

Association of Medicaid Expansion With Access to Rehabilitative Care in Adult Trauma Patients

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IMPORTANCE Trauma is a leading cause of death and disability for patients of all ages, many of whom are also among the most likely to be uninsured. Passage of the Patient Protection and Affordable Care Act was intended to improve access to care through improvements in insurance. However, despite nationally reported changes in the payer mix of patients, the extent of the law's impact on insurance coverage among trauma patients is unknown, as is its success in improving trauma outcomes and promoting increased access to rehabilitation.

OBJECTIVE To use rigorous quasi-experimental regression techniques to assess the extent of changes in insurance coverage, outcomes, and discharge to rehabilitation among adult trauma patients before and after Medicaid expansion and implementation of the remainder of the Patient Protection and Affordable Care Act.

DESIGN, SETTING, AND PARTICIPANTS Quasi-experimental, difference-in-difference analysis assessed adult trauma patients aged 19 to 64 years in 5 Medicaid expansion (Colorado, Illinois, Minnesota, New Jersey, and New Mexico) and 4 nonexpansion (Florida, Nebraska, North Carolina, and Texas) states.

INTERVENTIONS/EXPOSURE Policy implementation in January 2014.

MAIN OUTCOMES AND MEASURES Changes in insurance coverage, outcomes (mortality, morbidity, failure to rescue, and length of stay), and discharge to rehabilitation.

RESULTS A total of 283 878 patients from Medicaid expansion states and 285 851 patients from nonexpansion states were included (mean age [SD], 41.9 [14.1] years; 206 698 [36.3%] women). Adults with injuries in expansion states experienced a 13.7 percentage point decline in uninsured individuals (95% CI, 14.1-13.3; baseline: 22.7%) after Medicaid expansion compared with nonexpansion states. This coincided with a 7.4 percentage point increase in discharge to rehabilitation (95% CI, 7.0-7.8; baseline: 14.7%) that persisted across inpatient rehabilitation facilities (4.5 percentage points), home health agencies (2.9 percentage points), and skilled nursing facilities (1.0 percentage points). There was also a 2.6 percentage point drop in failure to rescue and a 0.84-day increase in average length of stay. Rehabilitation changes were most pronounced among patients eligible for rehabilitation coverage under the 2-midnight (8.4 percentage points) and 60% (10.2 percentage points) Medicaid payment rules. Medicaid expansion increased rehabilitation access for patients with the most severe injuries and conditions requiring postdischarge care (eg, pelvic fracture). It mitigated race/ethnicity-, age-, and sex-based disparities in which patients use rehabilitation.

CONCLUSIONS AND RELEVANCE This multistate assessment demonstrated significant changes in insurance coverage and discharge to rehabilitation among adult trauma patients that were greater in Medicaid expansion than nonexpansion states. By targeting subgroups of the trauma population most likely to be uninsured, rehabilitation gains associated with Medicaid have the potential to improve survival and functional outcomes for more than 60 000 additional adult trauma patients nationally in expansion states.

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← Invited Commentary page 412

+ Supplemental content

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Trauma is a leading cause of death and disability for patients of all ages, many of whom are also among the most likely to be uninsured. For nonelderly adults in the United States aged 19 to 64 years, traumatic injuries account for more than 160 000 fatalities and an additional 20 million emergency department visits each year.¹ The experience of acute trauma is often life altering, with long-lasting sequelae that can extend well beyond patients' index hospital visit. It is for this reason that access to postdischarge rehabilitation after acute traumatic injury is considered "an essential component of high-quality trauma care."^{2,3} Recommendations from national and international organizations speak to rehabilitation's utility in promoting improved functional outcomes and health-related quality of life for patients with severe injuries.²⁻⁶ Access to rehabilitation is, in many respects, the first critical step in a postacute care pathway where the ability of a patients with injuries to pay has a recognized impact on what happens to that patient outside of hospital doors.⁷⁻¹⁰ Uninsured patients are more likely to be discharged without additional rehabilitation relative to privately and publicly insured patients.^{9,11}

Emerging studies on the impact of health care reform suggest that changes to insurance coverage taking place as a result of the implementation of the 2010 Patient Protection and Affordable Care Act (ACA) are changing care trajectories for adult trauma patients.¹²⁻²⁰ Passage of the ACA was intended to improve access to care through improvements in insurance coverage. While the law and its various provisions, including expansion of parental private insurance coverage to children younger than 26 years, establishment of an individual insurance mandate, formation of state health insurance exchanges, expansion of tax support for employer-sponsored health insurance plans, and optional state expansion of Medicaid with temporary federal funding to all citizens with an income of less than 133% of the federal poverty level are known to have increased insurance coverage and self-reported access to care on a national scale,²¹ the ACA's specific effect on trauma patients remains less clear. A growing number of single-center, projection, and noncontrolled before-and-after studies point toward mixed effects.^{12,13,17-20,22-25} While they all acknowledge changes in the payer mix of patients, the magnitude and extent of the ACA's impact on insurance coverage among trauma patients is unknown, as is the law's success in improving trauma outcomes and promoting increased access to rehabilitation.

The objective of this study was to use rigorous quasi-experimental regression techniques to assess the extent of changes in insurance coverage, outcomes, and discharge to rehabilitation among adult trauma patients before and after Medicaid expansion and implementation of the remainder of the ACA in Medicaid expansion vs nonexpansion states. As a secondary analysis, the study also looked at changes in insurance coverage and discharge to rehabilitation among age-, sex-, and race/ethnicity-stratified subgroups of the adult trauma population where disparities in insurance are known to exist. It considered differences in discharge to rehabilitation based on variations in Centers for Medicare and Medicaid Services' (CMS) rehabilitation payment rules and patient-level differ-

Key Points

Question To what extent have insurance coverage, outcomes, and discharge to rehabilitation changed among adult trauma patients as a result of Medicaid expansion and implementation of the remainder of the Patient Protection and Affordable Care Act?

Findings This difference-in-difference analysis found that adults with injuries in expansion states experienced an absolute 13.7 percentage point decline in the percentage of patients who are uninsured after Medicaid expansion compared with nonexpansion states. This coincided with a 7.4 percentage point increase in discharge to rehabilitation that persisted across inpatient rehabilitation facilities, home health agencies, and skilled nursing facilities.

Meaning By targeting subgroups of the trauma population most likely to be uninsured, rehabilitation gains associated with Medicaid have the potential to improve survival and functional outcomes for more than 60 000 additional trauma patients in expansion states.

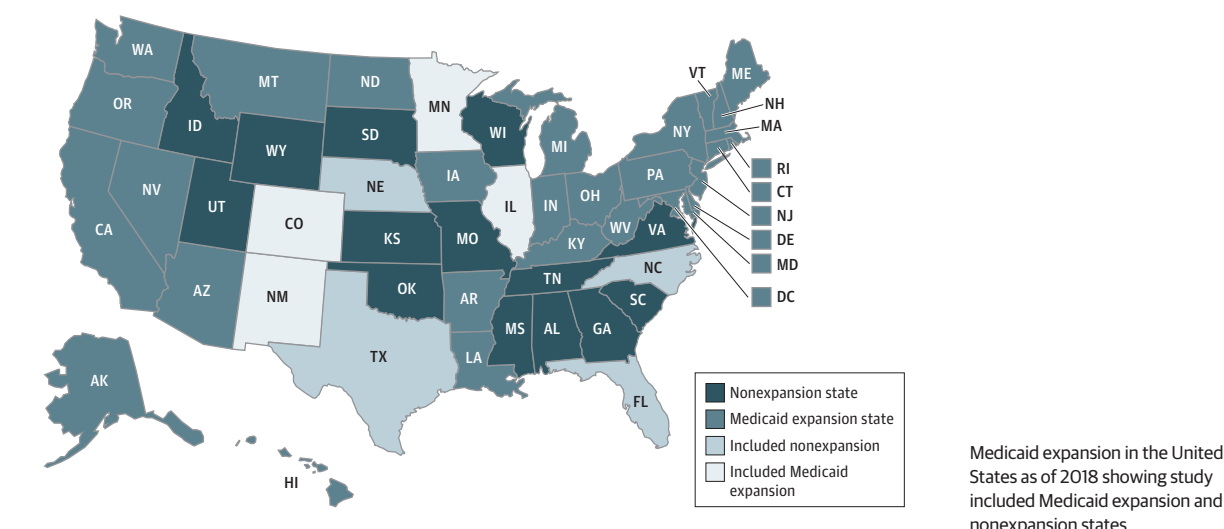
ences in the severity and clinical case mix of discharged trauma patients.

Methods

Data Source and Study Population

Data from state inpatient databases collected by the Agency for Healthcare Research and Quality and obtained directly from state departments of health in 4 large, geographically diverse nonexpansion states (Florida, Nebraska, North Carolina, and Texas) and 5 Medicaid expansion states (Colorado, Illinois, Minnesota, New Jersey, and New Mexico) were queried for adult trauma patients with *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* primary diagnosis codes consistent with trauma (800.x-959.x; **Figure 1**). Medicaid expansion states were chosen such that each included state expanded Medicaid in January 2014 and is not operating under a CMS waiver or alternative payment plan. Patients with diagnoses of late effects of injury or poisoning (905.x-909.x), superficial injuries (910.x-919.x), foreign bodies (930.x-939.x), and burns (940.x-949.x) were excluded to more closely mimic the definition of trauma used by US trauma registries.²⁶ Included patients were required to be admitted to inpatient hospitals in states where they were residents between January 1, 2011, and September 30, 2015. They were excluded if they were missing information on primary payer insurance, outcomes of interest, or demographic and clinical covariates used for stratification and population comparison (<5.0% of the total sample). Exceptions were made for states that do not report race/ethnicity (ie, Minnesota and Nebraska). To focus our analyses on patients potentially eligible for ACA-related insurance change, patients were also excluded if they had a primary payer other than private or Medicaid or were uninsured (eFigure in the [Supplement](#)). The Yale Human Investigation Committee approved the study. Patient consent was not required because this study

Figure 1. Population Definition



used retrospective administrative billing claims data from routine hospitalizations.

Data obtained from state inpatient databases contained patient-level information on hospitalizations for the majority of hospitals within each state, collectively accounting for approximately 29.6% of the total US population.²⁷ Each state database included information on patient encounters, encompassing 20 or more *ICD-9-CM* diagnosis, 15 *ICD-9-CM* procedure, and 4 E-codes. To attain additional information on hospital-level parameters, patient data from each state were matched to hospital data contained with the American Hospital Association Annual Survey Database.²⁸

Time Period and Variable Definitions

Included patients were categorized according to insurance during hospitalization. Changes in insurance and discharge to rehabilitation among survivors (patients discharged alive) were the primary outcome measures. Secondary outcomes included hospital mortality, major morbidity, failure to rescue (defined as mortality given major morbidity),^{13,29-31} and index hospital length of stay (LOS). Major morbidity was defined based on presence of 1 or more of the following complications calculated using *ICD-9-CM* codes: pneumonia, pulmonary embolism, renal failure, cardiovascular accident, myocardial infarction, cardiac arrest, acute respiratory distress syndrome, sepsis, and severe sepsis. Demographic covariates used in stratification included age categorized by decade into adults 19 to 25 years (also eligible for extended parental private insurance coverage as of September 2010),¹³ 26 to 35 years, 36 to 45 years, 46 to 55 years, and 56 to 64 years; sex (male, female); and race/ethnicity (non-Hispanic white, non-Hispanic black, and Hispanic).

Month and year of admission were used to define the time period of hospitalization. Patients admitted during the 33 months following extended parental private insurance coverage¹³ but before Medicaid expansion and the first open enrollment period were included as the preexpansion group (January 2011 to September 2013). Those admitted during the

21 months after Medicaid expansion and the first open enrollment period were included as the postexpansion group (January 2014 to September 2015). The first fiscal quarter of fiscal year 2014 (October to December 2013) was excluded as a wash-in period to account for anticipatory changes leading up to policy change. State of hospital admission determined Medicaid expansion vs nonexpansion states.

Statistical Analysis

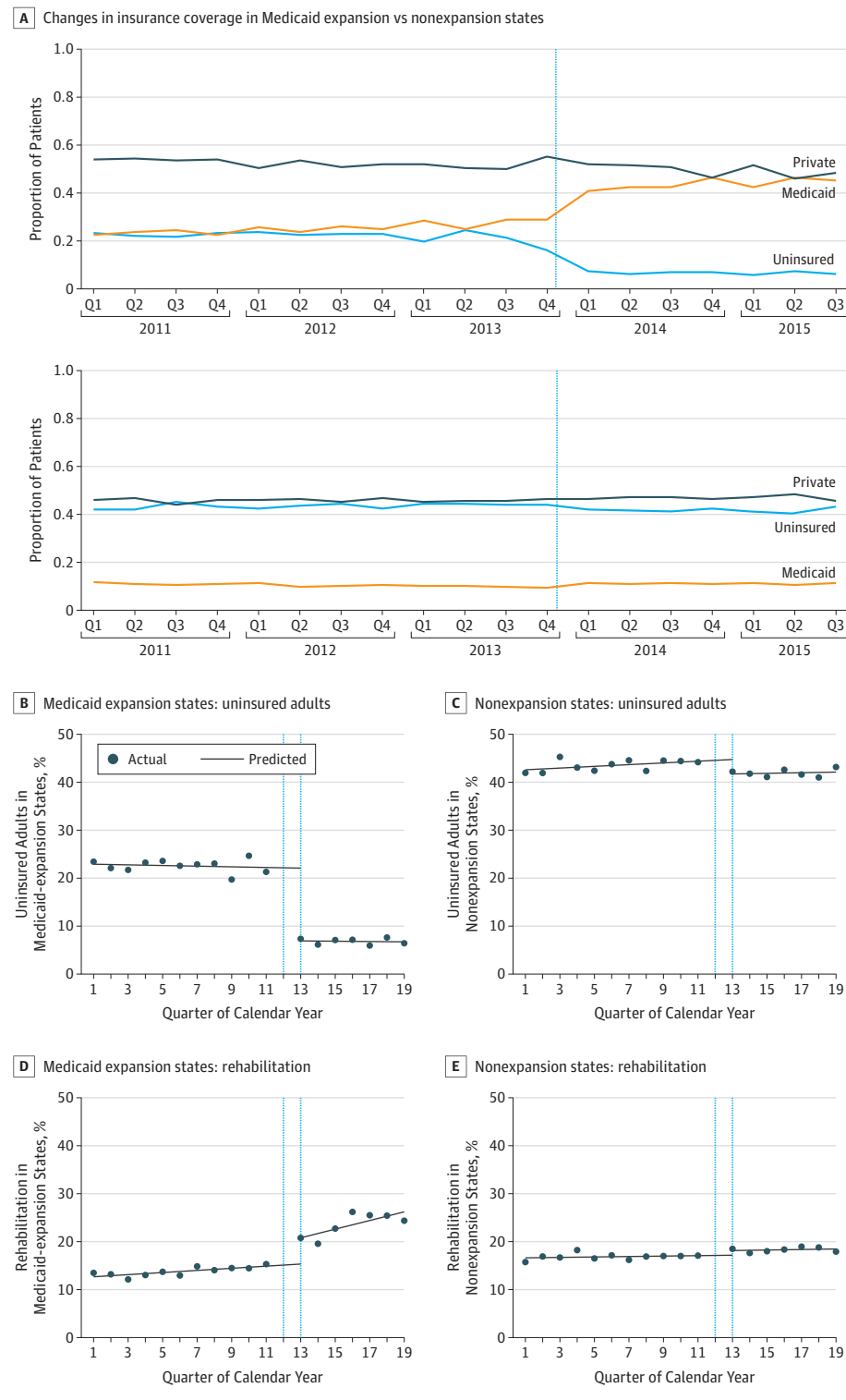
Population Comparison

Differences in demographic and clinical covariates were compared across time periods and Medicaid expansion vs nonexpansion states to determine the extent of potential underlying differences in the 4 study groups. Included covariates are listed in eTable 1 in the Supplement. In all 4 study groups, covariate distributions were similar with subtle, time-consistent differences between Medicaid expansion and nonexpansion states.

Before-and-After Effects

Changes in insurance before and after ACA implementation in Medicaid expansion and nonexpansion states were first compared graphically (Figure 2A) to visually inspect for changes in insurance and the presence of preimplementation parallel trends. Similar assessment was conducted for each outcome and discharge to rehabilitation. Quantitative assessment of before and after changes was also performed for changes in uninsured and discharge to rehabilitation using interrupted time-series analysis (Figure 2B). Interrupted time-series analysis is a quasi-experimental regression technique that uses longitudinal data to model temporal changes while accounting for preintervention trends.¹³ It functions by fitting linear models to values in the preintervention and postintervention periods and assessing for the magnitude of deviation in the postintervention model's intercept from preintervention trends. Deviations from expected values provide evidence of an association between changes in study outcomes and health policy change.¹³

Figure 2. Patient Protection and Affordable Care Act–Related Insurance and Rehabilitation Change



A, Changes in insurance coverage in Medicaid expansion vs nonexpansion states during 2011 to 2015. The vertical line represents the start of Medicaid expansion and the first open enrollment period (2014 Q1: January 1, 2014). B-E, Interrupted time-series analyses showing instantaneous changes (instant delta) in uninsured (B-C) and discharge to rehabilitation (D-E) in Medicaid expansion (B and D) vs nonexpansion (C and E) states. Dashed lines correspond to the model wash-in period (October to December 2013), prior to Medicaid expansion and the first open enrollment period (Q13: January 1, 2014).

Difference in Difference

Differences between Medicaid expansion and nonexpansion states were then compared using quasi-experimental difference-in-difference (DID) regression to ascertain the causal effects of Medicaid (and its interaction with other ACA-

related policies) separate from the remainder of the ACA. Difference-in-difference models function by fitting linear regressions to data that includes parameters for treatment (Medicaid expansion vs nonexpansion state), time period (before vs after ACA implementation), and an interaction

Table 1. Absolute Differences in Insurance Coverage—Results From DID Models^a

	%		Absolute Difference (95% CI), Percentage Points	P Value	DID Medicaid Expansion vs Nonexpansion	
Variable	January 2011 to September 2013	January 2014 to September 2015			Difference Between States (95% CI)	P Value
Medicaid Expansion and Open Enrollment						
Uninsured	22.7	6.8	−15.9 (−16.6 to −15.2)	<.001	−13.7 (−14.1 to −13.3)	<.001
Medicaid	24.8	43.7	18.8 (18.0 to 19.7)	<.001	18.2 (17.8 to 18.6)	<.001
Private insurance	52.5	49.5	−2.9 (−3.9 to −2.0)	<.001	−4.5 (−4.8 to −4.1)	<.001
Open Enrollment (Nonexpansion States)						
Uninsured	44.1	41.9	−2.1 (−2.7 to −1.6)	<.001	NA	NA
Medicaid	10.5	11.1	0.6 (0.3 to 1.0)	<.001	NA	NA
Private insurance	45.4	46.9	1.5 (1.0 to 2.0)	<.001	NA	NA

Abbreviations: DID, difference-in-difference; NA, not applicable.

^a Difference-in-difference results for Medicaid expansion were taken from linear models comparing the rates of change over time in (1) the experimental group (Medicaid expansion states that also implemented the remainder of the Patient Protection and Affordable Care Act) vs (2) the control group (states

that did not expand Medicaid and only implemented the remainder of the Patient Protection and Affordable Care Act before January 2011 to September 2013, after January 2014 to September 2015, and Medicaid expansion on January 1, 2014).

between the 2. Causal effects are calculated as the difference in the differences between treated and untreated groups in the preperiod and postperiod (ie, by the magnitude and significance of the interaction term).

Secondary Analyses

Age-, sex-, and race/ethnicity-stratified DID differences in individuals who were uninsured and discharged to rehabilitation were also assessed to determine the extent to which the ACA altered known differences in insurance disparities among at-risk portions of the adult trauma population. Variations in rehabilitation were further compared based on restriction of the study sample to patients meeting CMS payment rules for an inpatient vs observational hospital stay (index LOS, ≥ 3 days; 2-midnight rule)¹⁰ and with 1 or more of 1390 different presumptive diagnosis codes defined by CMS as a requirement for financial support of inpatient rehabilitation facilities (CMS-funded inpatient rehabilitation facilities must support a case mix of patients comprising 60% or more of such codes, ie, the 60% rule).¹⁰ We also looked at changes in discharge to rehabilitation for patients with more severe injuries, including those with severe head injuries, moderately severe trauma (Injury Severity Score, ≥ 9), major trauma (Injury Severity Score, ≥ 16), and with the most frequent clinical diagnoses requiring discharge to rehabilitation. Data were analyzed using Stata Statistical Software, release 14.2 (StataCorp). An allowable 2-sided α of .05 was considered significant.

Results

A total of 283 878 patients from Medicaid expansion and 285 851 patients from nonexpansion states were included. Variations in the distributions of population covariates are presented in eTable 1 in the [Supplement](#).

Changes in Insurance Coverage

Changes in insurance are presented in Figure 2 and Table 1. Prior to Medicaid expansion and implementation of the remainder

of the ACA in Medicaid expansion states, private insurance was the most common form of insurance among adult trauma patients, comprising 52.5% of included patients (149 036 of 283 878). An additional 24.8% of patients ($n = 70\,402$) were insured through Medicaid, and 22.7% ($n = 64\,440$) were uninsured. Following ACA implementation, the percentage of uninsured individuals dropped by 15.9 percentage points (95% CI, 16.6-15.2), a relative decline from a baseline of 70.0%. Medicaid increased by 18.8 percentage points (95% CI, 18.0-19.7), a relative increase of 75.8%, while private insurance decreased by 2.9 percentage points (95% CI, 3.9-2.0). During the same time span in nonexpansion states, the percentage of uninsured individuals declined by 2.1 percentage points (95% CI, 2.7-1.6), a relative drop from a baseline of 4.8%. Medicaid marginally increased by 0.6 percentage points (95% CI, 0.3-1.0), and private insurance increased by 1.5 percentage points (95% CI, 1.0-2.0). These changes corresponded to absolute DID differences attributable to Medicaid of -13.7 percentage points for uninsured individuals (95% CI, -14.1 to 13.3), 18.2 percentage points for Medicaid (95% CI, 17.8-18.6), and -4.5 percentage points for individuals with private insurance (95% CI, -4.3 to 4.1) (Table 1). Differences among all nonelderly adult trauma patients, including those with Medicare and other forms of insurance, are presented in eTable 2 in the [Supplement](#). Changes limited to adults not also eligible for expanded parental private insurance coverage under the ACA Dependent Coverage Provision enacted in September 2010, individuals aged 26 to 64 years, are presented in eTable 3 in the [Supplement](#).

Instantaneous changes detected following ACA implementation by interrupted time-series analysis (Figure 2B) suggest that declines in uninsured individuals in both Medicaid expansion and nonexpansion states happened immediately after January 2014 and remained relatively constant throughout the postimplementation period. No significant postpolicy temporal trends in either group were found.

Changes in Outcomes and Discharge to Rehabilitation

Changes in outcomes and discharge to rehabilitation are presented in Table 2. Compared with nonexpansion states, Med-

Table 2. Absolute Differences in Outcomes and Discharge to Rehabilitation^a

Variable	%		Open Enrollment (Nonexpansion States)		DID Medicaid Expansion vs Nonexpansion	
	Medicaid Expansion and Open Enrollment					
	January 2011 to September 2013	January 2014 to December 2015	January 2011 to September 2013	January 2014 to December 2015	Difference Between States (95% CI)	P Value
Trauma Outcomes						
Survivors discharged to rehabilitation	14.7	23.4	17.0	18.3	7.4 (7.0 to 7.8)	<.001
Inpatient rehabilitation facility	7.8	12.7	6.9	7.4	4.5 (4.1 to 4.9)	<.001
Home health agency	5.0	7.8	6.7	6.7	2.9 (2.5 to 3.2)	<.001
Skilled nursing facility	6.2	7.9	3.2	4.0	1.0 (0.5 to 1.4)	<.001
In-hospital mortality	1.9	1.8	2.3	2.2	0.0 (−0.4 to 0.4)	.99
In-hospital major morbidity	7.4	9.4	10.5	12.2	0.4 (0.0 to 0.7)	.52
Failure to rescue	14.9	10.7	13.4	11.8	−2.6 (−3.0 to −2.2)	.04
Predicted LOS, mean, d	4.11	5.28	5.99	6.32	0.84 (0.58 to 1.02)	<.001
Subsets of Survivors Discharged to Rehabilitation						
Admissions with LOS ≥3 d (ie, 2-midnight rule)	24.3	34.0	24.4	25.7	8.4 (7.2 to 9.6)	<.001
Admissions with ≥1 60% rule diagnosis code	28.4	38.8	32.0	32.2	10.2 (8.6 to 11.8)	<.001
5 Most frequent rehabilitation diagnoses						
Code 820: Fracture of neck of femur	56.2	58.8	51.3	51.4	2.5 (−1.3 to 6.3)	.20
Code 852: Subarachnoid, subdural, extradural hemorrhage after injury	18.5	24.9	22.7	22.3	6.8 (2.8 to 10.8)	.004
Code 801: Fracture of base of skull	18.0	23.8	25.2	25.7	5.3 (0.9 to 9.7)	.02
Code 808: Fracture of pelvis	36.8	44.8	32.6	31.9	8.7 (2.8 to 14.6)	.004
Code 806: Fracture of vertebral column with spinal cord injury	54.8	63.2	60.3	59.7	9.0 (−1.5 to 19.5)	.04
Severity of injury						
Severe head injury, AIS ≥3	19.0	23.5	15.3	14.0	5.8 (3.4 to 8.2)	<.001
Severe injury, ISS ≥9	24.1	30.8	26.6	27.0	6.3 (4.9 to 7.7)	<.001
Major injury (multiple trauma), ISS ≥16	26.3	34.9	28.7	29.0	8.3 (3.9 to 12.7)	<.001

Abbreviations: DID, difference-in-difference; NA, not applicable.

^a Difference-in-difference results for Medicaid expansion were taken from linear models comparing the rates of change over time in (1) the experimental group (Medicaid expansion states that also implemented the remainder of the Patient Protection and Affordable Care Act) vs (2) the control group (states that did not expand Medicaid and only implemented the remainder of the

Patient Protection and Affordable Care Act before January 2011 to September 2013, after January 2014 to September 2015, and Medicaid expansion on January 1, 2014). Predicted mean differences in LOS were calculated using γ models with \ln -transformed data and postestimation calculation of marginal effects to account for the skewed nature of LOS.

icaid expansion states experienced a 7.4 percentage point greater absolute increase in the percentage of survivors discharged to rehabilitation (95% CI, 7.0-7.8). The change persisted in the use of inpatient rehabilitation facilities (DID: 4.5 percentage points), home health agencies (2.9 percentage points), and skilled nursing facilities (1.0 percentage points). Interrupted time-series analysis results reported in Figure 2B point toward instantaneous changes in discharge to rehabilitation following January 2014 for both Medicaid expansion and nonexpansion states. Within expansion states, rehabilitation gains continued to increase throughout the postimplementation period, climbing by a mean of 0.9 percentage points per quarter (3 months; 95% CI, 0.3-1.5). No postpolicy trends were detected within nonexpansion states.

Changes in outcomes were less pronounced. Compared with nonexpansion states, adult trauma patients hospitalized in Medicaid expansion states experienced an absolute 2.6 percentage point drop in failure to rescue (95% CI, −3.0 to 2.2) and 0.84-day increase in predicted mean LOS (95% CI, 0.58-1.02). Difference-in-difference changes in mortality and major morbidity were not significant. In all states, mortality and failure to rescue slightly decreased, while major morbidity and LOS slightly increased.

Changes Among Subgroups of Survivors Discharged to Rehabilitation

Difference-in-difference changes in discharge to rehabilitation were significant in all considered subgroups except for

Table 3. Disparity-Stratified Absolute Differences in Uninsured Status and Discharge to Rehabilitation^a

Variable	% January 2011 to September 2013	January 2014 to September 2015	Difference Within Expansion States	P Value	Difference Relative to Nonexpansion States	P Value	% Due to Medicaid Expansion	% Due to Open Enrollment
Uninsured								
Age, y								
19-25	22.5	7.6	-14.9	<.001	-9.9	<.001	66.3	33.7
26-35	33.3	9.9	-23.4	<.001	-16.3	<.001	69.5	30.5
36-45	25.4	8.4	-17.0	<.001	-11.6	<.01	68.5	31.5
46-55	19.9	5.2	-14.7	<.001	-12.6	<.001	85.8	14.2
56-64	11.5	4.0	-7.5	<.001	-5.8	<.001	78.2	21.8
Sex								
Male	27.7	8.1	-19.5	<.001	-18.0	<.001	92.0	8.0
Female	12.0	4.3	-7.8	<.001	-5.1	<.001	65.3	34.7
Race/ethnicity								
Non-Hispanic white	16.8	4.8	-11.9	<.001	-9.7	<.001	81.4	18.6
Non-Hispanic black	27.1	5.5	-21.5	.001	-20.6	<.001	95.5	4.5
Hispanic	41.6	20.1	-21.5	<.001	-21.0	<.001	97.7	2.3
Discharge to Rehabilitation								
Age, y								
19-25	9.9	16.2	6.3	<.001	5.3	<.001	84.5	15.5
26-35	10.0	18.5	8.5	<.001	8.2	<.001	96.1	3.9
36-45	11.5	19.8	8.3	<.001	6.8	<.001	82.5	17.5
46-55	16.0	25.9	9.9	<.001	9.3	<.001	94.1	5.9
56-64	21.7	33.5	11.7	<.001	9.7	<.001	82.6	17.4
Sex								
Male	12.0	20.3	8.3	<.001	7.2	<.001	87.7	12.3
Female	17.3	29.5	12.3	<.001	9.9	<.001	80.6	19.4
Race/ethnicity								
Non-Hispanic white	15.8	26.5	10.7	<.001	9.2	<.001	86.1	13.9
Non-Hispanic black	11.2	20.8	9.6	<.001	8.9	<.001	92.5	7.5
Hispanic	10.9	14.4	3.5	<.001	2.2	.008	62.9	37.1

^a Difference-in-difference results for Medicaid expansion were taken from linear models comparing the rates of change over time in (1) the experimental group (Medicaid expansion states that also implemented the remainder of the Patient Protection and Affordable Care Act) vs (2) the control group (states

that did not expand Medicaid and only implemented the remainder of the Patient Protection and Affordable Care Act before January 2011 to September 2013, after January 2014 to September 2015, and Medicaid expansion on January 1, 2014).

patients with a fracture of the neck of the femur (DID point estimate: 2.5). They were most pronounced among patients with index hospitalizations that corresponded to CMS payment rules. Among patients within an index LOS of 3 days or longer, discharge to rehabilitation increased by an absolute DID of 8.4 percentage points (95% CI, 7.2-9.6). Among patients with 1 or more presumptive diagnosis codes, discharge to rehabilitation increased by 10.2 percentage points (95% CI, 8.6-11.8). Similar large changes were seen among patients with pelvic fractures (8.7 percentage points) and vertebral fractures with spinal cord injuries (9.0 percentage points) and among those with major injuries based on an Injury Severity Score of 16 or higher (8.3 percentage points).

Disparity-Stratified Results

Age-, sex- and race/ethnicity-stratified changes in uninsured and discharge to rehabilitation are presented in Table 3. For

all subgroups in expansion states, Medicaid expansion accounted for significant reductions in uninsured individuals and gains in discharge to rehabilitation beyond those observed owing to implementation of the remainder of the ACA. Changes in uninsured individuals were most pronounced among adult trauma patients at greatest risk, including non-Hispanic black individuals (DID, -20.6 percentage points), men (-18.0 percentage points), and those aged just ineligible for extended parental private insurance coverage (-16.3 percentage points). Among Hispanic patients, uninsured individuals dropped by a DID of 21.0 percentage points. Rehabilitation gains, in contrast, were marginally greater among subgroups more likely at baseline to be insured (non-Hispanic white, elderly women) and for whom a larger percentage of the overall change in discharge to rehabilitation could be attributed to the remainder of the ACA. Regardless of diagnostic group, Medicaid expansion alone accounted for 65.3% or more of total observed

changes in uninsured and 82.6% or more of changes in discharge to rehabilitation within expansion states. It lessened preimplementation insurance disparities, bringing differences in uninsured individuals to nearly identical levels while greatly enhancing access to rehabilitation for all adult trauma patients.

Discussion

The results of this study revealed significant changes in insurance and discharge to rehabilitation associated with Medicaid expansion and implementation of the remainder of the ACA. For adult trauma patients who are among the most likely demographics of the US population to be uninsured, expanded access to Medicaid was associated with absolute reductions in uninsured individuals that were 13.7 percentage points greater than those encountered among states with standard ACA implementation, marked increases in Medicaid (18.2 percentage points), and modest declines in the percentage of patients who were privately insured (4.5 percentage points). In contrast to expansion states where private insurance fell by 2.9 percentage points, private insurance increased within nonexpansion states by 1.5 percentage points. Changes in insurance were accompanied by significant increases in discharge to rehabilitation that were 7.4 percentage points greater within Medicaid expansion than nonexpansion states. Increased discharge to rehabilitation was most pronounced among patients with severe injuries eligible for Medicaid inpatient rehabilitation facility coverage under the 2-midnight (8.4 percentage points) and 60% (10.2 percentage points) CMS payment rules. Such a finding suggests that there is likely to be a sizable population of patients with injuries in nonexpansion states with clear medical indications for postacute rehabilitation who are unable to access it owing to a lack of insurance.

The study's findings are in keeping with what is known about anticipated changes in outcomes following ACA implementation among adult trauma patients.^{12,13,17-20} A prior risk-adjusted assessment of before-and-after changes among young adult trauma patients aged 18 to 34 years reported a significant 5.4 percentage point increase in discharge to rehabilitation, 0.5 percentage point decrease in mortality, and 4.5 percentage point decrease in failure to rescue following ACA implementation in Maryland.¹³ Overall results among adults within Medicaid expansion states were similar. Single-center studies in Arizona,²⁰ Oregon,¹⁷ and Washington, DC,¹² report nonsignificant changes in outcomes, slightly shorter LOS among trauma patients with nonsevere injuries, and increased discharge to skilled nursing facilities. Our results mimic findings of increased skilled nursing facilities use and suggest that for the trauma population as a whole, LOS actually increased. Early database assessments report mixed outcomes for patients with traumatic brain injuries¹⁹ and apparent reductions in racial and socioeconomic insurance disparities among adults aged 19 to 44 years.¹⁸ For the nonelderly trauma population as a whole and for young adults in Maryland,¹³ insurance disparities were also found to decrease.

Studies of all-comer emergency presentations to the emergency department³²⁻³⁴ suggest larger changes in insurance than those observed among high-acuity trauma patients, while emerging literature for elective surgery points toward more modest but still significant insurance gains.³⁵⁻³⁷ In a recent DID study comparing insurance changes in Medicaid expansion vs nonexpansion states, researchers showed that the magnitude of changes in insurance attributable to Medicaid decreased as the urgency of an operation decreased and, correspondingly, as the baseline probability of patients being uninsured decreased (C.K. Zogg, MSPH, MHS, unpublished data, November 2018). This study builds on that work, demonstrating that for adult trauma patients, larger increases in Medicaid coverage were associated with significant increases in discharge to rehabilitation. Corresponding declines in private coverage combined with greater rehabilitation gains among more privileged (albeit still at risk) trauma patients are intriguing. They likely speak to changes in the use of marginal private health insurance plans among "better-off" patients for whom increased access to Medicaid provided a preferable alternative to high-deductible or catastrophic-only private plans. Better coverage among insured patients coupled with remaining disparities in access to care that extend beyond insurance³⁸⁻⁴¹ are thought to account for the inverse association observed among which groups most benefited from Medicaid expansion's influence on reductions in uninsured and gains in discharge to rehabilitation.

Prior studies of changes in disparities among young adult trauma patients before and after expansion of parental private insurance coverage in 2010^{13,15,16} and Medicaid expansion in 2014^{13,18} reveal important differences in the impact that each program had on trauma patients. While expansion of parental private coverage was associated with significant reductions in uninsured individuals, changes were most pronounced among more privileged patients whose parents were more likely to be insured.^{13,15,16} Changes among minority groups were minimal, and little to no significant changes in outcomes were observed.^{13,15,16} Medicaid expansion, in contrast, targeted low-income US citizens and thus resulted in larger changes in insurance coverage; dramatic reductions in insurance disparities among racial, sex, and socioeconomic groups; and significant changes in outcomes.^{13,18} When applied to the nonelderly adult trauma population and ACA implementation as a whole, the same logic holds. We see much larger changes in insurance coverage, reductions in insurance disparities, increases in discharge to rehabilitation, and potential changes in hospital outcomes when insurance is given to patients in need.

For all of its financial, sustainability, and political challenges, Medicaid expansion uniquely affects trauma patients in a way that no other aspect of the ACA is able to as directly accomplish. The remainder of the ACA did still have an effect as evidenced by the small but significant reductions in the amount of uninsured individuals, gains in private insurance coverage, and increases in discharge to rehabilitation within nonexpansion states. Even in expansion states, the remainder of the ACA was associated with nonnegligible parts of overall decreases in uninsured individuals and increases in

discharge to rehabilitation—changes that are expected to lead to increased functional recovery and decreased risk of secondary injury (eg, falls) and/or need for emergency department visits.^{2-6,42} Lack of access to rehabilitation within non-expansion states has the potential to increase total trauma costs through patients' ongoing need for assistive care and durable medical equipment despite initial cost savings via lesser spending on acute postdischarge care.⁴²⁻⁴⁶ In coming years, as health care reform continues to be evaluated and Medicaid eligibility faces restructuring and debate, methodically rigorous assessment of health policy change is needed to advocate for the good in existing legislation and promote evidence-based changes to the parts that do not work. Future studies are encouraged to address and challenge this issue.

Limitations

The current analysis must be interpreted in light of the study's limitations. Most come from its reliance on administrative data where completeness of information, the potential for absent or misreporting of events, and a lack of nuanced clinical detail can be concerns. Use of multistate data facilitated assessment of a large quasi-experimental temporal cohort needed to evaluate health policy change. Few databases enable such assessment. However, in relying on combined state inpatient data, conclusions might not be nationally representative, and individual data sources might not be the same. Use of DID modeling assumes applicability of generalized linear models and the presence of parallel trends. Future studies are warranted to assess the extent of changes in longer-term and patient-

reported outcomes as a result of the increase in discharge to rehabilitation, including the specifics of rehabilitation provided during patients' index hospital stay and postdischarge care, related changes in functional recovery, eventual discharge home vs long-term residence in an assisted living facility, and potentially related reduction in mortality happening after patients' discharge from the inpatient setting.

Conclusions

This multistate, quasi-experimental assessment of ACA-related changes to insurance coverage, outcomes, and discharge to rehabilitation demonstrated significant reductions in uninsured individuals among adult trauma patients that were greater in Medicaid expansion than nonexpansion states. While changes in expansion states were primarily driven by increased enrollment in Medicaid, significant albeit smaller increases in private insurance coverage were also detected within nonexpansion states. Both changes corresponded to increased discharge to rehabilitation, particularly among patients with severe injuries and clinically complex trauma. By targeting subgroups of the trauma population most likely to be uninsured, Medicaid expansion led to rehabilitation gains that have the potential to improve the quality-of-life and functional outcomes²⁻⁶ of more than 60 000 additional adult trauma patients nationally in expansion states, directly affecting the health of some of the country's most vulnerable populations.

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