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## Massachusetts health reform's effect on hospitals' racial mix of patients and on patients' use of safety-net hospitals

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### Abstract

**Background**—Due to residential segregation and a lack of health insurance, minorities often receive care in different facilities than whites. Massachusetts (MA) health reform provided insurance to previously uninsured patients, which enabled them to potentially shift inpatient care to non-minority-serving or non-safety-net hospitals.

**Objectives**—Examine whether MA health reform affected hospitals' racial mix of patients, and individual patients' use of safety-net hospitals.

**Research design**—Difference-in-differences analysis of 2004–2009 inpatient discharge data from MA, compared to New York (NY), and New Jersey (NJ), to identify post-reform changes, adjusting for secular changes.

**Subjects**—(1) Hospital-level analysis (discharges): 345 MA, NY, and NJ hospitals; (2) patient-level analysis (patients): 39,921 patients with 2 hospitalizations at a safety-net hospital in the pre-reform period

**Measures**—Pre- to post-reform changes in percentage of discharges that are minority (black and Hispanic) at minority-serving hospitals; adjusted odds of patient movement from safety-net hospitals (pre-reform) to non-safety-net hospitals (post-reform) by age group and state.

**Results**—Treating NJ as the comparison state, MA reform was associated with an increase of 5.8% (95% CI 1.4% to 10.3%) in the percentage of minority discharges at MA minority-serving hospitals; with NY as the comparison state, the change was 2.1% (95% CI –0.04% to 4.3%).

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Patient movement from safety-net to non-safety-net hospitals was slightly greater in MA than comparison states (difference-in-differences adjusted OR 1.1, 95% CI, 1.0–1.2, p=0.04).

**Conclusions**—Following MA health reform, the safety-net remains an important component of the healthcare system.

### Keywords

vulnerable populations; safety-net hospitals; disparities

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## Introduction

Inpatient hospital care in the US remains largely segregated, with blacks and whites often receiving care in different facilities.<sup>1,2</sup> The Supreme Court case, *Brown v. Board of Education*,<sup>3</sup> ruled that “separate educational facilities are inherently unequal.” Similarly, separate health care facilities are unequal.<sup>4</sup> Safety-net hospitals, which disproportionately care for minority populations, often have lower --or negative-- profit margins, with fewer resources and services available,<sup>5</sup> including specialty care.<sup>2,6</sup> Hospitals in black neighborhoods have fewer technological resources than do hospitals in white neighborhoods.<sup>2</sup> Further, physicians in settings that disproportionately care for blacks are less likely to have board certification, an indicator of physician competence.<sup>2</sup> In this study, we examine use of inpatient care in two settings where care may be “separate and unequal:” minority-serving and safety-net hospitals. Many hospitals are both minority-serving and safety-net hospitals; we include the latter since changes in hospital use by whites of low socioeconomic status may not be captured by only examining hospitals with a large concentration of minorities.

Health insurance reform is one means of addressing the problem of segregated health care and enabling patients to obtain care in non safety-net settings, as providing insurance may enable greater choice in care settings. MA had a strong safety net prior to health reform; the Free Care program (the MA uncompensated care pool) covered many patients who would have otherwise been uninsured. Pre- reform, these patients received care at safety-net institutions where they could receive Free Care. Following health reform implementation, these patients as well as previously uninsured patients have an insurance card that enables them to receive care at nearly any hospital. Most other states, prior to the Affordable Care Act (ACA), did not have a comparable mechanism to enable uninsured patients who received charity care to move care from safety-net to non-safety-net settings. Shifts of patients to or away from safety-net hospitals would have significant financial implications for the hospitals’ operating budgets and thus are an important policy consequence of health reform. Thus, health reform has the potential to affect both segregation of patients across these health care settings and the financial health of safety-net institutions.

While the stated goal of MA reform, which served as the template for the Affordable Care Act (ACA), was not desegregation of hospitals and reduced use of safety-net hospitals, it was designed to decrease racial/ethnic disparities in coverage and access. Massachusetts (MA) health reform expanded coverage in three ways. First, there was an expansion of public coverage in July 2006. Second was an individual mandate for coverage, effective

January 2008. Third, the reform created a health insurance exchange for more affordable private insurance.<sup>78</sup> Among adults aged 18 to 64—the population targeted by reform—uninsurance declined from 8.4% (2006) to 3.4% (2009) overall, with greater declines observed among blacks (15% to 5%) and Hispanics (20% to 13%) compared to whites (7% to 2%).<sup>9–11</sup>

Since MA implemented its expansion in 2006–2008 prior to the ACA’s 2014 insurance expansion, MA’s experience may inform how national coverage expansion might affect the concentration of minorities in hospitals and safety-net hospital usage. Our primary objective was to examine the change in the concentration of minorities from the pre- to post-reform period in hospitals, comparing MA to two comparable control states (New York [NY] and New Jersey [NJ]) between 2004–2009 that lacked insurance exchanges and individual mandates for insurance coverage for adults. NY embarked on health reform in 2000, expanding Medicaid and making private coverage more affordable for low-income workers.<sup>12</sup> NJ created an individual mandate for children in 2008.<sup>13</sup>

Secondary objectives were to determine whether individual patients (of all races) in MA who used safety-net hospitals prior to reform were more likely to use non-safety-net hospitals following reform, and whether racial disparities in use of safety-net hospitals were reduced post-reform. We also examined movement according to different disease categories, income, insurance, and patient distance to safety-net hospital.

We hypothesized that following MA reform, given greater flexibility in hospital choice, minorities would be less concentrated in minority-serving hospitals, and that MA patients who utilized safety-net hospitals pre-reform would be more likely to utilize non-safety-net hospitals, relative to patients in control states.

## Methods

### Conceptual model

Vaughan-Sarrazin et al<sup>14</sup> provide a conceptual framework for evaluating segregation and disparities in utilization and outcomes of health care (Figure 1). The framework includes two major domains on constructs affecting racial differences in hospital service utilization and care outcomes: 1. community and social factors (e.g. socioeconomic inequities and housing discrimination) that lead to residential segregation, which in turn affects both environmental and individual-level determinants of health, in addition to hospital segregation; and 2. delivery system factors (e.g. referral patterns, institutional discrimination, patient-provider preferences, and third party payers) that also affect hospital segregation and delivery-system-level determinants of health.<sup>2</sup> In this context, our study focuses on the effect of insurance reform as a delivery system factor that affects racial differences in hospital service utilization. To account for socioeconomic inequalities, we used median zip code income as a measure of poverty. We used nearest hospital type as a measure of the construct “proximity to services.”

## Design Overview

We performed two main analyses to examine MA reform's effects on hospitals' racial mix of patients and on patients' use of safety-net hospitals, one at the hospital level, the other at the patient level, each comparing MA to control states (Figure 2). In both analyses, we used a difference-in-differences (D in D) design to identify post-reform change adjusted for secular changes unrelated to reform.<sup>1516–18</sup> The difference-in-differences method is often used to estimate the impact of a policy (e.g. health reform) on an outcome (e.g. readmissions) by computing a double difference. One difference is over time (before-after) and the other is across subjects (between reform beneficiaries (e.g., Massachusetts residents) and non-beneficiaries (e.g., residents of other states)). Because pre-intervention characteristics that may be associated with the outcome variable are likely to be unbalanced between groups, it is necessary to control for these variables. Thus, it is necessary to perform a logistic regression with interaction terms (e.g. between time (pre- vs. post-reform) and age category (age 18–64, affected by reform vs. age > 65, unaffected by reform)).<sup>19</sup> For the first, hospital-level analysis, we compared the percent of minority discharges in minority-serving hospitals among adults age 18–64 in MA to same-aged adults in minority-serving hospitals in comparison states, calculating the post-reform (net) change associated with health reform.

For the second, patient-level analysis, we identified a cohort of patients as “safety-net hospital users”, in the baseline period. We examined whether, post-reform, these patients moved from safety-net to non-safety-net hospitals, contrasting movement among patients age 18–64 in MA to those age > 65 in MA (likely unaffected by reform because of Medicare coverage) to the difference in movement among patients age 18–64 and age > 65 in comparison states. We also analyzed movement to non-safety-net hospitals according to race/ethnicity among patients age 18–64, to assess disparities in such changes.

## Data

We used all-payer inpatient discharge databases from MA<sup>20</sup>, NY and NJ. We chose NY and NJ as comparison states for their geographic proximity to MA and sizable minority populations. These databases include all non-Federal short-term acute care (non-psychiatric) hospitals. Using 2004–2009 data, we examined adult hospitalizations for all causes except obstetrical, excluding such diagnoses because pregnant women were largely insured in MA prior to and following reform.<sup>21</sup> We used median zip code income from 2000 Census data to infer patients' socioeconomic status; the latest year for which zip code level estimates are available prior to the study baseline period (2004–06).<sup>22</sup>

## Definition of minority-serving hospitals

In each state, we ranked each hospital by the proportion of discharged minorities (blacks and Hispanics) during the pre-reform period (10/1/2004–6/30/2006). We defined minority-serving hospitals as the 20% of hospitals with the highest proportion of minority patients discharged. Medium-volume minority-serving hospitals are the middle 60% of hospitals with the proportion of minority patients discharged.

### Definition of safety-net hospitals

We modified a definition used by others<sup>23</sup> based on the percentage of Medicaid patients, expanding this definition to include patients whose insurance was “self-pay,” “indigent,” and “hospital responsibility.” We calculated the percentage of patients in each hospital who fell into these groups during the pre-reform period, defining safety-net hospitals as hospitals in the highest quartile.

While some hospitals were both minority-serving and safety-net, others were either exclusively minority-serving or safety-net. We identified a cohort of patients as “safety-net hospital users:” patients with > 2 hospitalizations in the pre-reform and > 2 hospitalizations in the post-reform period, for whom all hospitalizations during the pre-reform period were at a safety-net hospital. We considered other possible definitions; one hospitalization in the pre-reform period was insufficient to define a patient as an exclusive safety-net hospital user, and a small number of observations precluded using a definition of three or more hospitalizations in the pre-reform period.

### Definition of Pre- and Post-Reform Periods

We examined hospital admissions for 21 months (1/1/2008 to 9/30/2009) following the MA mandate for health reform (“post-reform” period) and contrasted it with the 21 months (10/1/2004 to 6/30/2006) preceding reform (“pre-reform” period), excluding the transition period (7/1/2006 to 12/31/2007). Neither comparison state enacted comprehensive insurance expansions during the study period (see Appendix); we assume that observed changes in hospital use reflect secular trends unrelated to reform.

### Measures

For the hospital-level analysis of minority-serving hospital usage, our primary outcome was the change from the pre- to post-reform period in the percentage of discharges that are minority in minority-serving hospitals, comparing MA to control states (D in D is time × state).

For the patient-level analysis, limited to safety-net hospital users, our primary outcome was the adjusted odds of movement from a safety-net to a non-safety-net hospital, comparing younger (18–64) to older adults (> 65) within MA, and compared the differences between the same age groups within the control states. We defined movement to a non-safety-net hospital as > 1 hospitalization in the post-reform period at a non-safety-net hospital. Covariates included factors beyond health insurance that might affect choice of facility including age, race, sex, income, insurance, Charlson comorbidity index, and nearest hospital type (D in D is age group×state). We also analyzed movement to non-safety-net hospitals according to race/ethnicity among patients age 18–64, to assess disparities in such changes.

### Analysis

Using the SAS statistical package, Version 9.1 (SAS Institute Inc, Cary, NC), we used difference-in-differences design to identify the post-reform change associated with reform.<sup>24–26</sup>

### Hospital-level analyses of minority-serving hospital usage

For minority-serving hospitals in each state, we calculated the difference in the percent of discharges that are minority between the pre- and post-reform period. The unit of analysis was hospital-quarter (each three-month time period over the entire study period). Using percent minority by hospital quarter as the outcome measure, we estimated a hospital-level random effects linear regression model with a D-in-D specification. The model measured the change in the outcome measure associated with health reform. This was done separately for each control state to account for secular trends in each state. We present unadjusted findings.

### Patient-level analyses of safety-net hospital usage

For this analysis, our focus was on patients identified as “safety-net hospital users” (in the pre-reform period) and we measured the probability of these patients moving to a non-safety-net hospital setting in the post-reform period. Due to differences across states in use of safety-net hospitals, instead of making comparisons by state, as in the other analysis, we treated patients aged  $\geq 65$  as the reference group (as they were Medicare-covered and unaffected by the health reform), and estimated the probability of movement among patients aged 18–64 relative to that among patients aged  $\geq 65$ , separately by state. Using a logistic regression model with a difference-in-differences specification, the change in the switching probability associated with health reform (among those aged 18–64 in MA) was estimated as the relative change in the switching probability in MA vs. comparison states. The model adjusted for sex, and for factors known to affect safety-net hospital use,<sup>27</sup> including patient race, income, insurance, and whether the nearest hospital is a safety-net hospital. We included county-level fixed effects to adjust for systematic (time-invariant) area-level differences, and quarterly fixed effects to adjust for secular shifts in safety-net use; we estimated standard errors robust to county-level clustering.

We analyzed overall patient movement rates (from safety-net hospital to non-safety-net hospital) in each state, and then, to determine if such movement varied by patients’ clinical conditions, we stratified among the five most frequent discharge diagnoses (pneumonia, congestive heart failure, coronary artery disease, asthma, and diabetes) categorized by the Agency for Healthcare Research and Quality’s Clinical Classifications Software.<sup>28</sup> We also analyzed the proportion of patients who moved according to patient income, insurance, and according to whether patients’ nearest hospital was a safety-net hospital. Finally, we analyzed movement according to race among patients age 18–64, to assess for changes in the presence of disparities pre-and post-reform. For this analysis, we compared changes in movement from safety-net to non-safety-net hospitals among blacks and Hispanics relative to whites (D in D by race and state) and adjusted for nearest hospital type only.

To evaluate the appropriateness of D in D specification, we tested the assumption of parallel trends to ensure that the pre-reform trends in the target and control groups were similar.<sup>15</sup> (Appendix Table 1). The Boston University IRB approved this study. We did not suppress any results due to small cell size.

## Results

### Analysis 1: Hospital-level analysis of minority-serving hospitals

We identified 14, 17, and 42 minority-serving hospitals in MA, NJ, and NY, respectively. Of these, 8 (57%), 13 (76%), and 26 (62%) were also safety-net hospitals, respectively. In the pre-reform period, NJ and NY had a higher proportion of minority patient discharges (68.8% and 66.7%, respectively) at minority-serving hospitals than did MA (27.9%). In unadjusted analyses, the percentage of minority discharges at MA minority-serving hospitals rose by 3.2%. The change in percentage of minority discharges at MA minority-serving hospitals associated with reform was 5.8% (95% CI 1.4% to 10.3%) relative to NJ and 2.1% (95% CI -0.04% to 4.3%) relative to NY (Table 1). Among hospitals with a “medium volume” of minorities, the change in percentage of minority discharges in MA associated with reform was 1.6% (95% CI 0.5% to 2.7%) relative to NJ; there were no significant changes relative to NY. The tests of parallel trends indicated that the D in D models were appropriate (Appendix Table 1). In MA minority-serving hospitals, the increase in discharges of 3.2% for minorities corresponds to an absolute increase of 6,030 discharges.

### Analysis 2: Patient-level analysis of safety-net hospital usage

We identified 16, 21, and 53 safety-net hospitals in MA, NJ, and NY, respectively. Of these, 8 (50%), 13 (62%), and 26 (49%) were also minority-serving hospitals, respectively. In the three states combined, 39,921 patients were “safety-net hospital users” in the pre-reform period (Table 2). 24,879 (62%) continued to have hospitalizations in safety-net hospitals in the post-reform period, while 15,042 (38%) received post-reform care in non-safety net hospitals. In unadjusted analyses, non-whites, those with lower income, patients whose nearest hospital was a safety-net hospital, and patients who lived in MA or NJ were more likely than others to remain in a safety-net hospital in the post-reform period.

The difference in movement from safety-net hospitals to non-safety-net hospitals was greater among MA adults age 18–64, relative to MA elderly adults, than between non-elderly and elderly adults in comparison states (difference-in-difference adjusted odds ratio [AOR] 1.3, 95% CI, 1.0–1.7,  $p=0.04$ ; Table 3). In MA, there was a significant increase in movement to non-safety-net hospitals for patients with a diagnosis of pneumonia (AOR 2.1, 95% CI 1.3–3.5), but not for congestive heart failure, coronary artery disease, asthma, or diabetes. Relative to whites, there was no difference in movement to non-safety-net hospitals for MA blacks and Hispanics relative to blacks and Hispanics in comparison states (Table 4). Black patients (in any state) were less likely to move to a non-safety-net hospital (AOR 0.7 95% CI 0.6–0.7). Relative to patients with private insurance, self-pay patients (in any state) were less likely to move to a non-safety-net hospital (AOR 0.4 95% CI 0.3–0.4).

## Discussion

Following implementation of MA health reform, the concentration of minorities increased at hospitals serving predominantly minorities prior to reform. Among patients who had previously received hospital care in safety-net hospitals, only a small proportion moved away from the safety-net setting, with patients having a diagnosis of pneumonia being more

likely to have moved their inpatient care. There are several potential explanations for our findings. First, if the overall population of minorities increased more in MA over the study period relative to control states, this could affect the concentration of minorities in hospitals. However, this is unlikely, as the percentage increase in minorities from 2004–2009 was 1.5% in MA, relative to 1.0% in NY and 3.4% in NJ.<sup>29</sup> Second, an inclusion criterion for the patient-level, safety-net hospital analysis was that patients have four hospitalizations over the study period. Such patients may have been substantially sicker, on average, than the general population of patients admitted to a hospital, and may have had established relationships with providers at safety-net hospitals. Therefore, they may have been unlikely to change their site of care. Our finding that only patients with a diagnosis of pneumonia (an acute condition) had a significant increase in movement away from MA safety-net hospitals supports this assertion. MA patients with chronic conditions (congestive heart failure, asthma, and diabetes) did not move to non-safety-net hospitals at a greater rate than patients in control states. Relative to patients with acute conditions, patients with chronic conditions may have had more established relationships with a health care team and therefore may have been less likely to transfer care to another institution.

Patients, particularly blacks, may have “loyalty” to safety-net hospitals.<sup>30</sup> Hospital discrimination was widespread as late as the 1960’s, even in the North. Blacks may have allegiance to the hospitals that historically cared for minorities while others denied them services. Further, safety-net hospitals often provide services unavailable in other settings, such as assistance with insurance, interpretation, and case management; as well as other poorly reimbursed services such as substance abuse treatment and psychiatric care.<sup>5</sup> Indeed, many patients using the safety net find the facilities preferable, convenient and affordable.<sup>31</sup>

Another barrier preventing patients from moving care from safety-net settings is that patients may have been unable to obtain a primary care provider (PCP) at a non-safety net institution. MA has had a PCP shortage since 2006.<sup>32</sup> In addition, patients may have had difficulty finding a PCP accepting insurance gained under reform. Many providers do not accept public forms of insurance because of low reimbursement rates. In 2010, only 53%, 43%, and 35% of MA internists accepted patients with Medicaid, Commonwealth Care, and Commonwealth Choice (the latter two are new insurance plans under MA Health reform), respectively.<sup>33</sup> In addition, health plan networks may restrict where patients obtain care. It is possible that some non-safety-net hospitals were not included in these networks. Finally, supply-side factors such as bed availability or overall admission rates<sup>34</sup> may drive where patients are hospitalized.

Our study adds to a small but growing literature examining the impact of MA health reform on safety-net hospital use. Mohan et al,<sup>35</sup> in an analysis of inpatient and outpatient volumes, revenue, and operating margins at MA safety-net hospitals, found that such hospitals continued to play a disproportionately large role in caring for disadvantaged patients post-reform. However, safety-net hospitals experienced declining financial performance compared to non-safety-net hospitals. It is possible that performance-based payment policies may have undermined the financial stability of safety-net hospitals. Ku et al<sup>31</sup> found that following MA health reform, patient volumes at community health centers and safety-net hospital-based clinics increased, and that the number of inpatient admissions was similar at

safety-net and non-safety-net hospitals. Thus, our observation that there appears not to have been a substantial “migration” of patients from safety-net to non-safety-net hospitals is consistent with prior literature. If, as we and others have observed, patients continue to receive care in safety-net settings, yet disproportionate share (DSH) funds for the safety-net are cut and reimbursement rates from the public forms of insurance people received under the reform are lower than the cost of care, the safety net could be financially undermined.

### Strengths and Limitations

We lacked data on many of the constructs in Vaughan-Sarrazin et al’s<sup>14</sup> framework for evaluating segregation in health care. For example, we lacked data on levels of residential segregation among the patients studied. We suspect that residential segregation was a significant factor that may have inhibited minorities from changing the site of their inpatient care, insofar as safety-net institutions were more likely to be closer to their neighborhoods. Indeed, Boston, New York, and Newark all have high indices of segregation.<sup>2</sup> In addition, we lacked data on delivery system factors such as hospital closures and mergers, or on changes in managed care contracts, which may have varied in the states we studied. Regarding the construct of socioeconomic inequities, our study period coincides with the economic recession. The shifts in care patterns we observe may be a result of different economic climates in each state. However, the difference-in-differences design should control for such secular trends. Finally, we examined 21 months after reform. However, it may take time for behavior to adapt, especially behavior like inpatient care-seeking which most individuals do not do often. A strength of our study is that it is the first of which we are aware to examine the impact of extending insurance coverage on the concentration of minorities in hospitals, and our findings suggest that insurance reform alone is not sufficient to address issues of segregation in hospitals. The future of safety-net and minority-serving hospitals is likely to be an increasingly important policy issue, which warrants further study.<sup>36</sup>

### Conclusion

MA health insurance expansion was associated with slight increases in the minority racial composition of hospital patients, but some patients moved away from the safety-net setting, suggesting that the safety net remains an important component of the healthcare system. Yet following health reform, MA safety-net hospitals received large cuts in payments previously received from the uncompensated care pool, with the rationale that other hospitals would assume the care of previously uninsured patients.<sup>31</sup> Our finding that minorities did not, by and large, move from safety-net to non-safety-net hospitals suggests this did not occur. Our observation that the racial/ethnic patient mix at hospitals has not, as yet, changed substantively in MA suggests that the same may occur nationwide, with ACA implementation, and underscores the importance of continued support for safety-net and minority-serving hospitals as national reform unfolds.<sup>36</sup> A desirable outcome of health reform would have been a decrease in segregation -- the concentration of minorities in minority-serving hospitals. Since this did not occur, interventions at the level of health insurance (e.g. raising reimbursement rates for public forms of insurance) may be warranted in order to better integrate hospitals.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgments

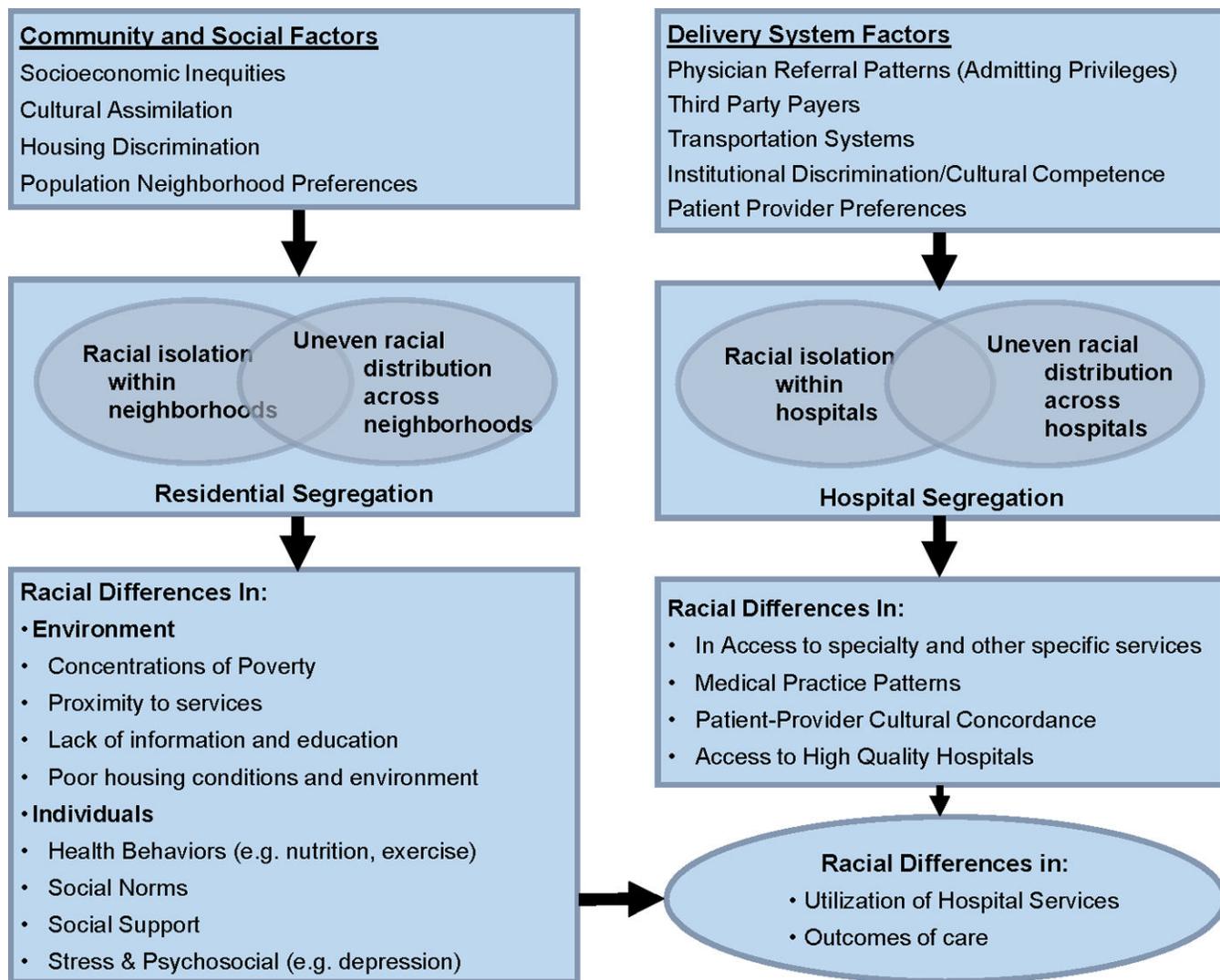
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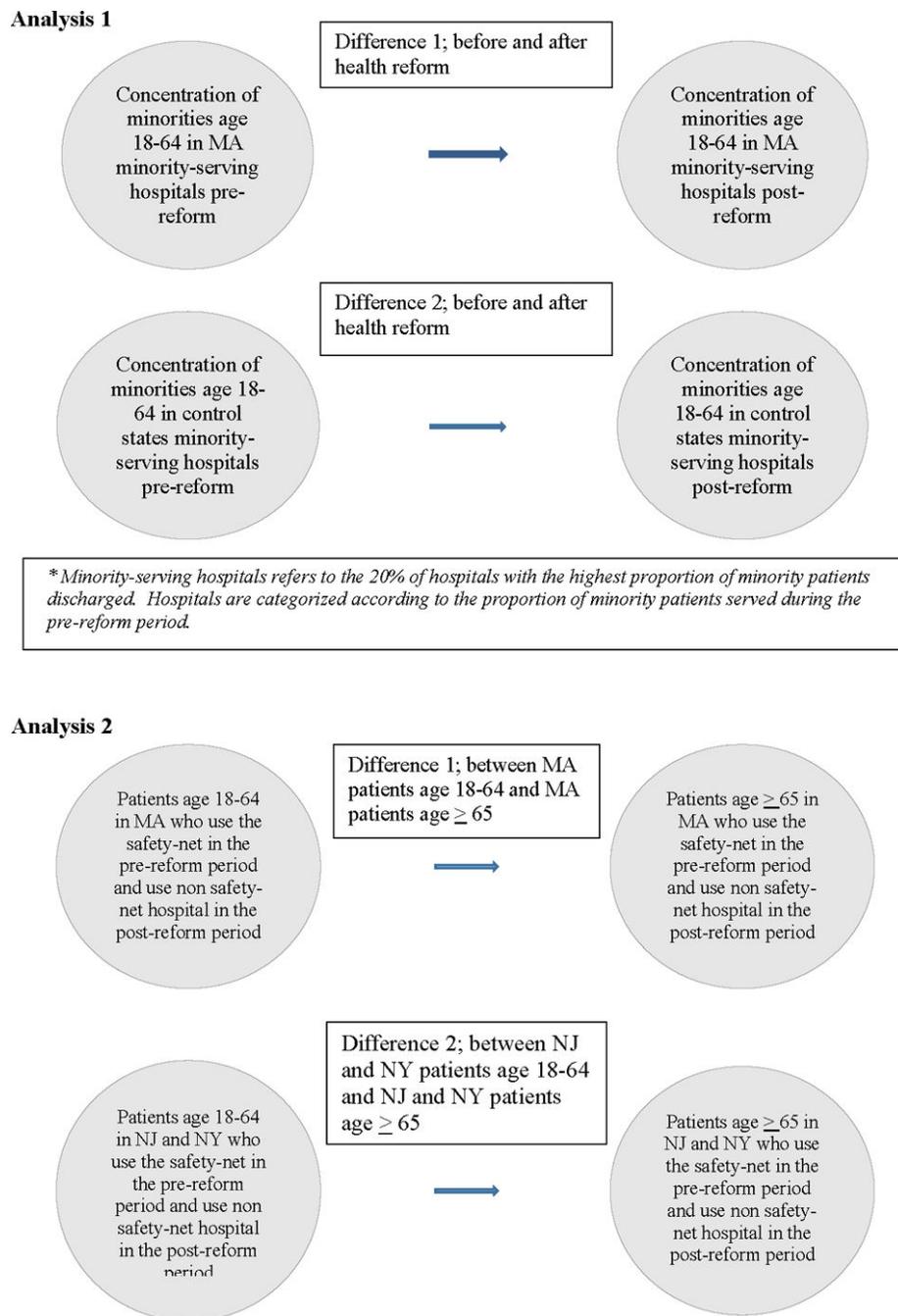
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**Figure 1.** Framework for Evaluating Segregation and Disparities Utilization and Outcomes of Health Care. Sarrazin MS, Campbell ME, Richardson KK, Rosenthal GE. Racial segregation and disparities in health care delivery: conceptual model and empirical assessment. *Health Serv Res.* Aug 2009;44(4):1424–1444.



**Figure 2. Study populations and analyses**

**Analysis 1:** Hospital level difference-in-difference analysis comparing concentration of minorities in minority-serving hospitals\* pre- vs. post-reform, MA vs. Control states (NY and NJ). Analysis compares Difference 1 and Difference 2.

**Analysis 2:** Patient-level difference-in-difference analysis comparing movement from safety-net to non-safety-net hospitals, MA vs. Control states (NY and NJ). Analysis compares Difference 1 and Difference 2.

Change in Volume of Minority (Black and Hispanic) Patients Served by Minority-Serving Hospitals in Massachusetts vs. Control States (New York & New Jersey), 2004–2009, Age 18–64

Table 1

Type of minority-serving hospitals*	State (14 Quarters) <sup>†</sup>	Percent of discharges that are for minority patients, pre-reform <sup>‡</sup>	Percent of discharges that are for minority patients, post-reform <sup>‡</sup>	Unadjusted change (%)	Percent (95% CI) change in percent of minority discharges in MA hospitals vs. control states <sup>‡</sup>	p-value
High-volume	MA minority-serving (14 hospitals)	27.90%	31.10%	3.20%		
	NJ minority-serving (17 hospitals)	68.80%	66.10%	-2.70%	5.84% (1.37% to 10.32%)	0.011
	NY minority-serving (42 hospitals)	66.70%	67.70%	1.00%	2.15% (-0.04% to 4.34%)	0.055
Medium-volume	MA minority-serving (40 hospitals)	9.83%	10.55%	0.72%		
	NJ minority-serving (48 hospitals)	28.08%	30.40%	2.32%	1.63% (0.55%, 2.71%)	0.003
	NY minority-serving (123 hospitals)	21.87%	22.05%	0.18%	-0.47% (-1.38%, 0.44%)	0.313
Low-volume	MA minority-serving (14 hospitals)	3.15%	3.54%	0.38%		
	NJ minority-serving (16 hospitals)	8.40%	8.24%	-0.17%	-0.49% (-2.31%, 1.32%)	0.595
	NY minority-serving (42 hospitals)	2.74%	3.43%	0.70%	0.26% (-1.27%, 1.79%)	0.737

\* High-, medium-, and low-volume minority-serving hospitals are the top 20%, middle 60%, and bottom 20% of hospitals with the proportion of minority patients discharged, based on the discharges during the pre-reform period.

<sup>†</sup> Unit of analysis is a hospital-quarter, with the study period divided into 14 quarters: 7 quarters pre-reform and 7 quarters post-reform. Estimates are based on hospital-level random effects linear regression model with a difference-in-differences specification described in the analysis section.

<sup>‡</sup> Pre-reform period defined as 10/1/2004–6/30/2006; post-reform period defined as 1/1/2008–9/30/2009.

**Table 2**

Comparison of Patient Characteristics Associated with Continued Safety-net Hospital Use versus Movement to a non-Safety-net Hospital following Massachusetts Health Reform, 2008–2009, Massachusetts, New York, and New Jersey\*

Characteristic	Patients who remain at Safety-net Hospital Post-reform % (n= 24879)	Patients who move to non-Safety-net Hospital Post-reform % (n=15042)	P –value <sup>†</sup>
Race			
Non-Hispanic black	36.73	30.06	< 0.001
Hispanic	20.37	17.97	
Other	4.89	2.88	
Non-Hispanic white	38.02	49.09	
Sex			
Female	52.18	50.34	< 0.001
Age			
18–64	58.96	59.91	0.06
65	41.04	40.09	
Income			
<\$50,000	85.72	72.14	< 0.001
Insurance <sup>‡</sup>			
Medicaid	23.00	19.38	< 0.001
Medicare	50.38	51.39	
Private	17.97	23.2	
Self-pay	5.53	3.69	
Other	3.12	2.34	
Nearest hospital is a safety-net hospital	76.99	62.5	< 0.001
State			
Massachusetts	25.3	22.5	< 0.001
New York	44.69	53.35	
New Jersey	30.01	24.15	
Top 5 Primary discharge diagnoses during pre-reform period <sup>§</sup>			
1 CHF	4.94	4.38	< 0.001
2 Pneumonia	3.56	3.00	
3 Coronary artery disease/chest pain	6.81	7.13	
4 Asthma	6.35	5.08	
5 Diabetes	3.44	3.45	
Mean Charlson Score pre-reform			
0	36.87	38.06	< 0.001
1–2	45.48	45.96	
3–4	13.25	12.42	
>4	4.40	3.56	

\* Patient-level analysis. Study cohort: Patients with 2 hospitalizations in the pre-reform period and 2 hospitalizations in the post-reform period (excluding obstetric hospitalizations) for whom all hospitalizations during the pre-reform period were at a safety-net hospital. Pre-reform period defined as 10/1/2004–6/30/2006; post-reform period defined as 1/1/2008–9/30/2009

<sup>†</sup> Chi square test examining the equality of two proportions between categories of remaining at safety-net hospital and moving to non-safety-net hospital

<sup>‡</sup> Defined as insurance in the post-reform period

<sup>§</sup> Patient diagnoses categorized by the Agency for Health Care Research and Quality's Clinical Classifications Software

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**Table 3**  
Changes in Patient Movement from Safety-net Hospitals to non-Safety-net Hospitals in Massachusetts and Control States (New Jersey and New York) Following MA Health Care Reform, Age 18–64 vs. Age 65\*

Index Admission Diagnosis	Massachusetts (n=9679)			Control States (n=30242)			MA vs. Control	
	% of patients who moved from SNH to non-SNH, age 18–64	% of patients who moved from SNH to non-SNH, age 65	Difference in movement rate	% of patients who moved from SNH to non-SNH, age 18–64	% of patients who moved from SNH to non-SNH, age 65	Difference in movement rate	Difference in Differences OR (95% CI) <sup>†</sup>	P-value
All diagnoses, excluding obstetrical	36.31%	33.63%	2.68%	38.50%	38.63%	-0.13%	1.31(1.01, 1.70)	0.04
Top 5 discharge diagnoses <sup>‡</sup>								
1 CHF	31.45%	28.64%	2.81%	37.08%	36.94%	0.14%	1.24 (0.76, 2.02)	0.39
2 Pneumonia	40.52%	29.61%	10.91%	32.63%	35.13%	-2.50%	2.14 (1.30, 3.54)	0.03
3 Coronary artery disease/chest pain	37.75%	36.62%	1.13%	40.52%	37.56%	2.96%	0.88 (0.53, 1.45)	0.62
4 Asthma	35.31%	35.92%	-0.61%	30.75%	32.69%	-1.94%	1.13 (0.90, 1.42)	0.30
5 Diabetes	30.99%	40.63%	-9.64%	38.84%	37.71%	1.13%	0.64 (0.23, 1.77)	0.40

\* Patient-level analysis. Study cohort: Patients with 2 hospitalizations in the pre-reform period and 2 hospitalizations in the post-reform period (excluding obstetric hospitalizations) for whom all hospitalizations during the pre-reform period were at a safety-net hospital. Pre-reform period defined as 10/1/2004–6/30/2006; post-reform period defined as 1/1/2008–9/30/2009

<sup>†</sup> Using a logistic regression model with a difference-in-differences specification, the change in the switching probability associated with health reform (among those aged 18–64 in MA) was estimated as the relative change in the switching probability in MA vs. comparison states. The model adjusted for sex, race, income, insurance, and nearest hospital type and controlled for area-level fixed effects.

<sup>‡</sup> Patient diagnoses categorized by the Agency for Health Research and Quality's Clinical Classifications Software. We included the most common diagnoses for which there was an adequate number of observations in each group (among patients 18–64 and age 65)

**Table 4**  
Changes in Patient Movement from Safety-net Hospitals to non-Safety-net Hospitals in Massachusetts and Control States (New Jersey and New York) Following Massachusetts Health Care Reform, Patients Age 18–64, According to Race and Ethnicity\*

	Massachusetts (n=4755)	Control States (n=18065)	MA vs. Control	P-value
% of patients who moved from SNH to non-SNH, age 18–64 <sup>†</sup>		% of patients who moved from SNH to non-SNH, age 18–64 <sup>†</sup>	Difference in Differences OR (95% CI) <sup>‡</sup>	
White	40.60%	50.39%	reference	reference
Black	29.14%	33.94%	–16.45%	1.04 (0.69, 1.56)
Hispanic	24.73%	36.42%	–13.97%	1.08 (0.80, 1.45)

\* Patient level analysis. Study cohort: Patients with 2 hospitalizations in the pre-reform period and 2 hospitalizations in the post-reform period (excluding obstetric hospitalizations) for whom all hospitalizations during the pre-reform period were at a safety-net hospital. Pre-reform period defined as 10/1/2004–6/30/2006; post-reform period defined as 1/1/2008–9/30/2009

<sup>†</sup> Among each race category, % of patients moved from safety-net hospital to non-safety-net hospital; denominators are the populations by race and state

<sup>‡</sup> Logistic regression model with a difference-in-differences specification; adjusted for nearest hospital type, sex, income, and insurance, and controlled for area-level fixed effects.