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RESEARCH ARTICLE

Impact of Massachusetts Health Reform on Inpatient Care Use: Was the Safety-Net Experience Different Than in the Non-Safety-Net?

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Objective. Most inpatient care for the uninsured and other vulnerable subpopulations occurs in safety-net hospitals. As insurance expansion increases the choice of hospitals for the previously uninsured, we examined if Massachusetts health reform was associated with shifts in the volume of inpatient care from safety-net to non-safety-net hospitals overall, or among other vulnerable sociodemographic (racial/ethnic minority, low socioeconomic status, high uninsured rate area) and clinical subpopulations (emergent status, diagnosis).

Data Sources/Study Setting. Discharge records for adults discharged from all non-federal acute care hospitals in Massachusetts, New Jersey, New York, and Pennsylvania 2004–2010.

Study Design. Using a difference-in-differences design, we compared pre-/post-reform changes in safety-net and non-safety-net hospital discharge outcomes in Massachusetts among adults 18–64 with corresponding changes in comparisons states with no reform, overall, and by subpopulations.

Principal Findings. Reform was not associated with changes in inpatient care use at safety-net and non-safety-net hospitals across all discharges or in most subpopulations examined.

Conclusions. Demand for inpatient care at safety-net hospitals may not decrease following insurance expansion. Whether this is due to other access barriers or patient preference needs to be explored.

Key Words. Health reform, insurance expansion, safety net, inpatient care, disparities

With sharp reductions in public payments to safety-net hospitals (e.g., disproportionate share payments) under the Affordable Care Act (ACA), safety-net hospitals will have to adapt to a new payment environment where financial

viability is more closely tied to patient demand for inpatient care and insurance reimbursement rates for that care in a potentially more competitive marketplace that includes the newly insured (Andrulis and Siddiqui 2011). Declining safety-net hospital inpatient volumes could signal the declining of the importance of safety-net hospitals in the care of vulnerable populations and lead to a worsening of their financial position or even closure. Insurance expansion may (Newhouse 1996; Finkelstein et al. 2012) or may not (Kolstad and Kowalski 2012) lead to increased demand for health care, including inpatient care. As care for the uninsured is largely delivered through safety-net providers, following insurance expansion, the newly insured gain a wider choice of providers, and some patients may switch hospitals based on preference, convenience, care coordination, or perceived provider quality (Hadley and Cunningham 2004; Chatterjee et al. 2012; Lasser et al. 2016). The extent of switching, though, may be curbed by the influence of other potential barriers, including physician availability and narrow provider networks (Gruber 2011; McCormick et al. 2012; Chandra, Gruber, and McKnight 2014; Cusano and Thomas 2014). Therefore, the actual impact of reform on use of inpatient care from safety-net hospitals, which may occur over an extended period of time, is difficult to predict and is important to examine empirically. Understanding post-reform changes in utilization of safety-net hospitals is critical for future public policy aimed at ensuring health equity, a primary goal of the ACA (Andrulis and Siddiqui 2011).

A precursor to the ACA, the MA reform shared all the major elements of the ACA: individual and employer insurance mandate, subsidized insurance coverage, and establishment of an exchange for individual and group insurance plans (Miller 2012). Prior research on the impact of the MA reform about use of care from the safety net is limited

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(Ku et al. 2011; Mohan et al. 2013; Bazzoli and Clement 2014). Two studies found that overall inpatient discharges, covering all patient age groups, increased at a similar pace between 2006 and 2009 in safety-net (1.8 percent) and non-safety-net hospitals (2.1 percent) (Ku et al. 2011; Mohan et al. 2013). Another study examined discharge volumes by payers (Bazzoli and Clement 2014). However, as prior studies were based on aggregate hospital-level data, examination of patients aged 18–64, the target population for reform, or vulnerable sociodemographic subpopulations (race-ethnic minorities or low income patients) was not possible.

Thus, given the paucity of data regarding patterns of inpatient care use specific to patients targeted by insurance reform, we used discharge-level data for 2004–2010, to estimate the change in inpatient care utilization associated with MA reform among safety-net and non-safety-net hospitals. To isolate the change associated with reform, we used a difference-in-differences design, contrasting the pre-reform to post-reform change in MA with the corresponding change in comparison states without an expansion. The primary outcome measure was hospital discharge volume covering patients aged 18–64. We tested the null hypothesis that MA health reform was associated with a reduction in discharge volume in safety-net hospitals for overall care, and for care provided to subpopulations based on sociodemographics (racial/ethnic minority, low socioeconomic status, high uninsured rate area) and admission characteristics (emergent status and diagnostic condition).

METHODS

Data and Study Population

Our primary data sources were the annual inpatient discharge databases for 2004–2010 from MA and three comparison states: New Jersey (NJ), New York (NY), and Pennsylvania (PA). We selected the comparison states for their geographic proximity to MA and sizable minority populations. We excluded discharge data for patients who were not residents of the state where the hospital was located, since our interest is in comparing the utilization patterns of MA residents with their counterparts in the comparison states. Due to state-level differences in the types of hospitals covered in the discharge databases, we selected “community” hospitals, as defined by the American Hospital Association Annual Survey; specifically, these excluded nonacute long-term care, psychiatric and rehabilitative care hospitals (American Hospital

Association 2014). We also excluded hospitals that were not in operation during all years of the study period so that post-reform changes could be compared with pre-reform experience.

Cases and Controls

We identified all inpatient discharges for adults aged 18–64 in MA, the primary target beneficiaries of the reform (“cases”). Controls consisted of all inpatient discharges for the same age group in NJ, NY, and PA.

Pre-reform and Post-reform Periods

The main elements of MA health care reform — Medicaid expansion, subsidies for private insurance, and establishment of the insurance exchange — were introduced in phases beginning on 7/1/2006 and ending with the establishment of a penalty-enforced individual mandate effective January 1, 2008. Treating this time interval as the “transition” period, we defined “pre-reform” (1/1/2004–6/30/2006) and “post-reform” (1/1/2008–6/30/2010) periods as 30 months preceding and following the transition period, respectively.

Primary Outcome Measure

Our primary outcome measure was the *volume of hospital admissions*. Treating a hospital as the unit of observation, volume was measured as the total count of hospital patient discharges stratified by quarter. With 498 hospitals and 26 quarter, there were a total of 12,948 observations.

Safety-Net and Non-Safety-Net Hospitals

Safety-net hospitals are generally characterized as the main providers of inpatient care for underserved and vulnerable populations (Institute of Medicine 2000). In the absence of a formal definition to identify safety-net hospitals, we followed previous work and defined them as the top quartile of hospitals by the share of all discharges in each hospital covered by self-pay, Medicaid, or other subsidized public care (e.g., Uncompensated Care Pool coverage in MA) (Werner, Goldman, and Dudley 2008; Ku et al. 2011). Hospitals in each state were grouped separately into safety-net and non-safety-net hospitals. Only pre-reform discharges were used in obtaining this grouping, to prevent

potential confounding arising from the reform affecting receipt of care at safety-net hospitals.

Patient and Admission Subgroups

Our main focus is on changes in outcome measures, following reform, in safety-net versus non-safety-net hospitals in MA as compared to NJ, NY, and PA. We also examined these changes for several vulnerable subpopulations, to elicit greater granularity within the groups affected, including Hispanics, non-Hispanic blacks, and low-income-area residents. Race and ethnicity data, obtained from the discharge data, were nearly complete. For instance, 3.6 percent and 1.9 percent of discharges in MA and control states, respectively, had missing race and/or ethnicity; these were grouped with non-Hispanic whites based on evidence from our prior work (Hanchate et al. 2015; McCormick et al. 2015). Using median income of patient residence zip code, we identified residents in the lowest income quartile of zip codes (Jha et al. 2005).

To examine if outcome changes differed by baseline uninsured rate, we used county-level data on pre-reform uninsured rate and divided each state into two parts: the top and bottom half of counties by pre-reform uninsured rate (Health Resources and Services Administration 2014).

Severity and acuity of medical condition may also affect the likelihood of switch from safety-net to non-safety-net hospitals; for instance, demand for nonacute elective procedures is more likely to be susceptible to switch in provider. To examine such patterns, we estimated reform-associated change in hospital volumes in safety-net and non-safety-net hospitals for admissions differing in patient acuity and severity. Patient acuity was determined by whether the patient admission was through an emergency department (high acuity) or not (low acuity). Patient severity was quantified by risk of inpatient death; grouping the principal diagnosis code for all admissions into 283 categories using Agency for Healthcare Research and Quality (2010) Clinical Classification System, we identified the top half of diagnostic categories by average inpatient mortality as high risk and the remaining categories as low risk (Agency for Healthcare Research and Quality 2010).

Estimation

As an indicator of summary longitudinal trends, we compared quarterly rates of average admission volume for safety-net and non-safety-net hospitals, adjusted for seasonality by using a four-quarter moving average. We

estimated log-linear time series models to measure overall rates of change in the two hospital settings, in MA and comparison states. To isolate the change in volume associated with health reform, in each hospital setting (safety-net and non-safety-net), we performed difference-in-differences analysis using linear regression models, including dichotomous indicators for post-reform period (1/0) and MA hospitals (1/0) as covariates. The estimate of the post-reform change in volume in MA associated with health reform — henceforth termed “net change” — was obtained from the coefficient of the interaction of the indicators for post-reform period and MA hospitals (Wooldridge 2002; Kolstad and Kowalski 2012; Nasseh and Vujicic 2013; Dimick and Ryan 2014; Hanchate et al. 2015). We adjusted for state-level annual changes in population aged 18–64 using an index of annual change with baseline (2004) value set at 1.0 in each state. Using a difference-in-differences specification, we also estimated the relative change between the two settings, that is, the difference in the change between safety-net and non-safety-net hospitals associated with health reform. In both model specifications we also adjusted for unobserved hospital-level differences with hospital fixed effects, and for secular temporal fluctuations (e.g., the economic downturn in 2008) with quarterly fixed effects (Cameron and Trivedi 2005; Hanchate et al. 2008; Kolstad and Kowalski 2012). We obtained robust standard error estimates adjusted for clustering at the hospital level (Bertrand, Duflo, and Mullainathan 2004; Cameron and Trivedi 2005). For ease of interpretation, we have also reported the net change in terms of percentage change in hospital volume using the pre-reform mean value in MA as the baseline level.

We also assessed the suitability of the difference-in-differences design based on the criteria proposed by Ryan, Burgess, and Dimick (2015); results of this assessment are reported in Tables SA1–SA6. Statistical significance was assessed at the level of $p < .05$. All estimation was performed using *Stata Version 13.1* (StataCorp 2014).

Sensitivity Analysis

We assessed the robustness of the main findings to choice of alternative thresholds in the hospital-level proportion of patients covered by self-pay, Medicaid, or other subsidized public program in the definition of safety-net hospitals. Change in hospital capacity can confound volume changes; to assess this possibility we examined if annual hospital bed capacity varied systematically pre-/post-reform period across MA and control states, separately in safety-net and non-safety-net hospitals.

The Boston University Medical Campus Institutional Review Board approved this study.

RESULTS

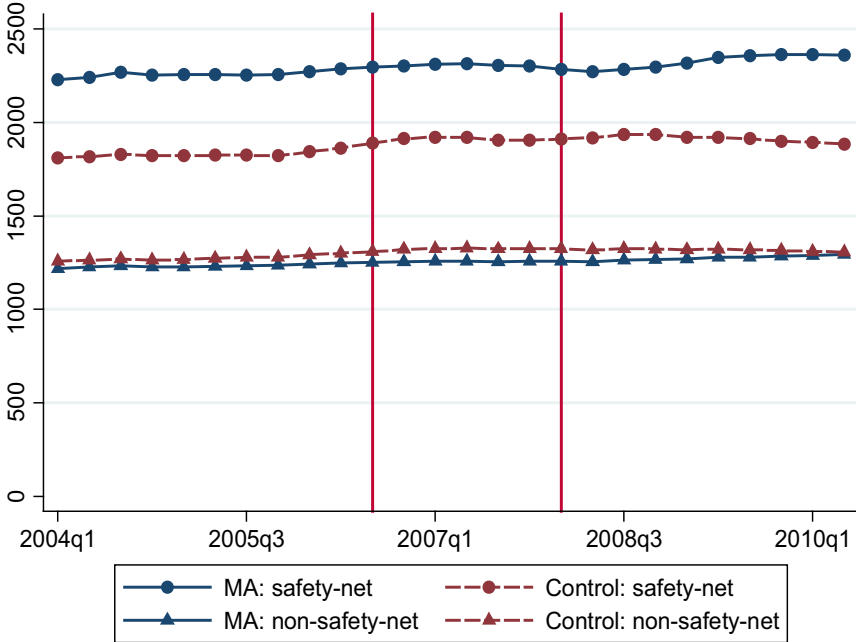
We examined 64 hospitals in MA and 434 hospitals in the three control states which accounted for 99.8 percent and 96.7 percent of all discharges, respectively. We categorized 16 hospitals in MA and 107 hospitals in the control states as safety-net hospitals (Table 1). Safety-net hospitals had more young, non-white, and low-income patients compared to non-safety-net hospitals during the study period (2004–2010). Hospital volume, on average, was higher in safety-net (2,308/quarter) than non-safety-net hospitals (1,261) in MA.

During 2004–2010, quarterly hospital volumes showed similar longitudinal trends across safety-net and non-safety-net hospitals in MA and

Table 1: Study Population of Inpatient Discharges Age 18–64 in Massachusetts, New Jersey, New York, and Pennsylvania, 1/1/2004–6/30/2010

	<i>Massachusetts</i>		<i>Control States</i>	
	<i>Safety-Net Hospitals</i>	<i>Non-Safety-Net Hospitals</i>	<i>Safety-Net Hospitals</i>	<i>Non-Safety-Net Hospitals</i>
No. of hospitals	16	48	107	327
No. of discharges	960,269	1,573,550	5,247,415	11,178,273
Patient age, %				
18–44	52.4	50.1	53.2	48.4
45–54	23.5	23.4	24.0	24.0
55–64	24.1	26.5	22.7	27.6
Race/ethnicity, %				
Whites, non-Hispanic & Others	73.8	87.7	51.7	78.2
Blacks, non-Hispanic	12.7	6.1	32.4	13.7
Hispanic	13.5	6.2	15.9	8.1
Income, Zip code median, %				
Low	50.5	19.9	50.6	22.6
Medium	22.6	25.6	22.8	25.9
High	26.9	54.5	26.6	51.5
Outcomes				
Mean discharge volume, quarterly	2,308	1,261	1,886	1,307

Figure 1: Longitudinal Trends in Average Hospital-Level Discharge Volume by Safety-Net Status Quarterly Volumes for Patients Aged 18–64 [Color figure can be viewed at wileyonlinelibrary.com]



Notes. To adjust for seasonality, we calculated a four-quarter moving average. The vertical lines indicate the beginning and end of reform implementation (transition period).

comparison states. Overall, the volume of hospital admissions increased both in safety-net (0.8 percent per year) and non-safety-net hospitals (1.0 percent) in MA (Figure 1); these rates were similar in control states (0.8 percent and 0.64 percent, respectively). Based on difference-in-differences analysis, health reform was associated with a 0.6 percent and 1.6 percent net increase in hospital admission volume in safety-net and non-safety-net hospitals in MA, respectively; however, these changes were not statistically significant (Table 2 A and B). The relative change between safety-net and non-safety-net hospitals associated with reform was -0.5 percent and not statistically significant. These quantities indicate cumulative changes over a 4-year time interval (between the mid-points of the pre- and post-reform periods).

Table 2: Change in Hospital Admission Volume with Health Reform: (A) Regression Estimates and (B) % Change between Pre- and Post-reform Periods

<i>Outcome</i>	<i>Safety-Net Hospitals (a)</i>	<i>Non-Safety-Net Hospitals (b)</i>	<i>Relative Change between Safety-Net and Non-Safety-Net Hospitals (c)</i>
(A)			
Post-reform period × Massachusetts × safety-net			-11.52 [-122.58, 99.54]
Post-reform period × Massachusetts	13.03 [-88.37, 114.42]	20.32 [-30.00, 70.63]	21.36 [-29.20, 71.92]
Post-reform period × safety-net			36.64 [-13.70, 86.98]
Post-reform period	274.53* [29.61, 519.45]	198.07* [75.54, 320.59]	207.89* [95.52, 320.26]
Safety-net			
Transition period × Massachusetts × safety-net			-14.97 [-78.91, 48.98]
Transition period × Massachusetts	-46.67 [-104.97, 12.04]	-29.11 [-58.38, 0.16]	-29.70* [-58.61, -0.80]
Transition period × safety-net			33.40 [-0.40, 67.20]
Transition period	163.62* [47.63, 279.61]	103.93* [41.45, 166.41]	110.42* [53.98, 166.86]
State population index, age 18-64 (2004 = 1.0)	-5,817.89 [-13,428.19, 1,792.40]	-4,095.19* [-7,481.27, -709.11]	-4,520.30* [-7,670.04, -1,370.57]
Indicators of quarters (N = 26)	Yes	Yes	Yes

Continued

Table 2. Continued

Outcome	Safety-Net Hospitals (a)	Non-Safety-Net Hospitals (b)	Relative Change between Safety-Net and Non-Safety-Net Hospitals (c)
(B) Change in admission volume associated with health reform	0.6% [-3.9%, 5.0%]	1.6% [-2.4%, 5.7%]	-0.5% [-5.4%, 4.4%]

Notes. Statistical significance: * denotes $p < .05$.

These are estimates from the linear regression models used to estimate net change in MA associated with reform using residents of NJ, NY, and PA as controls and defining safety-net hospitals as hospitals in the top 25% of state hospitals by share of all discharges covered by patients on self-pay, Medicaid, and other subsidized public care. The outcome measure is the number of admissions in each hospital each quarter. We used data from 1/1/2004 to 6/30/2010, divided into 26 quarters, with the first 10 and last 10 representing the pre- and post-reform periods, and the intermediate six quarters representing the transition period during which elements of the reform were phased in. All regressions allowed for hospital fixed effects to adjust for time invariant factors associated with volume. For safety-net hospitals (column (a)), the difference-in-differences specification contrasted change between safety-net hospitals in Massachusetts versus safety-net hospitals in comparison states as follows (Ryan, Burgess, and Dimick 2015): $y_{it} = \beta_0 + \beta_1(Post-reform * MA) + \beta_2(Post-reform * MA) + \beta_3(Transition * MA) + \beta_4(Transition * MA) + \beta_5(Population_index + I_t + I_t$ where y_{it} denotes admission volume in hospital i in quarter t , $Post-reform$ (1/0) is an indicator of the post-reform period, MA (1/0) is an indicator of a hospital in Massachusetts, $Transition$ (1/0) is an indicator of the transition period, and I_t and I_t denotes the set of dichotomous (dummy) indicators for 24 quarters (with indicators of 2 of the 26 quarters not included so as to identify the coefficients of $Transition$ and $Post-reform$ terms; indicators of the last quarter of transition and post-reform periods were not included) and hospital (N = 123 safety-net hospitals). $Population_index$ is an indicator of growth in annual state population treating the base year (2004) as 1.0; a $population_index$ of 1.11 in 2008 indicates 11% increase in state population (relative to 2004); all quarters of each year are assigned the same index value. For non-safety-net hospitals, we estimated an analogous model (column (b)), now with N = 375 non-safety-net hospitals. To estimate relative change in safety-net vs. non-safety-net hospitals in Massachusetts, contrasted with that in the comparison states (column (c)), we estimated the following model: $y_{it} = \beta_0 + \beta_1(Post-reform * MA * Safety-net) + \beta_2(Post-reform * MA) + \beta_3(Post-reform * Safety-net) + \beta_4(Post-reform * MA * Safety-net) + \beta_5(Transition * MA) + \beta_6(Transition * Safety-net) + \beta_7(Transition * Safety-net) + \beta_8(Transition + \beta_9(Population_index + I_t + I_t$ where $Safety-net$ (1/0) is an indicator of a safety-net hospital.

We used regression estimates in Table 2A along with mean pre-reform values of outcome measures in MA to obtain the cumulative % change (between pre- and post-reform periods) in hospital volume associated with reform reported in Table 2B.

Table 3: Change (%) in Hospital Admission Volume in Massachusetts Associated with Health Reform among Vulnerable Subpopulations by Safety-Net Hospital Status

<i>Subpopulation</i>	<i>Safety-Net Hospitals (a)</i>	<i>Non-Safety-Net Hospitals (b)</i>	<i>Relative Change between Safety-Net and Non-Safety-Net Hospitals (c)</i>
Race/ethnicity			
Hispanics	5.2% [−5.2%, 15.7%]	4.3% [−15.2%, 23.7%]	4.1% [−7.4%, 15.5%]
Blacks, non-Hispanic	−6.4% [−27.3%, 14.4%]	11.1% [−5.9%, 28.1%]	−1.3% [−13.0%, 10.5%]
Socioeconomic status			
Low-area-income residents	1.9% [−2.2%, 6.0%]	−1.8% [−8.8%, 5.2%]	2.4% [−2.0%, 6.7%]
Baseline uninsured rate			
High uninsured rate counties	0.2% [−8.3%, 8.7%]	3.4% [−1.2%, 8.0%]	−4.1% [−14.1%, 5.8%]
Low uninsured rate counties	0.8% [−3.1%, 4.7%]	−0.9% [−7.2%, 5.4%]	1.4% [−2.7%, 5.4%]

Note. The regression models are identical to those used for Table 2 estimated separately for volumes for different subgroups of patients.

As a test of the suitability of NJ, NY, and PA as comparison states to MA, we obtained difference-in-differences estimates based on comparisons in hospital volume at distinct periods prior to reform (parallel trends test); estimates of no net change, indicating similar trends, support the choice of the comparison states (Table A2–A4).

In sensitivity analyses, alternate cut-offs — top 10 percent and top 5 percent of hospitals by share of patients covered by self-pay, Medicaid, and other subsidized public programs — in identifying safety-net and non-safety-net hospitals also indicated no change in hospital volumes following reform (Table A5). We found no difference between MA and control states in the pre-/post-reform changes in hospital bed capacity in either the safety-net or the non-safety-net hospitals (Table A6).

We also found no significant change in hospital discharge volume associated with health reform among the sociodemographic vulnerable subgroups: Hispanics, blacks, low-income-area residents, and high baseline uninsured rate areas (Table 3). Similarly, we found no significant change in hospital volumes for admissions grouped by patient risk and acuity (Table 4).

Table 4: Change (%) in Hospital Admission Volume by Admission Severity, Acuity, and Safety-Net Hospital Status

<i>Admission Type</i>	<i>Safety-Net Hospitals (a)</i>	<i>Non-Safety-Net Hospitals (b)</i>	<i>Relative Change between Safety-Net and Non-Safety-Net Hospitals (c)</i>
<i>Admission severity</i>			
High-risk conditions	5.4% [−1.3%, 12.1%]	1.8% [−4.9%, 8.4%]	4.9% [−2.7%, 12.4%]
Low-risk conditions	−2.0% [−6.6%, 2.5%]	1.6% [−2.7%, 5.8%]	−3.4% [−8.4%, 1.6%]
<i>Admission acuity</i>			
High acuity	−2.2% [−16.6%, 12.3%]	4.2% [−2.9%, 11.2%]	−5.0% [−19.7%, 9.7%]
Low acuity	4.0% [−13.3%, 21.3%]	−0.6% [−6.7%, 5.6%]	5.1% [−12.3%, 22.6%]

Note. The regression models are identical to those used for Table 2, estimated separately for hospital volumes of different types of admissions.

DISCUSSION

The 2006/07 health reform in MA was not associated with any significant shifts in the volume of admissions at safety-net hospitals after two and a half years. This finding was consistent across different sociodemographic and clinical subgroups.

Our findings are consistent with, but extend, those from earlier studies on the impact of MA health reform on inpatient care by safety-net status. Two previous studies that examined overall discharge volume between 2006 and 2009 found similar growth in safety-net (1.8 percent) and non-safety-net hospitals' volume (2.1 percent); however, the experience of the top two safety-net hospitals differed considerably with one increasing by 6.7 percent and the other decreasing by 17.5 percent (Ku et al. 2011; Mohan et al. 2013). Compared to these studies, our study contrasted the temporal change in MA with that in states where reform did not occur. In addition, while the previous studies combined discharges for all age groups, we examined discharges for patients aged 18–64, the beneficiary group targeted by reform. Our finding of no volume changes across the entirety of all MA hospitals is consistent with the finding of another previous study based on comparison of a random sample of MA hospitals with a sample from a large number of other states using Agency for Healthcare Research & Quality National Inpatient Sample data; that study focused on changes in

the first year after reform (2008), in contrast with a longer horizon in this study (2008–2010) (Kolstad and Kowalski 2012).

Extending prior research, our findings indicated no shifts in discharge volumes, neither for overall admissions, nor for almost all subgroups by patient sociodemographics and admission characteristics. We concede that the precision of estimates for many of the subgroups is poor (i.e., wide confidence intervals), thereby not ruling out substantial changes (Tables 3 and 4). This is likely the result of multiple factors: the relatively small subgroup share out of overall discharges, high variation in post-reform volume changes across MA safety-net hospitals, and our use of a relatively conservative model (fixed hospital effects) that only utilizes within-hospital longitudinal changes to evaluate outcome changes associated with reform; this specification was chosen to adjust for systematic unobserved differences across hospitals that may influence hospital-level differences in volumes (Cameron and Trivedi 2005; Frakt 2015). In related studies using the same data sources, we found that, following reform, use of selected high-volume inpatient elective procedures increased among Hispanics and lower-income-area residents in MA (Hanchate et al. 2012), and the share of two of these procedures (knee and hip replacement) performed in safety-net hospitals decreased by 1 percent (Hanchate et al. 2015). While indicative of the potential for shifts away from safety-net hospitals, such shifts in selective cohorts have not been sizable enough to affect the overall discharge volumes.

There are several possible interpretations for the lack of a shift away from safety-net hospitals. One prior study found that between 2005 and 2009, safety-net community health clinics, those receiving federal grants, experienced a 31 percent jump in the number of patients that received primary care, even as the proportion of those uninsured dropped sizably following insurance expansion (Katz 2011; Ku et al. 2011). Reporting findings of a population level survey, that study noted that the majority of patients who received care at safety nets did so for convenience (79 percent) and affordability (74 percent), with only a minority (25 percent) reporting difficulty with access to care elsewhere. The authors also noted that preference for safety-net clinics and hospitals may be for additional services provided, including transportation, insurance enrollment assistance, language assistance, and community outreach activities. This view is consistent with national evidence from other studies, based on Medicare utilization data, which point to disproportionately higher concentration of racial/ethnic minority and low-income patients in a small number of hospitals, often bypassing more proximate higher volume alternatives (Jha et al. 2007, 2008; Losina et al. 2007).

A contrary interpretation is that despite gaining insurance coverage after reform, many beneficiaries continued to face other barriers in accessing non-safety-net care. One post-reform statewide survey indicated that 20 percent of respondents reported difficulty in finding outpatient care providers who accepted their insurance (Long and Masi 2008). One explanation is that for the initial 3 years following reform, the four managed care organizations that were contracted by the state to provide Medicaid plans prior to reform were the only insurers to offer plans under Commonwealth Care, the MA exchange insurance; as such, even the newly insured were likely to be restricted largely to the network of providers who were contracted with these managed care organizations (Massachusetts Medical Society 2007; Lischko, Bachman, and Vangeli 2009). By 2008, 277,000 previously uninsured gained subsidized coverage, of which 178,000 were covered by Commonwealth Care, the state-subsidized exchange insurance, and the remaining 99,000 obtained Medicaid coverage (Doonan and Tull 2010). As two-thirds of this latter population, with income below 150 percent FPL, was previously enrolled in the state's Uncompensated Care Pool program, which provided care primarily through safety-net providers, it is likely that many in this population continued to receive care within the same cohort of safety-net affiliated providers, even under Commonwealth Care (Blue Cross Blue Shield Foundation of Massachusetts 2011b).

Due to preference or lack of access to alternative providers, demand for inpatient services from safety-net hospitals was not adversely affected by reform. The impact on overall revenues of the safety-net hospitals is unclear. Financial performance of many MA safety-net hospitals deteriorated immediately following reform (Kowalczyk 2009; Syre 2009). An important component of the reform package was the transition from lump sum uncompensated care payments by the state to hospitals to providing subsidized individual coverage for low-income enrollees; between 2007 and 2008, the state reduced uncompensated care funds from \$620 million to \$373 million. Evidence on whether reductions in uncompensated care payments were offset by increased payments via insurance claims is limited. A recent analysis of the financial performance of MA hospitals indicated that the net margins for most safety-net and non-safety-net hospitals did not vary much following reform; however, for the two largest safety-net hospitals (Boston Medical Center and Cambridge Health Alliance), net margins suffered significantly (Bazzoli and Clement 2014). In retrospect, a more potent threat for the safety-net hospitals following reform was not the loss of newly insured patients to non-safety-net hospitals, but instead the potential of revenue loss arising from the sudden reductions in uncompensated care payments not matched by increased revenues through

insurance claims (Blue Cross Blue Shield Foundation of Massachusetts 2011a). Looking forward, as safety-net hospitals have adjusted to the realignment of revenue sources following reform, with a greater share coming from insurance claims, a policy concern is that their financial performance will remain vulnerable to changes in reimbursement rates for those covered by Medicaid and Commonwealth Choice, particularly in times of state fiscal austerity (Blue Cross Blue Shield Foundation of Massachusetts 2011b).

Limitations

We recognize several limitations of our study. First, the ability to isolate the impact of reform on utilization changes depends on the choice of comparison states; while we confirmed that patterns of utilization changes in all states were similar prior to reform, there may be other unobserved factors post-reform that differentially affected MA and the comparison states. Second, as noted earlier, our estimates cannot rule out sizable changes in utilization for some of the subgroups by race-ethnicity and admission acuity/severity; however, specification of hospital fixed effects, a likely source of this lack of precision, is important for controlling confounding arising from unobserved systematic hospital differences (Cameron and Trivedi 2005; Kolstad and Kowalski 2012; Frakt 2015). Third, a limitation of the administrative data sources is the inability to identify individuals who changed insurance status after reform and identify their other health care utilization.

CONCLUSIONS

Our study found no significant changes in the volume of admissions following MA reform at safety-net hospitals among the overall population as well as among sociodemographic vulnerable subgroups, including Hispanics, blacks, and low-income area residents. An implication of our findings of patients' continued reliance on safety-net hospital inpatient care is that with a disproportionately higher load of those insured with state subsidies, and of those who continue to remain uninsured, the financial viability of safety-net hospitals will continue to be sensitive to the levels of reimbursement rates of the state-subsidized coverage plans and supplemental funding.

Due to the similarity in the central features of the two reforms, the experience in MA is indicative of the likely impact of ACA on safety-net hospitals nationwide (Ayanian 2012). The scale of impact on safety-net hospitals may

vary by state, depending on baseline differences in the size of the uninsured, size of the safety-net infrastructure, state support, and provider availability. The stability of hospital volumes at safety-net hospitals in MA may partly be due to the integration of inpatient and outpatient care services provided to the previously uninsured through the uncompensated care pool program. Also, while overall demand for inpatient care did not increase in MA, other states may experience sizable increases, due either to pent-up demand, larger proportional increases in numbers of newly insured or identification of new need following increased access to outpatient care. Patient preference for safety-net hospitals and narrow provider networks may limit diversion of inpatient care to non-safety-net hospitals, particularly for those on subsidized coverage (Andrulis and Siddiqui 2011); however, in meeting this continued demand, safety-net providers may be financially vulnerable as they adjust to the realignment of reimbursement of care for those newly insured and the ways in which states compensate for care for those who remain uninsured.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table A1: Average (quarterly) Growth Rate by Hospital and State Setting.

Table A2: Difference-in-Differences Checklist Performance.

Table A3: Test of Validity of Comparison Cohort: Difference-in-Difference Estimate of Net Change in MA versus Comparison States during Pre-Reform Period.

Table A4: Correlation between Longitudinal Volume Change and Baseline Hospital Volume.

Table A5: Change (%) in Hospital Discharge Volume Associated with Health Reform by Alternative Choice of Safety-Net Hospital Grouping.

Table A6: Pre/Post-reform Comparison of Change in Bed Capacity between Massachusetts and Control States.