HEALTH POLICY

The Effect of Market Reform on Racial Differences in Hospital Mortality

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OBJECTIVE: To determine whether racial differences in hospital mortality worsened after implementation of a New Jersey law in 1993 that reduced subsidies for uninsured hospital care and changed hospital payment from rate regulation to price competition.

DATA SOURCES/STUDY SETTING: State discharge data for New Jersey and New York from 1990 to 1996.

STUDY DESIGN: We used an interrupted time series design to compare risk-adjusted in-hospital mortality rates between states over time. Adjusting for patient characteristics, baseline interstate differences, and common intertemporal trends, we compared the effect sizes for whites and blacks in the following 4 groups: overall, uninsured, insured under age 65, and Medicare patients.

DATA COLLECTION/EXTRACTION METHODS: The study sample included 1,357,394 patients admitted to New Jersey or New York hospitals between 1990 to 1996 with stroke, hip fracture, pneumonia, pulmonary embolism, congestive heart failure, or acute myocardial infarction (AMI).

PRINCIPAL FINDINGS: The increase in mortality in New Jersey versus New York was significantly larger among blacks than among whites for AMI (2.4% points vs 0.1% points, *P*-value for difference .026) but not for the other 6 conditions. In groupings of conditions for which hospital admission is non-discretionary and conditions in which admission is discretionary, we found qualitatively larger increases in mortality for blacks but no statistically significant racial differences among patients overall, uninsured patients, insured patients under age 65, or Medicare patients.

CONCLUSIONS: Market-based reform and reductions in subsidies for hospital care for the uninsured in New Jersey were associated with worsening racial disparities in in-hospital mortality for AMI but not for 6 other common conditions.

KEY WORDS: quality of health care; economics; medical; financing; organized.

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Racial disparities in health outcomes are well recognized as a major problem within the American health system. Explanations for health disparities have included racial bias and differences in patient access to care, insurance status,

sociodemographic and clinical characteristics, and treatment preferences.¹

Over the past 20 years, market-based reforms have been implemented throughout the United States to slow increases in health care costs. For example, in 1993, New Jersey's Health Care Reform Act (HCRA) replaced an all-payer system that regulated hospital rates with a system that allowed insurers to selectively contract with hospitals and negotiate prices. In addition, HCRA reduced subsidies to hospitals for providing uncompensated care by ending the 19% surcharge on all hospital bills that had been earmarked for this purpose.² As a result, total subsidies for uncompensated care in New Jersey fell from \$700 million in 1992, the year before HCRA, to \$350 million by 1996.^{3,4}

In the early 1980s, about 30 states employed some form of hospital rate-setting as a cost-containment device, but all of these states except Maryland have eliminated hospital rate-setting in favor of market-based systems.⁵ Little is known about how such reforms have affected either quality of care in general or racial differences in outcomes.⁶⁻⁸ Such reforms have been shown to reduce hospital profit margins,⁹ the quantity of services provided to the uninsured,¹⁰ and hospital costs in more competitive markets.^{11,12} For the uninsured, whose care is financed largely from hospital margins, such reforms could potentially affect either access to hospital care or the quality of care once patients are admitted to hospitals.

There are several reasons that racial disparities may worsen as a result of cost containment pressures. Black patients are more likely to be uninsured,¹ and because care for the uninsured is largely financed out of hospital margins, cost containment efforts that reduce hospital margins may exacerbate disparities. In addition, blacks who are insured are more likely to carry lower-end insurance or be covered by Medicaid, and they are less likely to have supplemental insurance. Such patients are likely to face higher cost sharing and stricter limits on medical services as cost containment efforts increase.^{1,13,14} Cost containment pressures likely increase the need for physicians to ration time spent with each patient, exacerbating the degree to which subjectivity, clinical discretion, communication barriers, and stereotypes affect medical resource allocation decisions given underlying clinical uncertainty.^{15,16}

Our previous work demonstrated that uninsured patients with acute myocardial infarction (AMI) admitted to hospitals in New Jersey had a higher mortality rate after HCRA than before HCRA relative to either patients in New York or a nationally

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representative sample of patients.⁸ We subsequently demonstrated that uninsured patients with congestive heart failure and stroke admitted to hospitals in New Jersey also had a higher mortality rate after HCRA than before HCRA. Changes in mortality for insured patients, however, were generally not significant.¹⁷ We examine here whether mortality changed at different rates for black and white patients and whether this change was associated with insurance status.

METHODS

This project was approved by University of Pennsylvania Institutional Review Board.

Study Sample and Control Group

We obtained hospital discharge data from the state data granting agencies in New Jersey and New York for 1990 to 1996 to analyze in-hospital mortality among patients with any of 7 conditions. Mortality rates for 6 of these conditions—hip fracture, stroke, acute myocardial infarction, gastrointestinal bleeding, congestive heart failure, and pneumonia—have been identified by the Agency for Healthcare Quality and Research (AHRQ) as important indicators of hospital quality.^{18,19} We chose the seventh condition—pulmonary embolism (ICD-9 CM diagnosis codes 415.1x)—because it is a relatively common condition with significant mortality risk that should be affected by hospital quality. We further identified a subset of 5 conditions for which hospital admission is generally non-discretionary—hip fracture, stroke, AMI, gastrointestinal bleeding, and pulmonary embolism—because any changes in mortality rates for these conditions should not be caused by changes in admission frequency. To adjust for secular trends in in-hospital mortality, we used New York as a control state because it has a large population; it is an adjacent state; similar patient data were available; and there were no major changes in its hospital financing system during the study period.²⁰

There were 2,433,588 hospitalizations in the 2 states for patients with 1 of the 7 study conditions. We excluded patients who were neither black nor white ($N=233,699$) (race was derived from a combination of observer-recorded and self-report data); transferred out to another hospital ($N=127,310$) (because we could not determine whether the patient subsequently died); were less than 18 or older than 120 years ($N=123,096$); stayed in the hospital longer than 30 days ($N=122,266$); transferred in from a skilled nursing facility ($N=60,018$) (because such patients may be treated less aggressively, and the degree to which this holds true could vary in New Jersey and New York post-HCRA, as hospitals in New Jersey faced smaller margins); had missing information about the hospital's market characteristics ($N=53,592$); were residents of a state other than the one in which they were treated ($N=49,285$); had condition-specific exclusions defined by the AHRQ Quality Indicators ($N=11,439$)¹⁸; were pregnancy-related discharges ($N=426$); or had missing gender ($N=59$). We also excluded patients who were discharged alive in 1 day or less ($N=38,210$) because these patients either were miscoded or had extremely mild cases, and patients with myocardial infarction and lengths of stay less than 2 days if the patient was transferred in from another hospital or less than 4 days if not transferred in ($N=18,609$).⁸ In addition, we excluded patients from hospitals that did not have at least 1 death among black

and white patients in both the periods before and after the New Jersey reform ($N=205,972$). These exclusions, which had similar rates in both states, left us with 1,357,394 discharges.

Our focus was on care provided in acute care hospitals. Our data did not provide a way of identifying which ones were acute care hospitals, but by including data from all hospitals that treated patients over age 18 with principal admitting diagnoses of our study conditions, accidental inclusion of pediatric or rehab hospitals was unlikely. All the hospitals in our sample for which there are matching Medicare and American Hospital Association (AHA) identifiers (about 85% of sample) are listed as short-term general acute care hospitals by the AHA.

Risk Adjustment

We controlled for the following comorbidities using an approach similar to that used by Iezzoni et al.²¹ and Needleman et al.²² in previous studies using administrative data: metastatic cancer and other types of cancer with a poor prognosis, AIDS, chronic pulmonary disease, congestive heart failure, peripheral vascular disease, severe chronic liver disease, diabetes with end organ damage, chronic renal failure, nutritional deficiencies, dementia, and functional impairment. Patient gender, age, and age squared also were included in the models. In the second part of this analysis we added the proportion of black patients within each hospital to the regressions to determine whether hospital-level race effects mitigated individual-level race effects.

Empirical Specification

We defined our primary dependent variable as 30-day in-hospital mortality.

We used linear probability models (ordinary least squares [OLS] models with the dependent variable equal to 0 if the patient was discharged alive and 1 if discharged dead) to examine how risk-adjusted mortality changed in New Jersey relative to New York from the period before to the period after the New Jersey reform. We followed the approach taken by McClellan and Staiger in developing the AHRQ Inpatient Quality Indicators by using OLS to model mortality risk.¹⁹ This approach has the advantage of providing direct and easily interpretable estimates of the average percentage point change in mortality for different subgroups of the population that is most analogous to direct examination of the unadjusted changes in mortality rates. In all of our analyses, we performed sensitivity analyses to verify that our linear probability models produced estimates of the effects of the reform that were similar to models using logistic regression.

The models allowed baseline mortality to differ between New Jersey and New York and assumed that the 2 states had a common time trend in mortality rates until the implementation of HCRA but not afterwards. To test the validity of using New York as a control, we compared the time trends for New Jersey with those of New York before HCRA (from 1990 to 1992) using a Wald test of whether the 2 coefficients for the interaction terms for New Jersey combined with 1991 and 1992 were jointly equal to 0.⁸ In cases in which the time trends from 1990 to 1992 were significantly different than 0, we tested the robustness of our results to inclusion of the interaction terms New Jersey*1991 and New Jersey*1992 to adjust for the differential pre-reform trend between groups.

Our primary study variables were 3-way interactions of time, race, and state of residence. We estimated the magnitude and statistical significance of the coefficients on the interactions that measured the relative change in mortality in New Jersey versus New York from 1990 to 1992 to 1994 to 1996 by race for patients with different insurance status.

We calculated Huber–White robust standard errors²³ that accounted for the clustering of patient discharges within hospitals. Data analysis and model estimation were performed with the SAS 8.2 and Stata 7 statistical software packages. All results are presented with the coefficients multiplied by 100 to show percentage point changes in the risk of mortality.

RESULTS

Table 1 provides information about the 7-condition sample. The number of admissions for the 5 non-discretionary conditions changed little from pre- to post-HCRA in both New Jersey and New York, changing by less than 2.5% for whites and increasing nearly identically by 4% for blacks in both New Jersey and New York. Among whites admitted with the 2 conditions for which admission may be discretionary, admissions increased by 3.9% in New York and 3.7% in New Jersey, whereas among blacks admissions increased by 18.8% in New York and 12.2% in New Jersey. Unadjusted mortality rates decreased for both blacks and whites in New York as well as among whites in New Jersey. Uninsured black patients in New Jersey were the only patients to experience an increase in unadjusted mortality after the New Jersey reform. The average lengths of stay decreased to a slightly greater degree in New Jersey than in New York in most subgroups. The test of controls (not shown) confirmed that the rates of change in mortality outcomes for whites and blacks in New Jersey and New York were not significantly different from 0 for all conditions besides AMI.

Table 2 provides information about the statistical significance of the mortality change in New Jersey relative to New York post-HCRA by condition. Among white patients with AMI, there was a relative increase in mortality of 0.1% points in New Jersey versus New York. However, there was a 2.4% point relative increase in mortality among black patients (*P* value .01), and this black–white difference in relative mortality was statistically significant (*P* value .03). After adjusting for the underlying difference in AMI mortality trends from 1990 to 1992 pre-HCRA, the mortality increase among blacks remained 2.4% points above that for whites (*P*-value .06).

For the other 4 conditions for which hospital admission is relatively non-discretionary (hip fracture, stroke, pulmonary embolism, and gastrointestinal bleeding) the magnitude of the relative mortality increase in New Jersey compared with New York was statistically no different for whites versus blacks. White patients with the 5 non-discretionary conditions experienced an average relative mortality increase of 0.5% points (*P* value .09) whereas black patients experienced an average relative increase of 1.3% points (*P* value .02). The difference between the effect sizes among whites and blacks was not statistically significant (*P* value .17).

Among patients with congestive heart failure and pneumonia, 2 conditions for which hospital admission is discretionary, white patients experienced a less than 0.1% point relative mortality increase in New Jersey versus New York (*P* value .74), whereas black patients experienced a 0.4% point relative increase (*P* value .20). For the 7 conditions overall, whites experienced a 0.3% point relative mortality increase (*P* value .20) compared with a 0.7% point relative increase for blacks (*P* value .03). The difference between these effects among whites and blacks was not significant (*P* value .18).

Analysis of the adjusted changes in mortality in New Jersey compared with New York for patients with different insurance types for the 7 conditions overall (Fig. 1) showed that

Table 1. Characteristics of the 7-Condition Sample

	Pre-HCRA (1990 to 1992)			Post-HCRA (1994 to 1996)		
	Medicare	Insured <Age 65	Uninsured	Medicare	Insured <Age 65	Uninsured
Number of cases						
NJ						
Whites	51,779	16,383	2,018	57,985	15,652	2,304
Blacks	4,690	3,160	1,072	6,213	3,220	1,195
NY						
Whites	95,761	31,672	2,447	116,865	31,451	3,330
Blacks	9,329	7,997	1,218	12,446	8,343	1,255
Unadjusted mortality						
NJ						
Whites	14.1	6.1	11.0	12.0	5.7	10.0
Blacks	12.9	8.3	12.3	11.4	7.8	13.9
NY						
Whites	13.6	6.2	12.2	10.9	5.4	7.4
Blacks	13.6	10.4	16.2	11.0	8.1	11.7
Average LOS						
NJ						
Whites	11.2	8.6	8.4	9.0	7.0	6.9
Blacks	11.6	9.3	8.6	9.8	7.9	7.6
NY						
Whites	10.9	8.6	7.8	9.9	7.7	7.5
Blacks	11.2	9.2	8.2	10.0	8.3	7.5

Conditions include acute myocardial infarction, stroke, pulmonary embolism, hip fracture, gastrointestinal bleeding, congestive heart failure, and pneumonia.

NJ, New Jersey; NY, New York.

Table 2. Condition Specific Percentage Point Change in Mortality from Pre-Reform to Post-Reform Period in New Jersey vs. New York

	Number of Patients	Whites		Blacks		Test of Differences Between Whites and Blacks	
		PPC	P value	PPC	P value	PPC (95% CI)	P value
Acute myocardial infarction	215,908	0.1	.91	2.4	.01	2.3 (0.6, 4.1)	.026
Hip fracture	113,827	0.7	.034	-0.7	.61	-1.3 (-3.6, 0.9)	.33
Stroke	66,337	4.1	.007	2.1	.339	-1.9 (-5.6, 1.7)	.38
Pulmonary embolism	22,545	1.5	.106	0.8	.67	-0.7 (-4.1, 2.7)	.73
Gastrointestinal bleeding	150,850	0.2	.48	0.1	1.6	0.1 (-0.4, 1.9)	.3
Nondiscretionary admission 5 condition average	569,467	0.5	.094	1.3	.024	0.8 (-0.3, 2.0)	.17
CHF	458,816	0	.9	0.6	0.11	0.6 (0, 1.3)	.125
Pneumonia	329,111	0.2	.69	0.2	0.717	0 (-1.0, 1.0)	.94
Discretionary admission 2 condition average	787,927	0.0	.74	0.4	.203	0.4 (-0.3, 1.1)	.31
Seven condition average	1,357,394	0.3	.197	0.7	.029	0.4 (-0.2, 1.1)	.182

These models also adjust for age, age squared, gender, types of cancer with a poor prognosis, metastatic cancer, AIDS, chronic pulmonary disease, congestive heart failure, peripheral vascular disease, severe chronic liver disease, diabetes with end organ damage, chronic renal failure, nutritional deficiencies, dementia, and functional impairment.

The original coefficients were multiplied by 100 to represent the percentage point changes in the risk of mortality in New Jersey relative to New York. AMI, acute myocardial infarction; PPC, percentage point changes.

mortality increased at similar rates in New Jersey compared with New York for both whites and blacks. This was true for patients overall, for the uninsured, for the under-65 insured, and for Medicare patients, as none of the effect sizes among whites or blacks was significantly different. Stratifying by conditions with discretionary versus non-discretionary admissions did not affect these findings.

Several robustness checks confirmed the above findings. The estimates achieved with linear probability models were qualitatively similar using logistic regression. Inclusion of length of stay as a covariate in the models resulted in no substantive changes in any of the coefficients that measured differences in the degree of change in mortality between whites and blacks. Inclusion of the proportion of blacks within each hospital as a covariate did not change the sign or significance of any of the study coefficients. We also confirmed that the rate of discharges to nursing homes changed at similar rates in the 2 states for whites and blacks, suggesting that discharges to nursing homes were not an important confounder.

DISCUSSION

Our findings indicate that a policy reform in New Jersey that encouraged price competition among hospitals and reduced

subsidies for hospital care for the uninsured did not disproportionately increase mortality rates for black patients. We found significantly larger relative increases in mortality among blacks for only 1 of our 7 study conditions (AMI). We also found no evidence of larger relative increases in mortality for blacks by insurance type.

We believe that the lack of observed differences are valid representations of the effects on outcomes once patients were admitted to hospitals, as we studied the impact of the reform not only for 2 conditions for which hospital admission may be discretionary but also for a set of 5 conditions for which admission is generally non-discretionary. Changes in the number of admissions over time appeared consistent across our 2 comparison states, indicating that the observed effects on outcomes were unlikely to have resulted from intertemporal changes in admission patterns or thresholds.

Increased financial pressures after HCRA to discharge patients early or transfer them to other facilities, such as nursing homes, might have masked relative increases in mortality in New Jersey in our study, because we examined only inpatient deaths in acute care hospitals. We did not find any relative increases in the rate of transfers among blacks in New Jersey relative to blacks or whites in New York during this period. Length of stay did decrease slightly more in New Jersey than in New York for blacks and whites with all 3 insurance types. However, adjusting for differential changes in length of stay did not alter our findings.

In assessing these results, other limitations should be kept in mind. Our analysis is limited to 7 medical conditions in 2 states, and thus we do not know whether these results are generalizable to patients with other diagnoses or in other areas. Our study was observational, and any policy reforms implemented in New York during this period could have limited our ability to detect effects of HCRA on racial mortality differences. However, New York did not implement a change in hospital financing until January 1, 1997 (after our study period), and a review of the New York Department of Health website (<http://www.health.state.ny.us/>) did not reveal any reforms that would have had a confounding impact on health outcomes between 1990 and 1996.

There are inherent limitations to studying quality of care using administrative data, including inadequate risk adjust-

*Conditions include Acute myocardial infarction, stroke, pulmonary embolism, hip fracture, gastrointestinal bleeding, pneumonia, and congestive heart failure.

Differences between Whites and Blacks in the degree of relative increase in mortality are not significant.

FIGURE 1. Adjusted change in mortality in New Jersey compared with New York for whites and blacks - 7 condition sample.

ment, potentially inaccurate coding, and in this case lack of data on post-discharge deaths. Some of these limitations are mitigated by the fact that we studied relative differences in mortality over time and across states. It is unlikely that the limitations associated with administrative data would affect 1 time point or state but not another. Coding of patient race has not been verified independently within these data. However, the accuracy of data on black versus white race is generally high in large administrative databases.^{24,25}

Although the ability to adjust for severity of illness is always limited when using administrative data, risk adjustment was less important in this study for several reasons: many of the conditions we studied are diagnoses for which the decision to hospitalize is generally non-discretionary (i.e., not affected by severity of illness); we included every eligible admission in both states; and we compared outcomes for large population groups within large geographic areas. The fact that the number of admissions among whites and blacks was reasonably constant over time, particularly for the 5 non-discretionary conditions, suggests that differential changes in unobserved severity of illness were unlikely to have significantly affected our results. Moreover, if severity of illness had increased at differential rates for blacks relative to whites, one might expect LOS to have increased more for blacks in New Jersey, and this was not the case. Finally, if HCRA policies created financial disincentives for patients in New Jersey to seek care or for physicians to admit those patients to the hospital, higher severity from treatment delays would be considered an adverse effect of the reform measure itself. Because the intent of our study was to assess the possible adverse effects of HCRA on racial disparities in mortality, more stringent risk adjustment could pose the risk of "overadjusting" and thereby mask 1 potential pathway by which hospital financing reform might adversely affect health outcomes.

Few other studies have directly examined how disparities in outcomes are affected by changes in hospital financial incentives. Gruber showed that in the shift to price competition in California, the amount of uncompensated care, which is financed out of hospital net revenues, was reduced in more competitive hospital markets relative to less competitive hospital markets.¹⁰ Our earlier work demonstrated that the New Jersey Health Care Reform Act worsened mortality for patients with AMI, stroke, and congestive heart failure, and that these effects were larger among the uninsured and in more competitive hospital markets.^{8,17} Quasi-experimental studies on the effects of health insurance on health provide additional evidence that limiting access to medical services might affect health.²⁶

This study suggests that policy reforms designed to reduce hospital costs may exacerbate existing racial disparities for some conditions. This premise should be examined carefully in other policy contexts to determine reasons why disparities may worsen for some conditions and not others and the extent of the tradeoffs between cost savings from such reforms and decrements in quality either in general or for more vulnerable population groups.

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