Racial Profiling
The Unintended Consequences of Coronary Artery Bypass Graft Report Cards

Rachel M. Werner, MD, PhD; David A. Asch, MD, MBA; Daniel Polsky, PhD

Background—Although public release of quality information through report cards is intended to improve health care, there may be unintended consequences of report cards, such as physicians avoiding high-risk patients to improve their ratings. If physicians believe that racial and ethnic minorities are at higher risk for poor outcomes, report cards could worsen existing racial and ethnic disparities in health care.

Methods and Results—To investigate the impact of New York’s CABG report card on racial and ethnic disparities in cardiac care, we estimated differences in the use of CABG, PTCA, and cardiac catheterization between white versus black and Hispanic patients hospitalized for acute myocardial infarction in New York before and after New York’s first CABG report card was released, adjusting for patient and hospital characteristics and national changes in racial and ethnic disparities in cardiac care. The racial and ethnic disparity in CABG use significantly increased in New York immediately after New York’s CABG report card was released, whereas disparities did not change significantly in the comparison states. There was no differential change in racial and ethnic disparities between New York and the comparison states in the use of cardiac catheterization or PTCA after the CABG report card was released. Over time, this increase in racial and ethnic disparities decreased to levels similar to those before the release of report cards.

Conclusions—The release of CABG report cards in New York was associated with a widening of the disparity in CABG use between white versus black and Hispanic patients. (Circulation. 2005;111:1257-1263.)

Key Words: ethnic groups • revascularization • myocardial infarction

Several states began publishing CABG report cards in the 1990s in an effort to improve the quality of CABG care in those states. These report cards report risk-adjusted mortality rates for surgeons and hospitals that perform CABG surgery. They are designed to improve quality by enabling healthcare consumers to select high-quality providers and giving providers benchmarks and incentives to improve the quality of care they provide.

Surgeons might also respond to report cards in less favorable ways. Recent evidence suggests that after CABG report cards were released, surgeons began to avoid patients they perceived as being high risk. As a result, relatively fewer CABG surgeries were performed on the sickest patients, and outcomes for these patients worsened.

Racial and ethnic disparities in quality of cardiovascular care and receipt of revascularization have been documented extensively. Although quality-improvement initiatives such as report cards have the potential to reduce racial and ethnic disparities, report cards might cause surgeons to avoid patients they perceive to be high risk. If surgeons use race and ethnicity to assess this risk, existing healthcare disparities may increase. Indeed, previous studies demonstrate that physicians perceive that racial and ethnic minorities are less likely to comply with treatment, are more likely to refuse treatment, adhere poorly to treatment regimens, and delay seeking care for their comorbid medical conditions. If surgeons believe that racial and ethnic minority patients will have worse outcomes, published report cards might lead surgeons to disfavor them. Therefore, the objective of the present study was to examine the impact of New York’s surgeon-specific CABG report card on racial and ethnic disparities in receipt of CABG surgery.

Methods

Data and Study Population

We analyzed hospital discharges in New York State using records from the New York State Department of Health’s inpatient data files and hospital discharges in a group of comparison states in the Nationwide Inpatient Sample from the Healthcare Cost and Utilization Project (HCUP-3). States were also excluded from the study if they did not report patient race during the study period, 1988 to 1995 (Arizona, Illinois, Oregon, Pennsylvania, Tennessee, and Washington). All remaining states (California, Colorado, Connecticut, Florida, Iowa, Kansas, Massachusetts, Maryland, Montana, New Jersey, New York, South Carolina, and Wisconsin) were included in the

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analysis. Among these states, only New York released CABG report cards during the study period.

These data include information on patient age, race, ethnicity, insurance type, hospital code, and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes for all patients. Additionally, the HCUP-3 data have median income in each patient’s ZIP code. The New York State discharge data contain patient ZIP code, which we linked to median income in each patient’s ZIP code from the 1990 US Census.

We chose a study period of 1988 to 1995 to span December 1991, when New York released its first surgeon-specific CABG report card. After 1991, New York released CABG report cards annually. We selected patients who had been admitted to the hospital with the principal diagnosis of acute myocardial infarction (AMI; ICD-9-CM code 410.0 through 410.9). We limited the analyses to these patients because (1) patients with AMI are a relevant at-risk population for CABG who are almost uniformly hospitalized and therefore captured in the discharge data, and (2) in contrast to the population of patients who actually receive CABG, the composition of the population of patients hospitalized for AMI is unaffected by the release of the report card.7

Study Variables

The principal outcome variable was whether CABG was performed during the hospitalization. Use of cardiac catheterization and PTCA were also evaluated as outcomes. Patients were categorized by race (non-Hispanic white versus black or Hispanic, although we also used other categorizations), residence (New York versus a control state), and period (hospitalized for AMI before New York’s report card was released [1988–1991] versus after [1992–1995]). Covariates in the model included sociodemographic characteristics (age, gender, median income by ZIP code, and type of health insurance), the percentage of black and Hispanic patients with AMI admitted to each hospital, and a constructed index of patient severity of illness.

The severity index was constructed on the basis of comorbidity measures defined by the externally validated method of Elixhauser et al., designed specifically for use with administrative data. The Elixhauser comorbidity index includes the 30 comorbidities defined by Elixhauser and sociodemographic variables that include age, race, gender, and primary payer. The severity index is a patient’s predicted probability of in-hospital death after admission with AMI based on logistic regression of in-hospital death and the comorbidity measures in 1988 through 1991. The post–report card years were excluded from this severity model. This was done to provide a severity index that is unaffected by the impact of the CABG report card on outcomes. Had 1992 through 1995 been included in the severity model, the severity index would have biased the estimated impact of report cards on reported CABG surgery that succumbed to hospitalization and ethnic differences in CABG use. We controlled for the possibility by comparing the change in racial and ethnic differences in CABG use in 1992 through 1995 with that in CABG use in comparison states over the same time period that did not experience a policy change instituting report cards. This approach is well known in econometrics and is sometimes referred to as “differences-in-differences.”10 This approach recognizes that all states may change over time, but because of New York’s policy change that caused public reporting in December 1991, New York may change differently.

Differences in CABG use between white versus black and Hispanic patients in New York were estimated with a linear probability model. A linear model for a dichotomous outcome variable was chosen because the magnitude of an interaction effect in a linear model is a directly interpretable estimate of marginal probability, although nonlinear models, such as logistic regression, do not provide directly interpretable estimates of marginal probability from interaction terms.21

Because of the potential limitations of the use of a linear model on a dichotomous outcome variable, 2 tests were performed. First, the outcome variable was a dichotomous variable, but linear models do not bound the outcome variable between 0 and 1. Therefore, we tested what proportion of predicted values fell inside the 0-1 bounds and found that only 96% of predicted values were between 0 and 1. Second, ordinary least squares may produce biased estimates of confidence intervals, because the errors of a linear probability model are necessarily heteroscedastic. Given the large sample sizes for the parameters estimated, such efficiency is not likely to be an important concern. Nevertheless, we estimated models using weighted least squares, which accounts for heteroscedasticity, to determine whether our estimates were affected. The results were very similar to those obtained with ordinary least squares, which supports the assertion that the bias from heteroscedasticity is small. To test whether there were changes in racial and ethnic disparities in cardiologists’ performance of cardiac catheterization and PTCA, changes in catheterization and PTCA rates were estimated with the same method described above.

A further confirmation of a relationship between the introduction of CABG report cards in New York and changes in racial and ethnic differences between New York and the comparison states would be to observe how these racial and ethnic differences have changed on an annual basis. To examine this, differences in CABG rates between New York and the comparison states were estimated for each year between 1988 and 2000 using similar methods stratified by year.

To determine whether our results were robust, we performed 2 secondary analyses. First, the exit of surgeons from the New York market may have occurred differentially in areas with a high proportion of racial and ethnic minorities, and this effect might account for changes
in the use of CABG surgery in New York between white versus black and Hispanic patients. To test the sensitivity of this effect, the main hypothesis was retested after excluding the hospitals of 12 surgeons performing CABG in New York in 1988 to 1991 but not in 1992 to 1995. Second, racial and ethnic minorities may be differentially admitted to hospitals that do not perform CABG and would therefore be transferred before receiving CABG. Because we were unable to track patients who were transferred, we tested for the sensitivity of this effect by retesting our main hypothesis after excluding all patients who were transferred out of the hospital.

All standard errors were corrected for clustering within hospital using the Huber-White estimator of variance. All analyses were conducted with Stata 8.0 (Stata Corporation).

### Results

Characteristics of the 928,551 patients with AMI included in the study from New York (n = 310,412) and the comparison states (n = 618,139) are summarized in Table 1. Black and Hispanic patients accounted for 13.7% of patients in New York and 10.0% of patients in the comparison states. Compared with white patients, black and Hispanic patients were younger, more likely to be insured with Medicaid or to be uninsured, and were more likely to be in a lower income group.

Some population characteristics changed over time. The annual income among Hispanic patients increased over the study period. The percentage of patients with an annual income over $35,000 increased from the pre-report card period to the post-report card period, from 29.8% to 33.6% in New York and from 14.4% to 25.3% in comparison states. There was also an increase in the proportion of people who lacked insurance in the comparison states among all racial and ethnic groups. This increase did not occur in New York.

### Disparities in CABG Use In Increased in New York After Report Cards Were Released

Black and Hispanic patients were significantly less likely to receive CABG than white patients in New York after the report card was released (Table 2). Before the report card’s release in New York, white patients received CABG significantly more often than black patients but not Hispanic patients (3.6% of white patients versus 0.9% of black patients and 2.9% of Hispanic patients underwent CABG). After the report card was released, the difference in CABG use between white versus black patients and white versus Hispanic patients increased (8.0% of white patients versus 3.0% of black patients and 4.8% of Hispanic patients underwent CABG). At the same time in the comparison states, the change in the difference in CABG use by race and ethnicity was not statistically significant (the difference in CABG use changed from 3.4 percentage points to 3.7 percentage points in white versus black patients and from 2.1 percentage points to 1.2 percentage points in white versus Hispanic patients). Thus, the racial and ethnic disparity in CABG use in New York widened 2.3 percentage points in white versus black patients after the report card was released, whereas the disparity in the comparison states did not change significantly. In white versus Hispanic patients, the disparity in CABG use in New York widened 2.5 percentage points after the report card was released, whereas the disparity in the comparison states did not significantly change. Therefore, with adjustment for trends in comparison states, the net effect of the release of report cards in New York was an overall increase in racial and ethnic disparities in CABG use by 2.0 percentage points (95% CI 0.7 to 3.4, P = 0.006) in white versus black patients and by 3.4 percentage points (95% CI 0.8 to 5.9, P = 0.01) in white versus Hispanic patients.

### Disparities in Cardiac Catheterization and PTCA Did Not Change in New York After Report Cards Were Released

Overall, the racial and ethnic disparity between white versus black and Hispanic patients in the use of cardiac catheterization...
Similarly, among white versus Hispanic patients, PTCA use of 2.1 percentage points (95% CI 0.1 to 5.8, P=0.02) in New York compared with the comparison states after the CABG report card was released.

Disparities in CABG Use Initially Increased After Report Cards Were Released, Then Decreased Over Time

The Figure shows the trend differences in racial and ethnic disparities in CABG use between New York and the comparison states. From 1988 to 1991, racial and ethnic disparities in New York were slightly lower (from 0.3 percentage points in 1988 to 1.5 percentage points in 1991) than in the comparison states. In 1992, racial and ethnic disparities in CABG use increased dramatically between New York and the comparison states, which resulted in New York having higher (by 1.9 percentage points) racial and ethnic disparities than the comparison states. Over the course of the subsequent 8 years, the difference in disparities decreased to −0.4 percentage points in 2000, when New York had slightly lower racial and ethnic disparities than the comparison states.

Results Were Preserved After Exclusion of Surgeons Who Stopped Operating in New York and Exclusion of Patients Transferred to Another Hospital

To investigate the possible role of surgeons exiting the New York CABG market in the increase in racial and ethnic disparities in CAGB use immediately after the release of report cards, we repeated the main analysis after excluding the hospitals where surgeons stopped performing CABG surgery after report cards were released. This process excluded 42,262 patients admitted with AMI. The increased racial and ethnic disparities in CABG use remained, with the difference in CABG use for AMI increasing 1.3 percentage points between white versus black patients (95% CI 0.0 to 2.6, P=0.05) and increasing 3.2 percentage points between white versus Hispanic patients (95% CI 0.1 to 5.8, P=0.02) in New York compared with the comparison states after the CABG report card was released.

TABLE 2. Changes in Percentage of Patients With AMI Undergoing CABG Surgery in New York and the Comparison States Before and After New York’s CABG Report Card Was Released*

<table>
<thead>
<tr>
<th>Disparity in CABG use between white and black patients</th>
<th>CABG for AMI, %</th>
<th>Change in Percentage (95% CI; P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White (n=267736)</td>
<td>3.6</td>
<td>8.0</td>
</tr>
<tr>
<td>Black (n=23092)</td>
<td>0.9</td>
<td>3.0</td>
</tr>
<tr>
<td>White vs black disparity (95% CI; P)</td>
<td>2.7 (1.8 to 3.6; 0.01)</td>
<td>5.0 (3.8 to 6.2; &lt;0.001)</td>
</tr>
<tr>
<td>Comparison states</td>
<td>5.9</td>
<td>8.8</td>
</tr>
<tr>
<td>White (n=557501)</td>
<td>2.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Black (n=23092)</td>
<td>3.4 (2.6 to 4.3; &lt;0.001)</td>
<td>3.7 (2.8 to 4.5; &lt;0.001)</td>
</tr>
<tr>
<td>Difference in disparities between New York and United States (95% CI; P)</td>
<td>−0.7 (−1.9 to 0.4; 0.21)</td>
<td>1.3 (−0.2 to 2.9; 0.08)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disparity in CABG use between white and Hispanic patients</th>
<th>CABG for AMI, %</th>
<th>Change in Percentage (95% CI; P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White (n=267736)</td>
<td>3.6</td>
<td>8.0</td>
</tr>
<tr>
<td>Hispanic (n=19584)</td>
<td>2.9</td>
<td>4.8</td>
</tr>
<tr>
<td>White vs Hispanic disparity (95% CI; P)</td>
<td>0.7 (−0.9 to 2.2; 0.38)</td>
<td>3.2 (1.6 to 4.7; &lt;0.001)</td>
</tr>
<tr>
<td>Comparison states</td>
<td>5.9</td>
<td>8.8</td>
</tr>
<tr>
<td>Hispanic (n=19584)</td>
<td>3.8</td>
<td>7.6</td>
</tr>
<tr>
<td>White vs Hispanic disparity (95% CI; P)</td>
<td>2.1 (0.9 to 3.3; 0.001)</td>
<td>1.2 (−0.4 to 2.8; 0.13)</td>
</tr>
<tr>
<td>Difference in disparities between New York and United States (95% CI; P)</td>
<td>−1.4 (−3.2 to 0.4; 0.13)</td>
<td>2.0 (−0.4 to 4.4; 0.11)</td>
</tr>
</tbody>
</table>

*All results adjusted for age, gender, medium income by ZIP code, insurance, percentage of black and Hispanic patients admitted annually with AMI at each hospital, and severity of illness.
To investigate the possible role of patient transfers in these results, we repeated the main analysis after excluding all patients who were transferred to another hospital after admission for AMI. This process excluded 197,899 patients. The difference in CABG use for AMI increased 1.9 percentage points between white versus black patients (95% CI 0.4 to 3.3, \(P = 0.01\)) and 3.5 percentage points between white versus Hispanic patients (95% CI 0.6 to 6.4, \(P = 0.02\)) in New York compared with the comparison states after the CABG report card was released.

**Discussion**

It has generally been assumed that report cards have the potential to improve racial and ethnic disparities in healthcare quality9–11; however, the release of New York’s CABG report card was associated with a significant increase in racial and ethnic disparities in CABG use in New York compared with other states in the years immediately after the report card’s release. Despite the relatively lower use of CABG among racial and ethnic minorities in New York, the evidence suggests that racial and ethnic minorities did not receive the substitute procedure of PTCA to make up for their lower rates of CABG. The increased racial and ethnic disparities after CABG report cards between 1992 and 1995 resulted in 19% fewer CABG surgeries among black and Hispanic patients in New York, or a reduction from an expected 1134 CABGs in this population to the observed number of 953. Although this increase in racial and ethnic disparities appears to be transient, it took 9 years for disparities in New York to return to the levels they were at before the report card was released.
The value of report cards in improving health care has been assumed but not well demonstrated. Few patients use report cards to help choose healthcare providers, and many are unaware that report cards exist.\textsuperscript{25,26} Similarly, referring physicians rarely use quality information in their referral recommendations.\textsuperscript{5} Finally, studies that have examined whether report cards have caused an increase in high-quality hospitals’ or surgeons’ market share have found that when present, changes in market share are generally small and sometimes oppose the predicted direction.\textsuperscript{27–29}

Research suggests that report cards may paradoxically reduce quality of care by causing surgeons to avoid operating on high-risk patients. Omoigui et al\textsuperscript{6} noted that the number of patients transferred to the Cleveland Clinic from New York hospitals rose by 31% after the release of CABG report cards in New York, and that those patients who were transferred generally had higher risk profiles than patients transferred to Cleveland Clinic from other states. In a survey, 63% of cardiac surgeons rated in a CABG report card admitted to being reluctant to operate on high-risk patients, and 59% of cardiologists reported having increased difficulty finding a surgeon for high-risk patients with coronary artery disease since the release of report cards.\textsuperscript{5} Finally, Dranove et al\textsuperscript{7} reported that there was a relative decline in the illness severity of patients undergoing bypass surgery in states that publicly released CABG report cards after the report card was released compared with states that did not release the information. Additionally, among patients admitted to the hospital with a heart attack, outcomes were worse for patients in states with CABG report cards than in those states without such report cards.\textsuperscript{7} With the present study, we report another important, unintended consequence of healthcare report cards: they are associated with worsening racial and ethnic disparities in health care.

The present results suggest that surgeons responded to CABG report cards by differentially selecting patients for CABG surgery on the basis of race and ethnicity. Why should surgeons respond this way, given that racial and ethnic minorities have similar outcomes to whites after cardiac revascularization?\textsuperscript{29,31} Surgeons may use race and ethnicity to predict risk if they believe it measures severity that is unmeasured by the report card. To control for risk, New York’s CABG report card uses detailed clinical information, such as age, body surface area, hemodynamics, comorbidities, cardiac function, and a history of prior open heart surgery.\textsuperscript{1} Despite this detailed risk adjustment, if surgeons have information that is unmeasured by the report card but they believe is associated with risk of an adverse outcome, they might use that information to attempt to improve their report card ranking. One such piece of information that physicians believe is associated with risk is a patient’s race.

Prior research has found that physicians believe that minority patients are less likely to comply with treatment,\textsuperscript{12,13} more likely to refuse treatment,\textsuperscript{14} adhere poorly to treatment regimens, and delay seeking care\textsuperscript{15} for their comorbid medical conditions. Physicians also perceive that minority patients have less desirable social characteristics, including being more likely to abuse alcohol or drugs, to be unintelligent, and to be uneducated.\textsuperscript{12} Why these factors motivate physicians to treat racial and ethnic minorities differently remains unclear; it may be from bias (overt prejudice on the part of providers) or subconscious perceptions rather than deliberate actions (statistical discrimination).\textsuperscript{32} Nonetheless, our finding of differential treatment rates based on patient race is consistent with prior research.\textsuperscript{13}

The relative increase in racial and ethnic disparities in New York may not be entirely due to surgeons avoiding patients they perceive as being high-risk. Alternatively, it might be due to an expansion of CABG use among patients who were perceived as being low risk. Over the study period, there was an increase in CABG use among all racial and ethnic groups in New York and in the comparison states. This was expected given the expanding indications for CABG during the early 1990s; however, this expansion was particularly large among white patients in New York, whereas black and Hispanic patients in New York experienced expansion of CABG use that was smaller and similar in magnitude to that of the comparison states. Rather than representing a decline in CABG use among patients perceived as being high risk, this may suggest an expansion of CABG use among patients perceived as being low risk; however, without explicit measures of appropriateness, it is impossible to differentiate between these 2 alternatives.

If racial and ethnic disparities in CABG use increased as a result of patient selection to game the CABG report cards, why was the increase in disparities transient, declining to pre–report cards levels over the course of the decade? One possibility is that over time, surgeons learned that race and ethnicity are not good markers for risk and stopped selecting patients on that basis. Indeed, New York State’s Department of Health has not included race in their risk-adjustment model for that very reason. They have found that after adjusting for the detailed clinical information measured for the report card, race is not associated with CABG outcomes.\textsuperscript{1} Another possibility is that surgeons have stopped avoiding patients they perceive as being high risk to avoid bad outcomes because they have realized that the information in the report card has little impact on physician selection by patients and referring physicians.\textsuperscript{5,25,27}

The finding that CABG report cards increase racial and ethnic disparities in CABG use should not be taken as a reason to abandon quality-improvement efforts through measuring and reporting quality. Instead, it suggests that quality report cards may need to be improved, not only by increasing their impact on patients’ selection of high-quality physicians, but also by diminishing physicians’ incentive to select patients on the basis of their perceived risk. One way to decrease this unintended consequence is to include measures of the appropriateness of care. In the case of CABG report cards, appropriateness criteria would diminish surgeons’ incentive to substitute potentially less appropriate low-risk patients for potentially more appropriate high-risk patients. It is also possible that focusing the attention of report cards on processes of care, rather than outcomes of care, would diminish patient avoidance, because quality indicators that measure processes of care may be less dependent on individual patient characteristics. Another alternative is to privately report quality information by releasing the information only to the physicians who are being rated. This may lead physicians to improve their performance without giving them incentive to avoid patients they perceive as being high risk.

Our research is subject to several limitations. First, we have confidence in our findings of differences in healthcare processes before and after report cards, but we cannot draw definite conclusions about differences in health outcomes. Past research
suggests that CABG report cards were associated with worsening outcomes for patients admitted to the hospital with AMI, which suggests that the relative decline in CABG use among black and Hispanic patients in New York will adversely affect their health outcomes. Second, it is difficult to determine causation from this observational study or to be sure that the observed decline in CABG surgery among racial and ethnic minorities was attributable to changes in physician behavior. An alternative explanation is that the CABG report card changed patients’ selection of surgeons differentially by race and ethnicity, such that black and Hispanic patients chose to forego CABG surgery rather than have surgery by a low-quality surgeon or at a low-quality hospital. On the other hand, the limited response by healthcare consumers to report card information25,26 suggests that this explanation is unlikely to be responsible for the entire effect documented in the present study. Finally, our analysis examined racial and ethnic disparities in only 1 report card state, New York, and thus limits the generalizability of our results. Pennsylvania instituted a similar reporting mechanism in 1993, but their data omit race and so could not be considered.

Since the implementation of CABG report cards in New York, numerous other states have developed or are in the process of developing systems to publicly report quality of care and outcome measures. Although these efforts are plausible and well-meaning, the evidence examining their effectiveness at improving the quality of care is mixed. The present study adds to the accumulating evidence that suggests that healthcare report cards have unintended negative consequences that reduce the quality of care.

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