

Rates of Insurance for Injured Patients Before and After Health Care Reform in Massachusetts: A Possible Case of Double Jeopardy

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The burden of uncompensated care on the health care system and risk of personal financial ruin of uninsured individuals who experience a health shock (unexpected serious illness or accident)¹ are among the leading arguments in favor of an individual mandate in the 2010 federal health care reform legislation. Modeled after the Massachusetts health care reform implemented in 2006,^{2,3} comprehensive federal health care reform is presumed to result in the greatest gains of health insurance among able-bodied adults aged 18 to 64 years mandated to enroll in subsidized or unsubsidized insurance plans. Although opponents of an individual mandate may argue that otherwise healthy adults with minimal health care needs should not be required to purchase health insurance,⁴ no individual, irrespective of age or baseline health status, is immune to risk of injury. Trauma represents a significant health shock experienced by able-bodied, community-dwelling adults aged 18 to 64 years and is a leading cause of death and disability in this demographic group.^{5,6}

Another federal mandate enacted by the 1986 Emergency Medical Treatment and Active Labor Act (EMTALA) requires hospitals to provide emergency care to individuals experiencing a health shock, regardless of whether they are insured.⁷ Not surprisingly, emergency department (ED) resource use in response to health shocks has been shown to be independent of insurance status.⁸ In Massachusetts, implementation of health care reform did not affect trends in ED use.⁹ Patient care in the face of a health shock, however, rarely stops in the ED.

When injured patients without insurance arrive at a trauma center, they are not only stabilized, as mandated by EMTALA, but also provided comprehensive trauma care as required of verified trauma centers in our proven

Objectives. We determined how preinjury insurance status and injury-related outcomes among able-bodied, community-dwelling adults treated at a Level I Trauma Center in central Massachusetts changed after health care reform.

Methods. We compared insurance status at time of injury among non-Medicare-eligible adult Massachusetts residents before (2004–2005) and after (2009–2010) health care reform, adjusted for demographic and injury covariates, and modeled associations between insurance status and trauma outcomes.

Results. Among 2148 patients before health care reform and 2477 patients after health care reform, insurance rates increased from 77% to 84% ($P < .001$). Younger patients, men, minorities, and penetrating trauma victims were less likely to be insured irrespective of time period. Uninsured patients were more likely to be discharged home without services (adjusted odds ratio = 3.46; 95% confidence interval = 2.65, 4.52) compared with insured patients.

Conclusions. Preinjury insurance rates increased for trauma patients after health care reform but remained lower than in the general population. Certain Americans may be in “double jeopardy” of both higher injury incidence and worse outcomes because socioeconomic factors placing them at risk for injury also present barriers to compliance with an individual insurance mandate. (*Am J Public Health.* 2014;104:1066–1072. doi:10.2105/AJPH.2013.301711)

national and state-level trauma systems.^{10,11} Even after stabilization, injured patients often cannot be released because they are critically ill or require treatments (e.g., intravenous antibiotics, chest tube monitoring) that for practical reasons or out-of-pocket costs cannot be rendered outside of the hospital. These uninsured patients are often provided ongoing free care at the presenting hospital or transferred once stabilized to safety-net hospitals that typically do not refuse patients on the basis of insurance.¹² Depending on governance structure (publicly managed, publicly funded, or private nonprofit), 5% to 16% of patients at safety-net hospitals are provided free care.¹³ Data from the 2004 Medical Expenditure Panel Survey suggested that only 35% (95% confidence interval [CI] = 26%, 45%) of charges to uninsured patients for non-life-threatening emergency services were recouped by hospitals.¹⁴ In the case of injuries too severe to be treated and released, the burden of the cost of care is therefore assumed one way or another

by the health care system, raising costs for everyone. Furthermore, uninsured patients often incur greater costs of care compared with their insured counterparts, as they must remain hospitalized until they can be safely discharged home because no similar laws mandate uncompensated home health services, skilled nursing, or rehabilitation often required by medically stable injured patients.^{15–17}

Proponents of an individual mandate might presume that improved rates of insurance in the general population would result in fewer uninsured injured patients treated at trauma centers, but the effect of an individual mandate on insurance coverage among injured patients is unknown. Therefore, the effects of health care reform on the burden of uncompensated trauma care in Massachusetts may have important national implications on the potential effect of national health care reform on our nation's trauma system. We undertook this study to determine how an individual mandate affected insurance status among injured

Massachusetts residents. We hypothesized that we would have treated fewer uninsured patients after implementation of Massachusetts health care reform. Presumably, the individual mandate would have resulted in rates of insurance among our patients as observed state-wide.

METHODS

University of Massachusetts Medical Center is an American College of Surgeons Verified Level I Trauma Center with an annual volume of 2000 to 2500 adult and pediatric trauma activations.¹⁰ This center is the only designated Level I Trauma Center in central Massachusetts, encompassing a 63-mile radius. Our center has a comprehensive trauma registry that prospectively gathers data on injury mechanism, scene interventions, patient demographics (when race/ethnicity is self-reported by patient or family in the case of impaired or unconscious patients), payment source, clinical course, and in-hospital outcomes.

Cohort Selection

The implementation of Massachusetts health care reform in 2006 generated a natural experiment at our center allowing comparison of preinjury insurance status between trauma patients treated before and after health care reform. We retrospectively queried our trauma registry for adult, non-Medicare-eligible patients (aged 18–64 years) treated before health care reform (2004–2005) and after health care reform (2009–2010). We excluded 2006 to 2008 as an implementation period to account for incremental compliance with the individual mandate, particularly because penalties for noncompliance did not go into effect until 2008.¹⁸ At our center, 10% to 15% of the trauma patients were out-of-state residents; these patients also were excluded from our analyses.

If the registry was missing payer source, the patient’s face sheet at the time of presentation was reviewed. Similarly, because we were interested in studying baseline rates of health insurance at the time of injury, when “no-fault auto” or a retrospective granting of insurance (coded as “Masshealth pending”) was cited as the payer, we manually searched records to determine patient insurance status at the time

of presentation rather than at the conclusion of treatment.

Statistical Analyses

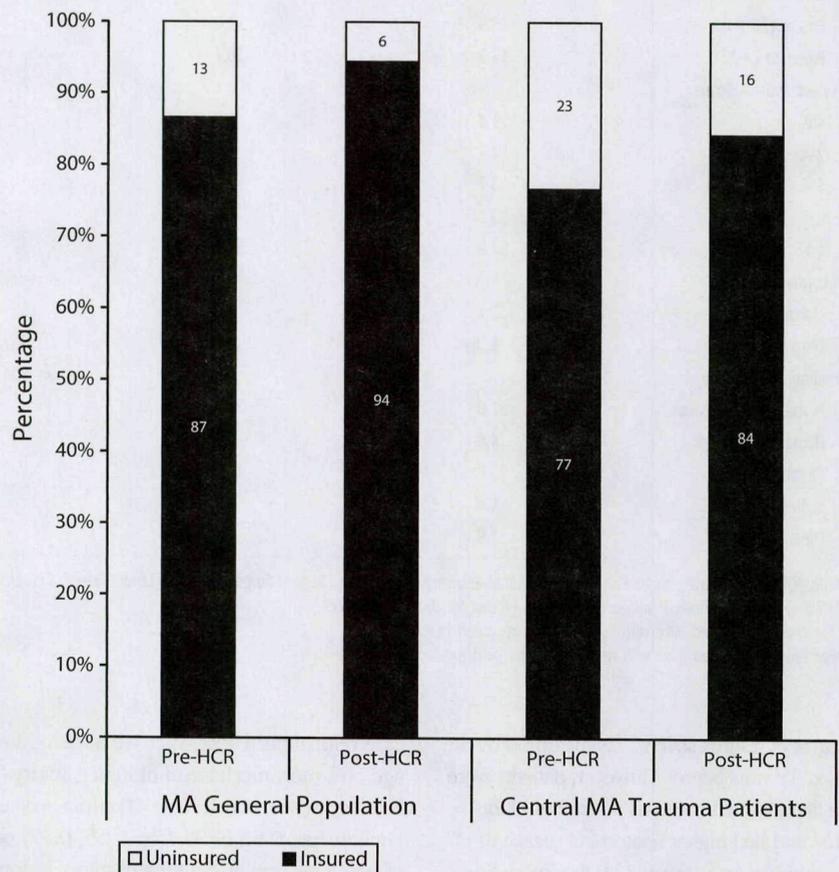
We compared rates and types of insurance across both time periods. We used univariate tests of association to compare means, medians, and proportions of patients in each group. A multiple logistic regression model was used to estimate insurance status as a function of patient demographics, mechanism of injury, Injury Severity Score, Revised Trauma Score, and time period. We also modeled length of stay, discharge disposition, and mortality as a function of patient demographics, injury mechanism, Injury Severity Score, Revised Trauma Score, insurance status, and time

period. All analyses were performed with SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

We identified 2148 patients before health care reform and 2477 patients after health care reform who met inclusion criteria. Rates of insurance increased from 76.7% before health care reform to 84.3% after health care reform ($P < .001$). Figure 1 shows the rates of insurance among our cohort of injured patients compared with a statewide cohort described by Long and Stockley¹⁹ in fall 2009.

Across both time periods, as shown in Table 1, patients were of similar sex and race/ethnicity and presented with similar physiological



Note. Trauma patients were selected from those treated at a single American College of Surgeons Verified Level I Trauma Center. Rates from the general Massachusetts population were estimated from Long and Stockley.¹⁹

FIGURE 1—Comparison of insurance rates among adult (18–64 years) trauma patients and Massachusetts general population before (2004–2006) and after (2008–2010) health care reform (HCR).

TABLE 1—Comparison of Patient Characteristics and Outcomes Among Adult (18–64 Years) Trauma Patients Before (2004–2006) and After (2008–2010) Massachusetts Health Care Reform

Characteristics	Pre Health Care Reform (2004–2005; n = 2148), Median (IQR) or %	Post Health Care Reform (2009–2010; n = 2477), Median (IQR) or %	P ^a
Age, y	35 (24, 46)	39 (25, 50)	< .001
Male	73.8	73.3	.71
Race/ethnicity			.35
White, non-Hispanic	80.9	80.7	
Black, non-Hispanic	5.3	5.2	
Hispanic	11.0	11.8	
Other	2.4	1.7	
Unknown	0.4	0.6	
Blunt injury	91.2	89.3	.03
Injury Severity Score			.004
Mild (< 9)	43.7	43.4	
Moderate (9–15)	29.1	28.9	
Severe (16–24)	13.9	17.0	
Profound (≥ 25)	13.3	10.7	
Revised Trauma Score			.7
< 2	1.2	1.0	
2–4	4.1	4.6	
4–6	3.7	3.3	
6–7	3.1	2.7	
> 7	87.9	88.5	
Outcomes			
Mortality	3.7	3.1	.52
Length of stay, ^b d	2 (1, 6)	2 (1, 5)	.002
Discharge disposition ^c			< .001
Home without services	81.9	70.9	
Home with services	4.6	8.7	
Rehabilitation	10.2	13.4	
Skilled nursing	1.4	3.7	
Other	1.9	3.3	

Note. IQR = interquartile range. Patients were treated at a single American College of Surgeons Verified Level I Trauma Center.

^aWilcoxon rank sum test *P* values for age and χ^2 test for discrete variables.

^bFor those discharged alive with length of stay recorded (n = 4267).

^cFor those discharged alive with recorded discharge disposition (n = 3948).

When comparing the characteristics and outcomes of insured and uninsured patients across both time periods, uninsured patients were younger and more likely to be male, non-White, and injured as a result of penetrating trauma (Table 3). No differences in Injury Severity or Revised Trauma Score were seen on the basis of insurance status. We found no statistically significant difference in in-hospital mortality (3.7% for insured patients vs 2.3% for uninsured patients; *P* = .09); although the median length of stay was the same for both insured and uninsured patients, the distributions showed shorter lengths of stay for the uninsured (2 days, interquartile range = 1–6, for insured patients vs 2, interquartile range = 1–5, for uninsured patients; *P* = .001; data not shown). As shown in Figure 2, uninsured patients were more likely to be discharged home without services compared with discharged home with services, rehabilitation, or skilled nursing.

In multivariate models that controlled for time period, patient demographics, mechanism of injury, Injury Severity Score, and Revised Trauma Score, there was no difference in odds of in-hospital death for the uninsured compared with the insured (adjusted odds ratio [AOR] = 0.87; 95% CI = 0.40, 1.88). A linear regression model that adjusted for the same covariates among survivors found a statistically significant 1.1-day lower mean length of stay (*P* = .002) in uninsured than in insured patients. However, uninsured patients had nearly 3.5 times higher adjusted odds of being discharged home without services compared with all other dispositions (AOR = 3.46; 95% CI = 2.65, 4.52; data not shown). Table 4 shows the individual odds ratios for discharge with more specialized services compared with discharge home without services in uninsured versus insured patients. Uninsured patients had lower odds of receiving added services after discharge when we controlled for time period, even though the univariate results (Table 1) showed an overall increase in use of home services, rehabilitation placement, and skilled nursing post health care reform.

DISCUSSION

Although our patient population did experience an increase in baseline insurance rates

measures of trauma severity (as measured by the Revised Trauma Score). However, patients were more likely to be injured as a result of blunt trauma and had higher anatomical measures of injury severity (as measured by the Injury Severity Score) after health care reform. Length of stay and percentage of patients discharged home with services or to rehabilitation or skilled nursing also improved after health care reform.

In the multivariate model, the temporal increase in the odds of being insured after health

care reform persisted. After we adjusted for age, sex, race, mechanism of injury, Injury Severity Score, and Revised Trauma Score, patients had 0.65 (95% CI = 0.55, 0.77) odds of being insured at the time of injury before health care reform compared with after. However, even when we adjusted for time period and other covariates, men, younger patients, minorities, and those injured as a result of penetrating trauma had lower odds of being insured irrespective of time period (Table 2).

TABLE 2—Adjusted Odds Ratios for Being Insured at the Time of Injury Among Adult (18–64 Years) Trauma Patients Before (2004–2006) and After (2008–2010) Massachusetts Health Care Reform

	AOR (95% CI)
Pre-HCR (2004–2005) vs post-HCR (2009–2010)	0.65 (0.55, 0.77)
Aged 18–24 vs 45–64 y	0.37 (0.30, 0.47)
Aged 25–44 vs 45–64 y	0.47 (0.38, 0.58)
Male vs female	0.40 (0.32, 0.50)
Non-Hispanic Black vs non-Hispanic White	0.43 (0.31, 0.58)
Hispanic vs non-Hispanic White	0.46 (0.37, 0.57)
Other race/ethnicity vs non-Hispanic White	0.63 (0.38, 1.07)
Missing race vs non-Hispanic White	1.24 (0.35, 4.37)
Penetrating vs blunt injury	0.76 (0.59, 0.97)

Note. AOR = adjusted odds ratio; CI = confidence interval; HCR = health care reform. Odds ratios were adjusted for age, sex, race, mechanism of injury, Injury Severity Score, and Revised Trauma Score. Patients were treated at a single American College of Surgeons Verified Level I Trauma Center. The sample size was n = 4108.

after Massachusetts health care reform, our results showed that overall insurance rates for injured patients from our trauma center were markedly lower than those reported for the Massachusetts general population both before (77% vs 87%) and after (84% vs 94%) health

TABLE 3—Comparison of Insured and Uninsured Adult (18–64 Years) Trauma Patients Before (2004–2006) and After (2008–2010) Massachusetts Health Care Reform Combined

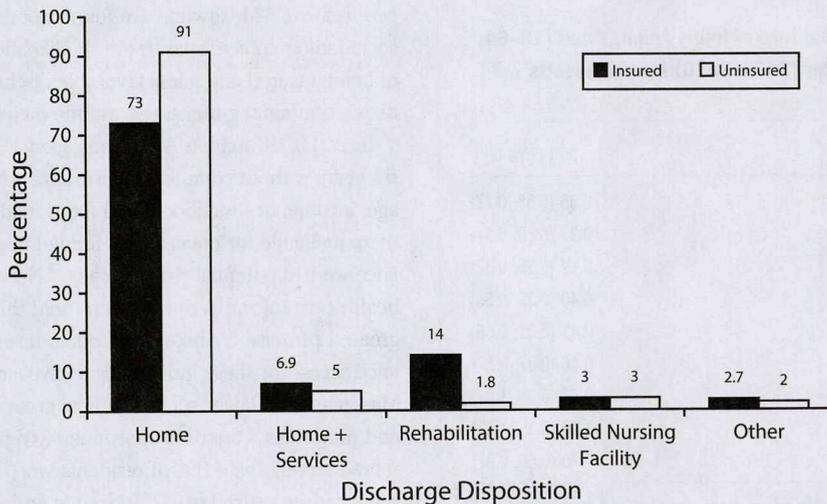
Characteristics	Insured (n = 3735), Median (IQR) or %	Uninsured (n = 890), Median (IQR) or %	P
Age, y	39 (25, 50)	29 (23, 40)	< .001
Male	70.6	86.0	< .001
Race/ethnicity			< .001
White, non-Hispanic	83.9	67.9	
Black, non-Hispanic	4.3	9.2	
Hispanic	9.3	20.3	
Other	2.0	2.3	
Unknown	0.5	0.3	
Blunt injury	92	84	< .001
Injury Severity Score			.07
Mild (< 9)	43.0	45.8	
Moderate (9–15)	28.7	30.0	
Severe (16–24)	15.8	14.4	
Profound (≥ 25)	12.5	9.8	
Revised Trauma Score			.22
< 2	1.2	0.9	
2–4	4.6	3.3	
4–6	3.7	2.7	
6–7	2.9	2.8	
> 7	87.6	90.3	

Note. IQR = interquartile range. Patients were treated at a single American College of Surgeons Verified Level I Trauma Center. Wilcoxon rank sum test P values for age and length of stay, χ^2 test for discrete variables, and Fisher exact test for race.

care reform.¹⁹ Meanwhile, we found notable sociodemographic disparities in the likelihood of being insured and a less favorable discharge disposition among uninsured trauma patients.

In 2010, 48 million Americans aged 18 to 64 years without commercial insurance whose age, income, or functional capabilities made them ineligible for government-funded insurance were at potential risk for injury.³ National health care reform is presumed to hold the greatest promise for improvements in insurance access for these individuals. However, in Massachusetts, lower socioeconomic groups and minorities were disproportionately represented among the 4.8% of residents who remained uninsured in 2009 despite an individual mandate.^{19,20} Nationally, these same individuals face a greater burden of trauma than other Americans, possibly because of environmental conditions and health behaviors.^{21,22} Our results suggest that although health care reform may decrease rates of uninsured injured patients cared for at our nation's trauma centers, certain Americans will remain in a sort of "double jeopardy" of having both higher injury incidence and worse outcomes because the same sociodemographic factors that place them at high risk for injury may present barriers to compliance with an individual mandate.

As a result of health care reform, Massachusetts residents experienced increased access to care for non-life-threatening concerns (4.7%) and prevention (5.9%).²³ Those who gained insurance through government subsidies had a 2.6% reduction in ED visits for "low-severity" conditions.²⁴ Furthermore, nonelderly lower-income residents and Hispanics experienced greater access to elective surgery after health care reform (low-income, 13% increase, or medium-income, 15% increase, vs high-income, 2% increase; and Hispanics, 23% increase, vs Whites, 7% increase).²⁵ Access to care after injury, however, is unlike that of primary care, preventive care, or elective surgery. Care of injured patients is seldom initiated by provider referral based on insurance considerations. Furthermore, individual consideration of out-of-pocket costs would be expected to have little, if any, role in seeking care for injury given the unexpected, potential life threat of trauma. Rather, a well-developed trauma system dictates triage, at the



Note. Trauma patients were selected from those treated at a single American College of Surgeons Verified Level I Trauma Center.

FIGURE 2—Comparison of discharge disposition among insured and uninsured adult (18–64 years) trauma patients in Massachusetts before (2004–2006) and after (2008–2010) health care reform combined.

injury. In our study, as hypothesized, we did notice an absolute 7.6% increase in insurance coverage in Massachusetts residents from before to after health care reform. Still, the highest observed rate of insurance among injured patients was 10% less than that reported for all adults aged 18 to 64 years in Massachusetts after health care reform.¹⁹ If uninsurance rates this high for trauma patients were to hold true nationwide, this would represent about \$100 to \$200 billion dollars in uncompensated trauma care annually, even after federal health care reform.

The effect of lack of insurance after injury—even among subsets of patients who share a major diagnosis, an injury mechanism, or treatment at the same hospital—both on mortality and on outcomes of those who survive to discharge is well known.^{30–37} Although acute-care hospitals are mandated to provide care for health shocks such as trauma, no such mandate exists for home health agencies, rehabilitation centers, or skilled nursing facilities, which are often needed by injured patients who cannot be safely discharged home without services. Our study lacked power to detect mortality differences, but among those who survived to discharge, we found that uninsured patients, even after health care reform, were more likely to be discharged home, even though they might have benefited from home services, more intensive rehabilitation, or skilled nursing. Other studies also have shown that uninsured patients have fewer resources for posttrauma rehabilitation, even though such services have been shown to improve functional outcomes and reduce the long-term costs of injury and critical illness.^{15–17} These instances of possibly inappropriate discharge disposition may explain Hadley’s¹ finding that lack of appropriate postdischarge treatment and follow-up after health shocks is associated with less favorable long-term functional outcomes.

Injury incidence is related to several complex, overlapping sociodemographic variables. Substance abuse is frequently a factor leading to injury in trauma patients^{38–41}; even after health care reform, as many as 23% to 30% of Massachusetts residents with substance abuse issues were uninsured.⁴² Unintentional injury is also more common among the uninsured,^{32,33} with nearly 75% of patients injured from gunshots presenting without insurance.³⁴ In our

time of injury, to capable centers that are mandated by EMTALA to provide emergency care regardless of ability to pay.^{7,11} Primary care providers may educate patients on injury prevention, thus potentially reducing use of trauma systems, but our finding that 16% of patients are uninsured at the time of injury suggests that health care reform will only partially ameliorate the burden of uncompensated care of uninsured trauma patients on our health care system.

In 2010, more than 1.2 million patients were admitted to US hospitals with injuries.²⁶

Injured patients who present without insurance have been shown to have low rates of payment for charges associated with their trauma care. For example, a study comparing 2 trauma centers’ collections for trauma activation fees found that none were received from uninsured patients.²⁷ In theory, this burden of uncompensated care, estimated at \$6000 to \$17 000 per uninsured patient when injured as a result of motor vehicle collisions or firearms,^{28,29} would be ameliorated as a result of health care reform because able-bodied individuals would be mandated to purchase insurance before

TABLE 4—Adjusted Odds Ratios for Discharge Disposition of Uninsured vs Insured Adult (18–64 Years) Trauma Patients Before (2004–2006) and After (2008–2010) Massachusetts Health Care Reform Combined

Discharge Disposition (vs Home Without Services) ^a	AOR (95% CI)
Home with services (n = 3230)	0.64 (0.44, 0.93)
Rehabilitation (n = 3434)	0.08 (0.05, 0.96)
Skilled nursing facility (n = 3074)	0.28 (0.11, 0.72)
Other (acute, hospital, other; n = 3075)	0.48 (0.27, 0.85)

Note. AOR = adjusted odds ratio; CI = confidence interval. Odds ratios were adjusted for age, race/ethnicity, sex, mechanism of injury, Injury Severity Score, Revised Trauma Score, and time period (pre and post health care reform). Patients were treated at a single American College of Surgeons Verified Level I Trauma Center.

^aIncludes only patients discharged alive without missing covariates (n = 3948).

study, despite the overall gains in insurance after health care reform, uninsurance remained high among patients experiencing penetrating trauma. Thus, common factors may both increase the risk of certain types of injury and preclude compliance with an individual mandate. Therefore, implementation of health care reform nationally may reduce costs by increasing disease screening and prevention, improving chronic disease management, and shifting away from procedure-based reimbursement, but hospitals with trauma centers may not benefit from these cost savings.

This study had several limitations. First, this was a single-center, retrospective study. Although we have shown an association between health care reform and improved rates of insurance at the time of injury, we could not establish causality. Nonetheless, our study is from the only Level I Trauma Center in central Massachusetts, servicing a wide geographic area covering nearly 1900 square miles with a population density of 458 per square mile that encompasses more than one third of the state of Massachusetts, thus representing a unique environment to study the natural experiment of health care reform on a trauma population. Second, the observed insurance rates among our trauma patients at the time of injury were still higher than those of larger national cohorts reported to be as low as 53% to 75%^{11,15,16,30–35}; thus, our results may not be generalizable nationally because of an even greater burden of uninsurance to be overcome. Finally, we used registry data with limited clinical and personal information; thus, we could not account for factors such as educational level, employment, or income, which may play a role in insurance use and comorbidities or complications that may affect mortality, length of stay, and discharge disposition. Nevertheless, to the extent that Massachusetts health care reform was used as a model for national health care reform, we believe that our results highlight the challenge of implementing a universal mandate among patients whose socioeconomic circumstances or health behaviors may increase their risk of injury.

In conclusion, despite a significant increase in insurance coverage in Massachusetts residents after health care reform, overall rates of insurance among injured patients remain markedly below that of the general

Massachusetts population. The social disadvantages that lead to higher injury rates also appear to operate as barriers to insurance, which is associated with fewer postdischarge services such as home health, rehabilitation, and skilled nursing, thus creating “double jeopardy” for socioeconomically disadvantaged groups. Addressing disparities in the ability to comply with an individual mandate when implementing insurance exchanges as part of the federal health care reform may improve insurance rates among nonelderly, able-bodied community-dwelling adults and ameliorate the burden of unreimbursed trauma care. ■

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Contributors

H. P. Santry originated and designed the study, analyzed and interpreted the data, drafted and revised the article, and approved the submitted version. C. E. Collins, J. T. Wiseman, and C. M. Psoinos participated in study design, data collection and interpretation, and drafting of the article and approved the submitted version. J. M. Flahive participated in data collection; performance of all analyses with oversight from H. P. Santry, C. E. Collins, and C. I. Kiefe; and drafting of the article and approved the submitted version. C. I. Kiefe participated in study origination and design, data interpretation, and critical revision of the article and approved the submitted version.

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Note. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Human Participant Protection

This study underwent full review by the University of Massachusetts institutional review board and was approved with a waiver of consent because of the retrospective nature of the chart review and lack of direct patient contact (Docket 14083).

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