Differential Use of Coronary Revascularization and Hospital Mortality Following Acute Myocardial Infarction

Janice M. Barnhart, MD, MS; Jing Fang, MD; Michael H. Alderman, MD

Background: The effect of racial/ethnic disparity in the use of cardiac procedures on short-term outcomes, such as hospital mortality, is limited. We sought to determine the association of revascularization procedures (percutaneous transluminal coronary angioplasty or coronary artery bypass graft) to hospital mortality in non-Hispanic black and white patients and Hispanic patients with acute myocardial infarction.

Methods: Analysis of the New York State Department of Health Statewide Planning and Research Cooperate System (SPARCS) data for 12555 patients admitted to New York City hospitals with acute myocardial infarction in 1996. Revascularization procedure frequencies and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for hospital mortality were calculated.

Results: Whites were older than Hispanics and blacks (mean ±SD age, 70±13.3 vs 64±13.3 and 64±12.9 years, respectively; P<.001) and more likely to have heart failure (36.3% vs 29.1% and 29.6%, respectively; P<.001). Blacks were least likely to be revascularized compared with Hispanics and whites (15.8% vs 25.8% and 25.2%, respectively; P<.001). Hispanics were more likely to survive than whites (adjusted OR, 0.73 [95% CI, 0.59-0.91]); this difference was not significant for blacks (adjusted OR, 0.83 [95% CI, 0.69-1.00]). Nonrevascularized blacks and Hispanics were more likely to be discharged alive than nonrevascularized whites (OR, 0.80 [95% CI, 0.66-0.98] for blacks; OR, 0.74 [95% CI, 0.59-0.93] for Hispanics). There were no significant racial/ethnic differences in hospital survival among revascularized patients.

Conclusions: Nonclinical and clinical factors appear to account for blacks being least likely to have been revascularized. Despite these differences in revascularization rates, survival was similar for blacks and whites, whereas Hispanics were more likely to survive than whites.

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ISCHEMIC HEART DISEASE is the leading cause of death among all Americans.1 Blacks with coronary heart disease experience higher rates of mortality compared with whites and Hispanics.2,3 Reasons for this disparity are still uncertain. Possible explanations include the distribution of risk factors for coronary heart disease such as hypertension and diabetes mellitus, delayed diagnosis of acute ischemia, differences in access to high-quality health care, and discrimination.2-9 Perhaps related to mortality are disparities by race/ethnicity in the use of diagnostic and therapeutic cardiac procedures, such as coronary angiography and revascularization.10-12 Blacks and Hispanics have been reported to be less likely to undergo coronary angiography and revascularization than whites. However, the effect of racial disparity in the use of cardiac procedures on short-term outcomes, such as hospital mortality among diverse patient populations, is limited.916,20

New York City (NYC) has a large socioeconomically and racially diverse patient population, low rates of inappropriate use of coronary angiography and revascularization, and rates of cardiovascular mortality that are higher than other major US cities.21-25 At the same time, racial and sex disparity has been reported in referral to and use of coronary revascularization among New Yorkers.12,26-28 Therefore, we examined hospital discharge records to determine the association of coronary revascularization (ie, percutaneous transluminal coronary angioplasty or coronary artery bypass graft) with hospital mortality in black, Hispanic, and white patients admitted to NYC hospitals with acute myocardial infarction.

METHODS

DATA SOURCES

We analyzed data contained in the New York State Department of Health Statewide Plan-
ning and Research Cooperate System (SPARCS) for all patients identified as black, white, or Hispanic who were 35 years and older and admitted to an NYC hospital urgently or emer-
gently with a principal discharge diagnosis of acute myocar-
dial infarction (MI). Data were available from 1994 to 1996 for
the analysis. We analyzed data only for the most recent year
(1996) to avoid possible recounting of the MI cases. Data on
race/ethnicity are based on demographic information ob-
tained from the medical records and coded to describe the eth-
nic origin of patients, such as Spanish/Hispanic origin or not
of Spanish/Hispanic origin. We based our comparisons on non-
Hispanic blacks, non-Hispanic whites, and Hispanics because
this represented the major racial/ethnic groups in NYC. The
International Classification of Diseases, Ninth Revision, Clinical
Modification (ICD-9-CM) codes 410.0 through 410.9 were used
for acute MI. We used the ICD-9-CM codes that identified coro-
nary angiography or catheterization (ICD-9-CM 88.5-88.59) in
the evaluation of coronary heart disease during hospitalization.
Codes used for angioplasty and coronary artery bypass
surgery were ICD-9-CM 36.01, 36.02, 36.05, and 36.06 and
ICD-9-CM 36.10 through 36.19, respectively. Variables ana-
lized included patient’s age, sex, race/ethnicity, principal di-
gagnoses, and discharge status (dead or alive). Cardiovascular
risk comorbidity was defined by ICD-9-CM codes (2nd to 14th
diagnostic codes) and included diabetes (ICD-9-CM 250), hy-
pertension (ICD-9-CM 401-405), and hypercholesterolemia
(ICD-9-CM 272). We also defined complications of acute MI as
congestive heart failure (ICD-9-CM 428) and cardiogenic
shock (ICD-9-CM 785.51). Type of insurance (private, Medi-
caid, Medicare, government, or no insurance) was an indica-
tor for socioeconomic status. There were 12,555 patients hos-
hospitalized in NYC in 1996 with a principal discharge diagnosis
of acute MI who met our eligibility criteria.

STATISTICAL ANALYSIS
Bivariate analyses were used to characterize the study popula-
tion and calculate frequencies for cardiac procedure use and
mortality stratified by age, sex, and race. Data for race/
ethnicity from the 2000 census were not available for analysis
at the time of this study. Therefore, age-adjusted rates for hos-
pital mortality per 100 hospitalizations (for each race/ethnic
group) were calculated using the NYC 1990 census as the stan-
dard population. The crude rates for hospital mortality were
also calculated. Race-specific multiple logistic regression mod-
els were constructed to compute the odds ratios (ORs) and 95%
confidence intervals (CIs) using hospital mortality as the out-
come variable, while controlling for covariates found to be sig-
ificant in bivariate analyses. The ORs for hospital death were
obtained by comparing those who did with those who did not
undergo the procedure, as the referent, within each racial/
ethnic group. Regression models were also constructed to as-
sess the risk-adjusted odds of having a revascularization pro-
cedure during hospitalization. In our final analyses, separate
regression models were stratified according to coronary revas-
cularization status to make direct comparisons of the adjusted
odds of death for blacks and Hispanics compared with whites
who did and did not undergo the procedure to discern if there
were any significant differences in mortality.

Table 1. Characteristics of the Study Population*  

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>White (n = 9138)</th>
<th>Black (n = 1873)</th>
<th>Hispanic (n = 1544)</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, y</td>
<td>70.2 ± 13.3</td>
<td>64.1 ± 13.3</td>
<td>64.0 ± 12.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Male</td>
<td>58.6</td>
<td>49.6</td>
<td>57.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>21.4</td>
<td>20.6</td>
<td>15.5</td>
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</tr>
<tr>
<td>Medicare</td>
<td>52.8</td>
<td>37.5</td>
<td>39.5</td>
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</tr>
<tr>
<td>Medicaid</td>
<td>8.5</td>
<td>16.8</td>
<td>27.7</td>
<td>.02</td>
</tr>
<tr>
<td>HMO</td>
<td>7.7</td>
<td>8.3</td>
<td>6.9</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>5.3</td>
<td>11.5</td>
<td>6.9</td>
<td></td>
</tr>
<tr>
<td>Comorbidity and clinical complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHOL</td>
<td>12.1</td>
<td>13.2</td>
<td>16.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>HTN</td>
<td>44.7</td>
<td>62.9</td>
<td>53.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>DM</td>
<td>25.9</td>
<td>38.2</td>
<td>40.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>CHF</td>
<td>36.3</td>
<td>29.1</td>
<td>29.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SHOCK</td>
<td>3.8</td>
<td>2.3</td>
<td>3.5</td>
<td>.005</td>
</tr>
<tr>
<td>Procedure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANGIO</td>
<td>40.0</td>
<td>34.1</td>
<td>46.0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PTCA</td>
<td>15.8</td>
<td>9.7</td>
<td>16.7</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>CABG</td>
<td>9.6</td>
<td>6.2</td>
<td>9.3</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: ANGIO, coronary angiography; CABG, coronary artery bypass surgery; CHF, congestive heart failure; CHOL, hypercholesterolemia; DM, diabetes melitus; HMO, health maintenance organization; HTN, hypertension; PTCA, percutaneous transluminal coronary angioplasty; SHOCK, cardiogenic shock.

*Data are percentage of patients unless otherwise specified. International Classification of Diseases, Ninth Revision, Clinical Modification codes 410.0 through 410.9 was used for acute myocardial infarction.
†P value for age is based on comparisons made by analysis of variance. All other P values are based on χ² test for overall racial/ethnic comparisons.

RESULTS

PATIENT CHARACTERISTICS
Whites were older than blacks and Hispanics (mean ± SD
age, 70 ± 13.3 vs 64 ± 13.3 and 64 ± 12.9 years; P<.001
and more likely to have Medicare (52.8% vs 37.5% and
39.5%, respectively) (Table 1). Almost 60% of whites and
Hispanics admitted for MI were men, whereas a similar
proportion of black men and women were admitted.
Blacks were also more likely than whites and Hispanics to
lack insurance (11.8% vs 5.3% and 6.9%, respectively;
P=.01) and have hypertension (62.9% vs 53.4% and
44.7%, respectively; P<.001). Hispanics and blacks were
more likely to have diabetes than whites (40.6% and
38.2% vs 25.9%, respectively; P<.001). Hispanics were
also more likely than whites and blacks to have hypercholesterolemia (16.8% vs 12.1% and 13.2%, respectively; \(P<.001\)) and Medicaid as insurance coverage (27.7% vs 8.5% and 16.8%, respectively; \(P=.01\)). Hispanics were as likely as whites to have angiography, percutaneous transluminal coronary angioplasty, or coronary artery bypass graft during hospitalization for acute MI. Blacks were least likely to undergo any procedure.

Analyses stratified by revascularization status revealed that there were no significant differences by race/ethnicity in the frequency of hypercholesterolemia, congestive heart failure, or cardiogenic shock for those revascularized (n = 2993), but blacks and Hispanics were more likely than whites to have diabetes (41% and 35% vs 23%, respectively; \(P<.001\)) and hypertension (64% and 52% vs 46%, respectively; \(P<.001\)) (Figure). Among those not revascularized (n = 9562), whites were more likely than blacks and Hispanics to have congestive heart failure (41% vs 31% and 33%, respectively; \(P<.001\)). Whites and Hispanics had more cardiogenic shock than blacks (3.8% and 3.2% vs 2.2%, respectively; \(P=.004\)).

**HOSPITAL MORTALITY**

The number of hospital deaths for the study population was 1392. Death rates were significantly higher among patients older than 60 years, women, and those who had congestive heart failure or cardiogenic shock compared with patients who did not have these characteristics (\(P<.001\) for all comparisons) (Table 2). There was no significant difference in survival among patients with and without diabetes, but coexistent hypertension appeared to afford a survival advantage. Revascularized patients had a significantly lower rate of hospital death than patients not revascularized, which was most striking among whites (4.2% [revascularized] vs 14.8% [nonrevascularized]; \(P<.001\)). The age-adjusted mortality rates, using the NYC census population as the standard, revealed that whites (6.4 deaths per 100 hospitalizations) had a higher hospital death rate than blacks (5.9 deaths per 100 hospitalizations) and Hispanics (4.9 deaths per 100 hospitalizations). However, this difference was significant only among whites and Hispanics (\(P=.02\)).

Multiple logistic regression models that used revascularization (percutaneous transluminal coronary angioplasty or coronary artery bypass graft) as the dependent variable and controlled for age, sex, insurance, comorbidities, and angiography status, revealed blacks were significantly less likely than whites to be revascularized (black-white OR, 0.56 [95% CI, 0.48-0.66]; Hispanic-white OR, 0.86 [95% CI, 0.75-0.99]). Having an angiography was the strongest predictor for revascularization (OR, 10.60 [95% CI, 9.60-11.80]), followed by cardiogenic shock (OR, 1.60 [95% CI, 1.20-2.00]). With hospital death as the dependent variable, while controlling for the aforementioned variables and revascularization status, the adjusted OR for hospital death revealed that the overall study population significantly benefited from revascularization (OR for total population, 0.30; \(P<.001\)) (Table 3). Revascularized whites and Hispanics were 72% more likely to be discharged alive than whites and Hispanics who did not have the procedure (OR, 0.28; \(P<.001\)). Blacks who underwent revascularization were 52% more likely to be discharged alive than blacks who did not undergo the procedure (OR, 0.48; \(P<.001\)). Cardiogenic shock was the strongest predictor of death for the overall population (OR, 14.90; \(P<.001\)), followed by age. Patients 60 years or older were 3 to 4 times more likely to die than those younger than 60 years. Men were almost 30% more likely to survive than women regardless of their race/ethnicity; however, this difference did not reach statistical significance for black and Hispanic men (OR, 0.70; \(P>.05\)). The paradoxical effect of hypertension on hospital death remained after controlling for potential confounders. The protective benefit was most pronounced among blacks with hypertension who were 45% more likely to be discharged alive than blacks without hypertension (OR, 0.55; \(P<.001\)). Patients with diabetes were as likely to be discharged alive as patients without diabetes. There was no significant interaction between race and sex in any models when either revascularization or death was the dependent variable.

The final logistic regression models determined the black-white and Hispanic-white adjusted odds of death for the overall population and according to revascularization status (Table 4). Using the same variables included in the previous logistic regression models with revascularization status added as an independent vari-
able, Hispanics were 27% more likely to survive than whites. Blacks did marginally better than whites (OR, 0.83; P = .06). Among those revascularized, blacks tended to be less likely to survive than whites, but this difference was not significant (OR, 1.32; P = .37). Both nonrevascularized blacks and Hispanics had significantly better survival than nonrevascularized whites.

Our principal findings are that despite racial/ethnic disparity in coronary angiography and revascularization use, adjusted hospital mortality among whites and blacks was similar and Hispanics had significantly better survival than whites. This report extends earlier studies by examining hospital mortality within, as well as between, the respective racial/ethnic groups according to procedure use. Overall, patients who were revascularized had better survival than those who were not. Among the nonrevascularized, blacks and Hispanics were more likely than whites to be discharged alive. This improved survival among Hispanics and blacks was related to differences in the illness profile of nonrevascularized patients. Nonrevascularized whites were more likely to have congestive heart failure and shock—both major determinants of hospital death. Because blacks and Hispanics who were not revascularized were healthier than whites, it is possible that nonclinical factors led to more aggressive use of revascularization among whites than blacks and Hispanics.

### Table 2. Crude Hospital Death Rate*

<table>
<thead>
<tr>
<th>Variable</th>
<th>White (n = 9138)</th>
<th>P Value</th>
<th>Black (n = 1873)</th>
<th>P Value</th>
<th>Hispanic (n = 1544)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total deaths</td>
<td>1111 (12.2)</td>
<td></td>
<td>163 (8.7)</td>
<td></td>
<td>118 (7.6)</td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;60</td>
<td>1918 (3.6)</td>
<td>&lt;.001</td>
<td>678 (3.5)</td>
<td>&lt;.001</td>
<td>551 (2.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥60</td>
<td>7220 (13.7)</td>
<td></td>
<td>1196 (11.6)</td>
<td></td>
<td>993 (10.8)</td>
<td></td>
</tr>
<tr>
<td>Sex†</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3784 (15.7)</td>
<td>&lt;.001</td>
<td>944 (10.7)</td>
<td>.002</td>
<td>655 (10.1)</td>
<td>.002</td>
</tr>
<tr>
<td>Male</td>
<td>5353 (9.7)</td>
<td></td>
<td>929 (6.7)</td>
<td></td>
<td>899 (5.8)</td>
<td></td>
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<tr>
<td>Admission</td>
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<td>Urgent</td>
<td>1535 (7.0)</td>
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<td>308 (7.1)</td>
<td>.29</td>
<td>268 (3.4)</td>
<td>.004</td>
</tr>
<tr>
<td>Emergent</td>
<td>7603 (13.2)</td>
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<td>1565 (9.0)</td>
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<td>1276 (8.5)</td>
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<tr>
<td>DM</td>
<td>2364 (12.6)</td>
<td>.40</td>
<td>716 (8.8)</td>
<td>.91</td>
<td>627 (8.8)</td>
<td>.17</td>
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<td>No DM</td>
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<td>1157 (8.6)</td>
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<td>917 (6.9)</td>
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<tr>
<td>HTN</td>
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<td>1179 (6.9)</td>
<td>&lt;.001</td>
<td>824 (6.9)</td>
<td>.25</td>
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<td>No HTN</td>
<td>5051 (14.2)</td>
<td></td>
<td>694 (11.8)</td>
<td></td>
<td>720 (8.5)</td>
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<td>Clinical complications</td>
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<tr>
<td>CHF</td>
<td>3321 (19.6)</td>
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<td>545 (14.1)</td>
<td>&lt;.001</td>
<td>457 (12.7)</td>
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<td>5817 (7.9)</td>
<td></td>
<td>1328 (6.5)</td>
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<td>1087 (5.5)</td>
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</tr>
<tr>
<td>SHOCK</td>
<td>350 (62.0)</td>
<td>.001</td>
<td>43 (74.4)</td>
<td>&lt;.001</td>
<td>54 (42.6)</td>
<td>&lt;.001</td>
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<td>No SHOCK</td>
<td>8788 (10.2)</td>
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<td>1830 (7.2)</td>
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<td>1490 (6.4)</td>
<td></td>
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<tr>
<td>Procedure</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No PTCA or CABG</td>
<td>2299 (4.2)</td>
<td>&lt;.001</td>
<td>295 (5.1)</td>
<td>&lt;.02</td>
<td>399 (2.8)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*See Table 1 for explanation of abbreviations. Data are number of patients (percentage who died) unless otherwise indicated.

†For whites, sex was missing for 1 person.

### Table 3. Adjusted Odds of Hospital Death Stratified by Race*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N = 12,555; 1392 Deaths)</th>
<th>White (n = 9138; 1111 Deaths)</th>
<th>Black (n = 1873; 163 Deaths)</th>
<th>Hispanic (n = 1544; 118 Deaths)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>3.19 (2.57-3.97)</td>
<td>2.89 (2.20-3.80)</td>
<td>3.10 (1.90-5.10)</td>
<td>4.00 (2.20-7.40)</td>
</tr>
<tr>
<td>Sex</td>
<td>0.72 (0.64-0.82)</td>
<td>0.72 (0.63-0.83)</td>
<td>0.72 (0.50-1.00)</td>
<td>0.68 (0.45-1.00)</td>
</tr>
<tr>
<td>Insurance</td>
<td>1.22 (0.95-1.55)</td>
<td>1.23 (0.92-1.65)</td>
<td>1.00 (0.59-1.80)</td>
<td>1.90 (0.94-3.90)</td>
</tr>
<tr>
<td>CHF</td>
<td>1.74 (1.54-1.97)</td>
<td>1.80 (1.60-2.10)</td>
<td>1.50 (1.10-2.20)</td>
<td>1.40 (0.94-2.20)</td>
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<tr>
<td>DM</td>
<td>0.97 (0.85-1.11)</td>
<td>0.99 (0.85-1.20)</td>
<td>0.96 (0.66-1.40)</td>
<td>1.20 (0.77-1.80)</td>
</tr>
<tr>
<td>HTN</td>
<td>0.68 (0.60-0.77)</td>
<td>0.72 (0.62-0.83)</td>
<td>0.55 (0.39-0.79)</td>
<td>0.78 (0.52-1.20)</td>
</tr>
<tr>
<td>CHOL</td>
<td>0.31 (0.22-0.43)</td>
<td>0.29 (0.20-0.43)</td>
<td>0.35 (0.15-0.80)</td>
<td>0.37 (0.16-0.83)</td>
</tr>
<tr>
<td>SHOCK</td>
<td>14.90 (12.00-18.60)</td>
<td>14.40 (11.20-18.50)</td>
<td>31.90 (15.00-68.00)</td>
<td>11.30 (6.00-21.50)</td>
</tr>
<tr>
<td>No PTCA or CABG</td>
<td>0.30 (0.24-0.37)</td>
<td>0.28 (0.22-0.36)</td>
<td>0.48 (0.25-0.90)</td>
<td>0.28 (0.14-0.56)</td>
</tr>
</tbody>
</table>

*See Table 1 for explanation of abbreviations. Data are odds ratio (95% confidence interval). Multiple logistic regression controlling for age (≥60 y vs <60 y), sex (male vs female), insurance status (any type vs none), comorbid clinical condition (present vs absent), and PTCA or CABG (revascularization vs no revascularization).
Taken together, the data here suggest that clinical factors are more important than race-based nonclinical factors in accounting for racial/ethnic disparity in coronary revascularization. We base this conclusion on the following 3 reasons: First, the adjusted odds of hospital death revealed that Hispanics had significantly better survival than whites (OR, 0.73) and blacks might have done marginally better than whites as well (OR, 0.83; \( P = .06 \)). Second, nonrevascularized blacks and Hispanics had significantly better survival than whites. And third, among the revascularized, survival did not differ by race/ethnicity. It might be anticipated that if patients were inappropriately denied access to the procedure, their death rates would have been higher. In fact, we found the opposite.

Nevertheless, nonclinical factors might also have influenced the intervention experience. For example, based on the clinical factors alone, it is unclear why white subjects were more likely to be revascularized than blacks (and Hispanics), since they were sicker (eg, had more congestive heart failure, cardiogenic shock, and advanced age). Even though Hispanics were as likely as whites to undergo a cardiac intervention, perhaps more Hispanics (and blacks) in the nonrevascularized group could have had the procedure, leading to even better survival if clinical factors alone were the determinant. Instead, for unclear reasons, there appears to be an avoidance of this healthy contingent group, which implies that the threshold for revascularization is different among whites and blacks. However, on the other hand, clinical factors could have been the sole determinant of revascularization. This would be so, for example, if whites had less well-preserved left ventricular function or coronary lesions more amenable to revascularization than did blacks and Hispanics.\(^2\),\(^2\),\(^3\),\(^2\),\(^0\) If this were the case, the racial/ethnic variation in revascularization seen here might have still been appropriate.\(^2\),\(^1\),\(^2\),\(^3\)

Few studies have examined the appropriateness of racial/ethnic disparity in cardiac interventions or mortality based on the clinical characteristics of patients who did and did not undergo the procedures.\(^9\),\(^1\),\(^1\),\(^3\) A recent cohort study examined Medicare claims data to determine if inappropriate use of revascularization among whites explained racial disparities in its use and found that inappropriate use (ie, overuse) of percutaneous transluminal coronary angioplasty did not fully account for the disparities.\(^3\) However, no data on survival following revascularization were reported. Data analyzed from Medicare beneficiaries hospitalized for acute MI from 1994 to 1995 revealed that racial/ethnic disparity in use of coronary angiography was not associated with the race of the physician and that differences in short-term black: white mortality persisted, regardless of procedure use.\(^9\)

However, this study\(^7\) examined the association of mortality and angiography. We found similar survival among blacks and whites, but Hispanics had better survival than whites. By contrast, a study of all patients admitted to the Veterans Health Administration hospitals in the United States for acute MI from 1988 to 1990 reported lower use of coronary revascularization among blacks but a significantly better 30-day survival rate compared with whites.\(^3\) It is difficult to compare our data with this study because it was an all male population that included patients with a secondary diagnosis of MI. Thus, the study group could have included patients admitted for noncardiac conditions that could differentially affect survival rates. Our population included only patients with a principal or primary diagnosis of MI, and almost half were women. The adjusted odds of death for women was higher than for men. Analyses stratified by sex revealed that there still was no significant difference in black-white mortality among men (data not shown). Thus, the similar illness profile of revascularized blacks and whites and the higher death rates among women, particularly white women, might have contributed to our failure to find survival differences among revascularized patients.

### LIMITATIONS

The principal limitation of using an administrative database is the absence of important information contained in the medical record on the physician’s treatment decisions or clinical data, such as the ejection fraction, coronary anatomy, or medication used. Such information could have a substantial impact on clinical outcomes and appropriateness of cardiac procedures.\(^2\),\(^0\),\(^3\) Clinical data were available for complications following MI, such as congestive heart failure and cardiogenic shock, which can be proxies for poor left ventricular function. The paradoxical effect of comorbidities, such as hypertension and hypercholesterolemia, on mortality might represent adequate control of these conditions due to medications prescribed or access to primary health care providers.\(^3\) Errors in coding of diagnoses, procedures, or demographic data such as race/ethnicity could affect our results. However, over the past decade there have been marked improvements in diagnostic coding and accuracy of administrative databases.\(^3\),\(^8\) The SPARCS database is a rigorous reporting system for New York. Data are edited monthly to identify errors, audit reports are generated following monthly updates, and related data are verified with 2 data sources for consistency (eg, Vital Statistics Death and Birth Registries).\(^3\)

Some patients might have been admitted to hospitals that were not equipped to perform invasive cardiac proce-
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