race did not affect the type of surgical treatment received for diverticulitis, notwithstanding that black patients were more likely than white patients to present with more complicated cases. In con-
trast, insurance status did correlate with the type of treatment provided. Uninsured and underinsured patients were more likely to receive a colectomy, even after adjusting for a higher rate of complicated diverticulitis in those patients than their insured counterparts.

Although multiple studies have suggested that race may influence treatment offered for a given condition, our study instead suggests that, for diverticulitis, the lack of adequate insurance coverage was more influential than race. Colectomy is usually performed in the setting of an acute surgical catastrophe, leaving little room for the personal preferences of an individual surgeon. Therefore, it stands to reason that the particular surgical choices made by surgeons in this study were less prone to racial bias than in other reports, in which treatments are offered in a more elective setting and consequently are inherently more subject to such bias. In a study looking at patients with colorectal carcinoma as an outcome, Nguyen and colleagues found that black patients hospitalized with ulcerative colitis were (1) less likely than white patients to receive a colectomy, and, (2) when colectomy was performed, were more likely than white patients to receive an ostomy instead of primary reanastomosis. A similar study, which looked at racial disparities in treatment for rectal cancer, demonstrated that black patients were more likely to receive a permanent colostomy than white patients and less likely to receive adequate adjuvant radiation therapy for the appropriate disease stage.8

Because there is such a high proportion of people with suboptimal insurance in the United States, this becomes an important aspect on which to focus. Many of the studies that show racial disparities have adjusted for insurance status,18,19 but few studies have looked at the specific effect of insurance. One way to address this issue is to look at outcomes of patients in situations in which everyone is covered by equal insurance. Two examples of this are Veterans Affairs (VA) Medical Centers and Medicare beneficiaries. Dominitz et al20 found that race was not associated with use of surgery or adjuvant therapy in the treatment of colorectal carcinoma among veterans seeking care nationwide at VA Medical Centers.
In a similar study, which examined surgery for colorectal cancer among Medicare beneficiaries, Cooper et al.\(^2\) found that black patients were less likely than white patients to undergo surgical resection, even after adjusting for multiple variables. These findings are in direct contrast to the VA study. The applicability of these findings to our study is attenuated by the fact that both the VA and Medicare studies are skewed toward a significantly older population. Moreover, most of the patients in the VA study are men, thus introducing the possibility of sex-related differences in treatment outcomes. The VA study does have the advantage of being able to assess racial differences in a situation in which there are no financial incentives for the treating physicians and minimal restrictions of access to care.

The study most comparable with ours is that of Kelz and associates\(^2\)\(^3\) in which all adult patients (aged, 40-64 years) admitted for surgery for colorectal carcinoma were evaluated. They found that uninsured and Medicaid patients had higher mortality than privately insured patients.

Our study had several limitations. Our data were derived from an administrative database. It has been well documented that claims-based databases, which are constructed primarily for reimbursement rather than research purposes, are inherently susceptible to errors due to missing or inaccurately entered codes.\(^2\)\(^3\) For example, the definition of complicated diverticulitis encompasses such conditions as phlegmon, abscess formation, and fistulization. However, the database contained no specific diagnostic codes for these conditions. Therefore, it is reasonable to assume that the number of complicated diverticulitis cases was underestimated in our study as a result of the absence of these codes. Whether this alters the validity of our findings depends on the distribution of these coding omissions among the different patient subsets considered. It is not unreasonable to assume that any such administrative coding errors ought to be randomly distributed across all categories of patients in our study. Moreover, any underdocumentation of medical comorbidities among patients with incomplete or inadequate prior health care would, if anything, have the effect of making the uninsured patients appear healthier than they actually are, thereby strengthening our findings.\(^2\)\(^3\) Additionally, as in any large database, there is some missing data in the Nationwide Inpatient Sample, especially with respect to race. This is because some hospitals choose not to collect and/or report race data. However, we do not believe this issue will affect our findings, as there is no reason to think that such policies are related to the disparity in surgical outcomes for patients with diverticulitis at that hospital; data were collected by people with no vested interest in our study and, as such, the missing data are completely random with respect to our study question.

In conclusion, our findings suggest that, in the context of patients undergoing surgery for diverticular disease, lack of adequate health insurance is a more powerful predictor of disease severity, suboptimal surgical treatment, and mortality than is race. This, to some degree, questions the conventional wisdom that race is the primary determinant of suboptimal outcomes in health care delivery and has obvious prescriptive implications for future health care policy decisions. To the extent to which these findings can be generalized to a variety of other medical conditions, a new paradigm of health care resource allocation may be in order, one based more on socioeconomic than racial distinctions. Future research should assess the means by which barriers to equal access to adequate health care can be reduced or eliminated by negating socioeconomic factors rather than emphasizing race-based distinctions.

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REFERENCES

Because US health care has focused on quality, an often-overlooked dimension is equity. Lidor et al examine the effect of race and insurance status on surgical management of diverticulitis. Using data from the Nationwide Inpatient Sample, they found that black race was associated with complicated presentation and mortality but not colostomy rates. Insurance status was a stronger predictor of surgical outcomes, as uninsured individuals is equally troubling. In 2007, according to the National Center for Studying Health System Change, approximately 1 in 5 people reported not getting or delaying needed medical care at some point in the previous 12 months, up significantly from 14% in 2003.1 This dramatic decline in access to both medical and surgical care is alarming.

We are faced with many challenges in health care in the 21st century. One of the most vexing is persistent health care disparities by race/ethnicity and the growing numbers of uninsured and underinsured individuals whose health care needs are not met.

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