

Emergency Medicaid enrollment after traumatic injury predicts long-term health care utilization

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BACKGROUND:	Injured patients have high rates of uninsurance, which is associated with worse outcomes. Insurance linkage programs that connect patients to Medicaid coverage can prevent catastrophic costs for patients. Less is known about the long-term impact of insurance enrollment. We examined health care utilization for previously uninsured patients, hypothesizing that newly insured patients postinjury would use health care more than those remaining uninsured.
METHODS:	We linked institutional trauma registry data to the electronic medical record to identify injured patients aged 18 to 64 years from 2017 to 2021. Patients admitted without insurance and then retroactively insured (RI) during hospitalization were compared with patients with preestablished Medicaid (Medicaid insured [MI]) and those remaining uninsured. We compared demographic and injury characteristics and future health care utilization, including hospitalizations, emergency department (ED) visits, and clinic visits, among groups at 30 days and 12 months postinjury. Patient-reported outcomes (PROs) 6 months after injury were compared by group for a subset of patients participating in an ongoing study of long-term PROs.
RESULTS:	We compared 494 RI patients with 1,706 MI and 148 uninsured patients. Retroactively insured patients were younger, more likely to have penetrating injuries, and longer hospitalization than other groups. There was a significant increase in ED and clinic visits and hospital admissions at 30 days and 12 months between RI and uninsured patients ($p < 0.001$). Using multivariable logistic regression, RI was associated with higher future ED utilization, hospital admissions, and specialist visits at 30 days and 12 months compared with uninsured patients. Of the 265 patients with 6-month PROs, Medicaid coverage was not associated with any significant difference in physical function or anxiety.
CONCLUSION:	Patients enrolled in insurance postinjury are more likely to use health care in the future than patients without insurance, but the downstream effects are less clear. Health insurance is a necessary step but not independently sufficient to optimize care and improve health outcomes. (<i>J Trauma Acute Care Surg.</i> 2024;00: 00–00. Copyright © 2024 Wolters Kluwer Health, Inc. All rights reserved.)
LEVEL OF EVIDENCE:	Prognostic and Epidemiological; Level IV.
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Patients who are traumatically injured are twice as likely to be uninsured as the general population.¹ Lack of insurance is identified as an independent risk factor for mortality after trauma even after adjusting for severity of injury.^{2,3} Lack of insurance hinders preventive care before the injury episode and limits access to rehabilitation and follow-up. Uninsurance affects health systems, as well. Nearly one quarter of trauma patients are uninsured, and hospitals recoup less than 20% of inpatient costs for their care.⁴ Expansion of insurance access with the Affordable Care

Act (ACA) decreased the proportion of trauma patients without insurance, which was associated with improved access: injured patients were 31% more likely to benefit from postacute care after the ACA.⁵ Trauma patients experience changes in their insurance coverage after injury with a higher number enrolling in government sponsored insurance plans.¹

When an uninsured patient is admitted to the hospital, the hospital has a financial and mission-based incentive to help that patient obtain insurance.⁶ Health systems are incentivized to enroll eligible patients in Medicaid to improve reimbursement for otherwise uncompensated trauma care. This enrollment can also help decrease catastrophic health care spending for vulnerable trauma patients. In some cases, patients can be directly enrolled in long-term Medicaid insurance. In other cases, coverage is temporary. Hospital Presumptive Eligibility (HPE) allows patients to apply for emergency Medicaid insurance at the time of emergency admission and receive temporary Medicaid coverage for up to 60 days before they are required to enroll in long-term Medicaid or lose their coverage.

Studies from Knowlton et al.⁶ have demonstrated the potential of this program to lead to sustained insurance among California trauma patients. Trauma patients were more likely to enroll in Medicaid under HPE if they had inpatient admission,

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higher Injury Severity Score (ISS), operative intervention, or were discharged to postacute care.⁷ The risk of catastrophic health expenditure (defined as >40% of postsustenance income) decreased dramatically with expansion of Medicaid insurance coverage across states.⁸ In a retrospective study of a statewide database with longitudinal postdischarge data, Knowlton et al.⁶ evaluated rates and predisposing factors to Medicaid sustainment. Just over two thirds of traumatically injured patients enrolled in California emergency Medicaid were able to sustain enrollment 6 months after the inciting event.⁹ Patients with sustained Medicaid coverage were similarly more likely to have higher ISS, operative intervention, and discharge to postacute care and have a longer hospital length of stay.⁹

While reducing financial toxicity is clearly beneficial, health insurance also has the potential to improve access to care, quality of care, and, ultimately, health outcomes. Little is known about the downstream effects of emergency Medicaid enrollment after trauma. In this study, we track postinjury health care utilization and patient-reported outcomes (PROs) for patients enrolled in Medicaid during a trauma admission to our center, compared with patients with preexisting Medicaid and those remaining uninsured. We hypothesized that newly insured patients postinjury would have greater health care utilization compared with those remaining uninsured.

PATIENTS AND METHODS

Patient Population

Patients aged 18 to 64 years admitted with a traumatic injury to a single, urban level 1 academic trauma center between March 1, 2017, and December 31, 2021, and residing in Pennsylvania were included in this retrospective cohort study. We used electronic medical record data from our institutional Data Analytics Center to identify patients admitted without insurance and then retroactively insured (RI). Comparison groups were patients with preexisting Medicaid (Medicaid insured [MI]) and patients remaining uninsured as previously described.¹⁰ We excluded patients older than 65 years, who did not reside in Pennsylvania, or who were admitted initially under an “observation” status because they are not eligible for emergency Medicaid assistance. Eligible patients were identified from the trauma registry and linked to administrative data from the electronic medical record to determine details regarding patient insurance coverage and hospital utilization.

Outcomes

Insurance Enrollment

We first evaluated factors associated with enrollment in insurance after traumatic injury. To identify risk factors associated with remaining uninsured, we did not discriminate between emergency Medicaid or durable Medicaid enrollment. We compared characteristics of the RI patients with the uninsured patients to determine the factors associated with remaining uninsured despite being eligible for emergency Medicaid enrollment. This included demographic and injury characteristics, including duration of trauma center contact.

Health Care Utilization

From the electronic medical record, we identified all health care utilization within our health system after the index

admission for the traumatic injury. This included emergency department (ED) visits, hospital admissions (both planned and unplanned), and primary care visits as well as specialist clinic visits, evaluated at 30 days and 12 months following hospital discharge. We also evaluated rates of postacute care use, including home health care and use of inpatient rehabilitation and nursing facilities.

Patient-Reported Outcomes

All included patients were assessed for concurrent inclusion in an ongoing prospective study on PROs occurring simultaneously at our institution. Patients in this study are screened using the Patient-Reported Outcomes Measurement Information System 29 instrument, assessing eight domains such as physical function, anxiety, depression, fatigue, sleep disturbance, and pain, as previously described.¹¹ Scores for each domain are assessed as *z* scores and compared with population averages. Scores are reported as a percentage of individuals in each group with a standardized score more than 1 SD worse than the population average.

Covariates

Patient characteristics such as age, sex, race, and English as primary language were compared between the insurance status groups. Characteristics of the traumatic injury were also compared, including mechanism of injury, ISS, hospital length of stay, and interventions such as additional surgical consultations (ie, orthopedics, plastic surgery) and procedures. The date and time of admission were also collected and characterized as weekday (Monday to Friday at 6 PM) versus weekend (Friday at 6 PM to Sunday).

Analysis

We compared baseline demographic, injury, and initial hospitalization characteristics between the three insurance status groups using χ^2 test for categorical variables and Kruskal-Wallis test for nonparametric continuous variables. We used multivariable logistic regression to determine characteristics associated with remaining uninsured. Each health care utilization measure was assessed as a binary outcome, and multivariable logistic regression was performed to evaluate the relationship between insurance status and health care use. Comparisons were made between the newly RI, and the two comparison groups, MI and uninsured. Patient-reported outcomes were collapsed into a binary assessment of whether or not the outcome was more than 1 SD worse than the weighted population average, and multivariable logistic regression was again used to assess for association with health care coverage. This study was deemed exempt by an institutional review board (no. 851305). The study was reported in accordance with Strengthening the Reporting of OBservational studies in Epidemiology Guidelines (Supplemental Digital Content, Supplementary Data 1, <http://links.lww.com/TA/D989>).

RESULTS

Characteristics of the RI Trauma Patients

From 2017 to 2021, 2,348 patients identified from the trauma registry met our inclusion criteria (Fig. 1), including 1,706 (72.1%) with preexisting Medicaid, 494 (21%) who were

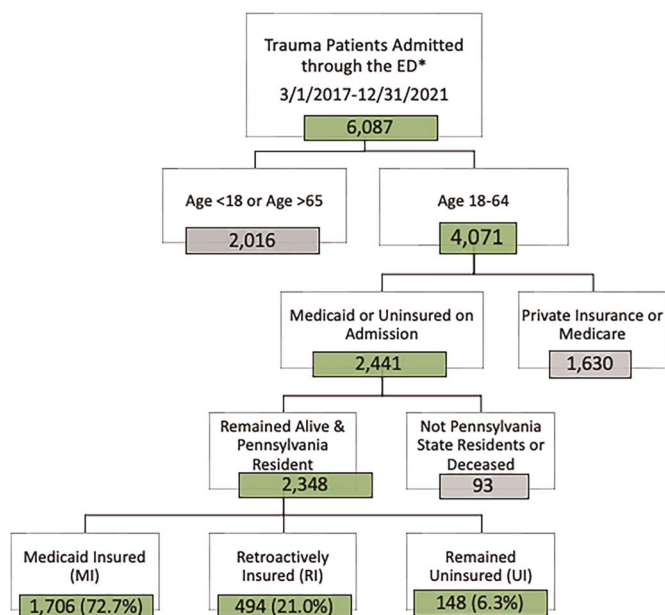


Figure 1. Flow chart of eligible patients, March 1, 2017, December 31, 2021.

RI, and 148 (6.3%) who remained uninsured. The median age of the cohort was 35 years (interquartile range, 27–51 years). Uninsured patients were more likely to be male (89.9%) than MI

(75.9%) and RI (83.0%, $p < 0.001$). Patients who were RI were less likely to speak English as their primary language (91.9%) versus MI and uninsured patients (98.4% and 94.6%, $p < 0.001$). A smaller proportion of Black patients (72.3% vs. 78.3% vs. 83.7%) and a larger percentage of White patients (12.2% vs. 9.5% vs. 9.7%) remained uninsured versus RI and MI.

Retroactively insured patients had higher rates of penetrating injury (43.9%) than MI (37.2%) and uninsured (29.1%) and were more likely to require immediate operative intervention (32.0%) than MI (25.9%) and uninsured (17.6%). Patients who remained uninsured were more likely to have a hospital length of stay of less than 48 hours (57.4% vs. 21.5% RI vs. 21.2% MI, $p < 0.001$). Baseline admission characteristics can be found in Table 1.

Factors Associated With Remaining Uninsured

In multivariable regression, males were more likely than females to remain uninsured (odds ratio [OR], 2.1 [95% confidence interval (CI), 1.1–3.9]). Older patients were all more likely to remain uninsured than the youngest group of patients (25 years or younger). Race was not associated with remaining uninsured. Patients who spoke English as their primary language were more likely to remain uninsured than those with another native language, but this finding was not statistically significant (OR, 2.8 [95% CI, 0.98–8.2]) (Table 2).

TABLE 1. Baseline Admission Characteristics of Traumatically Injured Patients, 2017–2021

Characteristic	Total	Medicaid Insured (MI)	Retroactively Insured (RI)	Remain Uninsured (UI)	<i>p</i>
Patients, n (%)	2,348 (100)	1,706 (72.7)	494 (21.0)	148 (6.3)	
Male sex, n (%)	1,838 (78.3)	1,295 (75.9)	410 (83.0)	133 (89.9)	<0.001
Age, median (IQR)	35 (27–50)	36 (27–51)	33 (26–47)	35 (28.5–46)	0.05
Race, n (%)					<0.001
Black	1,922 (81.9)	1,428 (83.7)	387 (78.3)	107 (72.3)	
White	231 (9.8)	166 (9.7)	47 (9.5)	18 (12.2)	
Other	195 (8.3)	112 (6.6)	60 (12.2)	23 (15.5)	
English primary language, n (%)	2,273 (96.8)	1,679 (98.4)	494 (91.9)	140 (94.6)	<0.001
Mechanism of injury, n (%)					0.003
Gunshot wound	674 (28.8)	477 (28.1)	167 (34.0)	30 (20.3)	
Fall	495 (21.2)	383 (22.5)	75 (15.3)	37 (25.0)	
Motor vehicle crash	239 (10.2)	183 (10.8)	39 (7.9)	17 (11.5)	
Stabbing	220 (9.4)	157 (9.2)	50 (10.2)	13 (8.8)	
Pedestrian accident	105 (4.5)	75 (4.4)	27 (5.5)	3 (2.0)	
Motorcycle accident	68 (2.9)	50 (2.9)	14 (2.9)	4 (2.7)	
Penetrating injury, n (%)	894 (38.1)	634 (37.2)	217 (43.9)	43 (29.1)	0.002
ISS, median (IQR)	9 (5–14)	9 (5–14)	9 (5–14)	5 (2–10)	<0.001
ICU LOS, median (IQR)	0 (0–2)	0 (0–2)	0 (0–3)	0 (0–1)	<0.001
Hospital LOS, median (IQR)	4 (2–8)	4 (2–8)	4 (2–9)	2 (1–3)	<0.001
Post-ED destination, n (%)					0.001
ICU	681 (29.0)	505 (29.6)	138 (27.9)	38 (25.7)	
Operating room/IR	626 (26.7)	442 (25.9)	158 (32.0)	26 (17.6)	
Medical/Surgical Floor	1,041 (44.3)	759 (44.5)	198 (41.1)	84 (56.8)	
Weekend admission, n (%)	890 (37.9)	637 (37.3)	187 (37.9)	66 (44.6)	0.22
LOS <48 h, n (%)	552 (23.5)	361 (21.2)	106 (21.5)	85 (57.4)	<0.001

ICU, intensive care unit; IQR, interquartile range; IR, interventional radiology; LOS, length of stay.

TABLE 2. Results of Multivariable Logistic Regression for Characteristics Associated With Remaining Uninsured vs. Enrolling in Retroactive Medicaid Insurance (Reference)

Characteristic	OR (95% CI)	p
Male (vs. female)	2.1 (1.1–3.9)	0.025
Age		
16–25 y	Ref.	
26–39 y	2.85 (1.50–5.40)	0.001
40–54 y	2.47 (1.20–5.06)	0.014
≥55 y	2.27 (1.01–5.09)	0.048
Race	Ref.	0.20
Black	1.55 (0.79–3.02)	0.23
White	1.60 (0.74–3.46)	
Other		
English as primary language	2.83 (0.98–8.17)	0.20
Penetrating injury	0.72 (0.24–1.22)	0.22
ISS		
≤8	Ref.	
9–15	1.11 (0.69–1.76)	0.67
16–24	0.95 (0.42–2.13)	0.90
≥25	0.61 (0.25–1.49)	0.28
LOS <48 h	5.37 (3.42–8.44)	<0.001
ICU admission	0.79 (0.48–1.30)	0.35
Direct to operating room/IR	0.53 (0.29–0.96)	0.037
Weekend admit	1.77 (1.14–2.72)	0.009

ICU, intensive care unit; IR, interventional radiology; LOS, length of stay; Ref., reference.

Patients who required immediate operative intervention, either by surgery or interventional radiology, were less likely to remain uninsured (OR, 0.53 [95% CI, 0.29–0.96]) compared with those who did not require immediate intervention. There was no association between mechanism of injury or ISS and remaining uninsured. The duration and timing of admission were also strongly correlated with remaining uninsured. Short hospital length of stay less than 48 hours was highly associated with remaining uninsured (OR, 5.4 [95% CI, 3.4–8.4]) as was admission over the weekend (OR, 1.8 [95% CI, 1.2–2.7]) (Table 2).

Health Care Utilization

Following their initial traumatic injury and insurance enrollment, the health-seeking behavior of RI patients differed from that of uninsured patients, resembling that of previously injured MI patients. Retroactively insured patients had a higher number of ED visits at 30 days and 12 months postenrollment than uninsured patients and a higher number of hospital readmissions (Table 3). Retroactively insured patients were not only more likely to have a primary care provider (PCP) assigned at 30 days and 12 months than uninsured patients, but they were also more likely to visit their PCP at 12 months than uninsured patients (Table 3).

Retroactively insured patients were more likely to present for outpatient specialist clinic visits than uninsured patients both at 30 days and 12 months (Table 4). When evaluating for common specialist visits for traumatically injured patients, RI patients were more likely to see orthopedic surgery in clinic than uninsured patients over 12 months but not at 1 month

(Table 4). When trying to more closely correlate orthopedics and plastic surgery specialist visits by those patients who received orthopedic and/or plastic surgery consultation while inpatient, there was no significant association (Supplemental Digital Content, Supplementary Tables 1 and 2, <http://links.lww.com/TA/D990>).

In adjusting for demographic and injury characteristics using multivariable logistic regression, the RI group had higher odds of having a PCP assigned at 30 days (OR, 2.3; 95% CI, 1.3–3.8) and 12 months (OR, 2.7; 95% CI, 1.7–4.3). They were, similarly, more likely to present to the ED and be readmitted in the same follow up period (Table 5). Even after adjusting for

TABLE 3. Future Health Care Utilization of Traumatically Injured Patients

Characteristic	Total	MI	RI	Remained Uninsured	p
Patients, n (%)	2,348 (100)	1,706 (72.7)	494 (21.0)	148 (6.3)	
Patients with 30 d ED visit, n (%)					<0.001
0	1,836 (78.2)	1,296 (75.9)	407 (82.4)	133 (89.9)	
1	384 (16.4)	298 (17.5)	73 (14.8)	13 (8.8)	
≥2	128 (5.5)	112 (6.6)	14 (2.8)	2 (1.3)	
Patients with 12 mo ED visit, n (%)					<0.001
0	1,262 (53.8)	842 (49.4)	307 (62.2)	113 (76.4)	
1	505 (21.5)	396 (23.2)	88 (17.8)	21 (14.2)	
≥2	581 (24.7)	468 (27.4)	99 (20.0)	14 (9.5)	
30 d Hospital readmissions, n (%)					0.025
0	2,227 (94.9)	1,609 (94.3)	471 (95.3)	147 (99.3)	
1	110 (4.7)	87 (5.1)	22 (4.5)	1 (0.7)	
≥2	11 (0.5)	10 (0.6)	1 (0.2)	0 (0)	
12 mo Hospital readmissions, n (%)					<0.001
0	2,065 (87.9)	1,475 (86.5)	447 (90.5)	143 (96.6)	
1	200 (8.5)	160 (9.4)	36 (7.3)	4 (2.7)	
≥2	83 (3.5)	71 (4.8)	11 (2.2)	1 (0.7)	
PCP assigned prior to admission, n (%)	718 (30.6)	618 (36.2)	85 (17.2)	15 (10.1)	<0.001
PCP assigned at 30 d, n (%)	954 (40.6)	805 (47.2)	128 (25.9)	21 (14.2)	<0.001
PCP assigned at 12 mo, n (%)	1,127 (48.0)	927 (54.3)	174 (35.2)	26 (17.6)	<0.001
PCP visits at 30 d, n (%)					0.068
0	2,264 (96.4)	1,636 (95.9)	482 (97.6)	146 (98.7)	
1	69 (2.9)	57 (3.3)	11 (2.2)	1 (0.7)	
≥2	15 (0.5)	13 (0.8)	1 (0.2)	1 (0.7)	
PCP visits at 12 mo, n (%)					0.013
0	2,131 (90.8)	1,532 (89.8)	457 (92.5)	142 (95.9)	
1	72 (3.1)	57 (3.3)	13 (2.6)	2 (1.4)	
≥2	145 (6.2)	117 (6.9)	24 (4.9)	4 (2.7)	
Incomplete coverage at 12 mo, n (%)	356 (22.5)	278 (19.6)	78 (47.9)	N/A	<0.001

N/A, not applicable.

TABLE 4. Specialist Clinic Follow-up for Traumatically Injured Patients

Characteristic	Total	MI	RI	Remained Uninsured	<i>p</i>
Patients, n (%)	2,348 (100)	1,706 (72.7)	494 (21.0)	148 (6.3)	
Patients with trauma clinic visit at 30 d, n (%)					0.06
0	1,756 (74.8)	1,280 (75.0)	351 (71.1)	125 (84.5)	
1	453 (19.3)	326 (19.1)	105 (21.3)	22 (14.9)	
≥2	139 (5.9)	100 (5.9)	38 (7.7)	1 (0.7)	
Patients with trauma clinic visit at 12 mo, n (%)					0.004
0	1,702 (72.5)	1,236 (72.5)	342 (69.2)	124 (83.8)	
1	411 (17.5)	290 (17.0)	98 (19.8)	23 (15.5)	
≥2	235 (10.0)	180 (10.6)	54 (10.9)	1 (0.7)	
Patients with specialist visit at 30 d, n (%)					<0.001
0	876 (37.3)	630 (36.9)	171 (34.6)	75 (50.7)	
1	774 (33.0)	549 (32.2)	174 (35.2)	51 (34.5)	
≥2	698 (29.7)	527 (30.9)	149 (30.2)	22 (14.9)	
Patients with specialist visits at 12 mo, n (%)					<0.001
0	616 (26.2)	426 (25.0)	123 (24.9)	67 (45.3)	
1	414 (17.6)	278 (16.3)	34 (20.7)	34 (23.0)	
≥2	1,318 (56.1)	1,002 (58.7)	269 (54.5)	47 (31.8)	
Patient with ortho visits at 30 d, n (%)					0.25
0	1,627 (69.3)	1,166 (68.4)	352 (71.3)	109 (73.7)	
1	539 (23.0)	409 (24.0)	99 (20.0)	31 (21.0)	
≥2	182 (7.8)	131 (7.7)	43 (8.7)	8 (5.4)	
Patients with ortho visits at 12 mo, n (%)					0.007
0	1,482 (63.1)	1,047 (61.4)	330 (66.8)	105 (71.0)	
1	226 (9.6)	174 (10.2)	35 (7.1)	17 (11.5)	
≥2	640 (27.3)	485 (28.4)	129 (26.1)	26 (17.6)	
Patient with plastics visits at 30 d, n (%)					0.75
0	2,227 (94.9)	1,618 (94.8)	466 (94.3)	143 (96.6)	
1	86 (3.7)	60 (3.5)	22 (4.5)	4 (2.7)	
≥2	35	28 (1.6)	6 (1.2)	1 (0.7)	
Patients with plastics visits at 12 mo, n (%)					0.53
0	2,194 (93.4)	1,592 (93.3)	459 (92.9)	143 (96.6)	
1	59 (2.5)	46 (2.7)	11 (2.2)	2 (1.4)	
≥2	95 (4.1)	68 (4.0)	24 (4.9)	3 (2.0)	

age, race, injury mechanism and severity, intensive care unit utilization, and operative intervention, RI patients were more likely than uninsured patient to see specialists in outpatient clinic even up to 12 months postinjury (OR, 2.0; 95% CI, 1.4–3.0).

Functional Outcomes

Of the 2,348 trauma patients included in the study, 384 (16.4%) were discharged to a postacute care facility (inpatient rehabilitation or skilled nursing facility). Approximately one thirds of all patients (32.2%) were discharged with home health services, with 187 RI patients (37.9%) and 541 MI patients (31.7%) receiving home health care and only 28 (18.9%) or uninsured patients (*p* < 0.001). As has previously been described, patients with insurance, both MI and RI, were more likely to be discharged to a postacute care facility (19.2% and 10.5%, respectively) than those remaining uninsured (2.7%, *p* < 0.001).

Patient-Reported Outcomes

A total of 265 included patients (11.3%) participated in the PROs study and provided 6-month follow-up survey data. From our total cohort, 8.7% of injured patients had physical

TABLE 5. Multivariable Logistic Regression for Impact of Obtaining Emergency Medicaid on Health Care Access in 2,348 Traumatically Injured Patients

	OR (95% CI)	<i>p</i>
Specialist clinic visit at 30 d	1.65 (1.12–2.44)	0.007
Specialist clinic visit at 12 mo	2.04 (1.37–3.04)	<0.001
ED visit at 30 d	1.91 (1.06–3.43)	0.03
ED visit at 12 mo	1.88 (1.23–2.89)	0.004
Hospitalization at 30 d	7.62 (1.02–57.2)	0.05
Hospitalization at 12 mo	2.98 (1.15–7.69)	0.02
PCP assignment at 30 d	2.26 (1.35–3.80)	0.002
PCP visit at 30 d	1.66 (0.36–7.67)	0.52
PCP assignment at 12 mo	2.68 (1.66–4.31)	<0.001
PCP visit at 12 mo	1.74 (0.71–4.25)	0.22

This table contains the results of 10 different multivariable logistic regression models assessing the odds of the described outcome of interest for RI patients as compared with uninsured patients (reference). All models are adjusted for the following covariates: sex, age, race, English as primary language, mechanism of injury, ISS, ICU admission, and immediate operative intervention (operating room and/or interventional radiology).

ICU, intensive care unit.

function scores at least 1 SD worse than the general population, and similarly 8.3% reported anxiety scores at least 1 SD worse. A total of 236 patients (89.1%) reported pain interfering with daily activities at 6 months postinjury. Of the respondents, there was no statistically significant difference in any of the PROs between the three insurance status groups (Supplemental Digital Content, Supplementary Table 3, <http://links.lww.com/TA/D990>).

DISCUSSION

Insurance is a crucial aspect of access to care and a necessary means to reduce the financial toxicity of acute unscheduled care episodes. Trauma patients who enrolled in Medicaid had subsequent health care utilization that more closely resembled that of patients with preexisting Medicaid and differed significantly from patients who remained uninsured. In some respects, the health insurance linkage program appears to successfully address barriers experienced by previously uninsured individuals to accessing health care by improving access to care. This results in health care utilization that resembles that of the Medicaid population. However, improved access alone is not independently sufficient to overcome the social determinants of health encountered by victims of injury.

Given the unexpected, unplanned nature of traumatic injury, patients are at higher risk of experiencing significant financial burden after their traumatic injury. Previous studies have demonstrated that 70% to 80% of uninsured traumatically injured patients experience catastrophic health expenditures following hospitalization.^{8,12} Health insurance enrollment decreases the burden of catastrophic health care expenditure for all patients,^{13–15} including the traumatically injured.^{8,16} This financial burden or “financial toxicity” encompasses both the objective burden of spending, lost income, and debt as well as the subjective emotional and psychological toll.^{17,18} Medicaid expansion for traumatically injured patients decreases the burden of financial toxicity.^{8,12}

The most expansive study evaluating the downstream effects of health insurance enrollment is the Oregon Health Insurance Experience, a randomized control trial that compared the effects of enrolling individuals off a waitlist to receive state-sponsored Medicaid.¹⁹ Baicker et al.¹⁹ demonstrated that Medicaid enrollment was associated with increased use of health care, reduced financial strain, and reduced depression but did not demonstrate any statistically significant effects on health care outcomes they examined, including blood pressure, cholesterol, or hemoglobin A1C. Compared with matched controls, obtaining health insurance not only significantly lowered patient's medical debt but also effectively eliminated the risk of catastrophic health expenditures.

Health insurance enrollment is not sufficient to reverse preexisting health harms, adverse health-related behaviors, or the social and physical environment that surrounds patients who are uninsured. We found that health insurance can improve access to care and can decrease delays in appropriate care, by providing opportunities for individuals to interface with the health care system more reliably and potentially even earlier without the same degree of financial burden. However, health insurance in its current state is not sufficient to address the social determinants of health experienced by low-income uninsured and underinsured patients, especially the victims of traumatic injury.

Linking traumatically injured patients to insurance provides an opportunity to address barriers to care experienced by this vulnerable population but should be coupled with other social services, including care coordination to address the social determinants of injury contributing to overall decline in health. Some states have effectively leveraged Medicaid to reimburse such services, including hospital-based violence recovery programs and peer counselors.²⁰

Of the 642 initially uninsured patients in our trauma population, 148 (23.1%) remained uninsured despite their acute hospitalization. Patients who remained uninsured were more likely to be admitted for less than 48 hours and over the weekend, affording financial counselors and social workers less opportunities to provide information and assistance with insurance enrollment. During an acute care visit, insurance linkage programs allow for the maximization of future benefit for both the patient and the health system. Expanding the availability of financial counselors to screen patients “off hours” and provide follow-up screening services for the patients not initially evaluated has the potential to improve Medicaid enrollment. Previous work by Jaramillo et al.⁷ used manual chart review to identify barriers to enrollment in emergency Medicaid or HPE for uninsured traumatically injured patients in California. The top two reasons for not enrolling were lack of patient screening by a financial counselor and failure of the patient to meet the state-approved threshold for Medicaid coverage.⁷ Understanding these barriers is essential to ensure that all patients who qualify have equal opportunity for enrollment. State Medicaid programs could leverage the resources of their local assistance offices to supplement the work being done by hospital financial counselors and ensure streamlined transition through the application process. In addition, in our cohort, having a surgical procedure was associated with lower likelihood of remaining uninsured, which may reflect that hospitals are particularly incentivized to link these patients with some form of insurance to provide remuneration for their services.

Emergency Medicaid enrollment or HPE also provides financial benefit to hospitals. Nearly one quarter of trauma patients are uninsured, and hospitals recoup less than 20% of inpatient costs for the care of uninsured patients.^{4,21,22} Enrolling patients in emergency Medicaid generates revenue for the hospital for what would otherwise be uncompensated care. Enrollment in durable Medicaid not only improves future health care utilization for the individual but also protects the system from bearing the full financial responsibility of that care. This has the greatest potential to benefit safety-net hospitals, where many level I trauma centers are housed.²³

Limitations

To overcome the challenges of identifying an appropriate control group without randomization, our retrospective study created two groups for comparison to address potential confounders. Patients who remain uninsured after inpatient hospitalization for traumatic injury represent a population that could benefit from enrollment in emergency Medicaid. Their future health care utilization serves as the counterfactual for our population, representing what it could have been if they were not enrolled. However, the baseline admission characteristics between these two groups varied, with RI patients being more severely injured and more likely to remain in the hospital longer. Our second comparison group, patients with existing Medicaid, experiences a

wide range of socioeconomic challenges and, as a result, experiences worse health outcomes across a range of clinical conditions, including trauma.² This population more closely resembled our group of interest and allowed us to evaluate how easy it was for our newly insured group to access health care with their newly obtained insurance.

Our findings have several limitations. Hospital Presumptive Eligibility is a policy extended to all states as part of the ACA that provides temporary Medicaid coverage for patients who qualify. Medicaid eligibility varies by state with prior studies identifying considerable HPE coverage variability.²⁴ This limits the external generalizability of our findings, as other states and even health systems may have further qualifications in place for insurance linkage. Furthermore, this study limited future health care utilization to a single health system, with no ability to meaningfully account for health care use at other institutions across our busy urban environment. In urban metropolitan areas, patients have countless health care options, and it is not uncommon for patients to receive care across multiple health systems. Future efforts are ongoing to obtain regional health care data to capture health care utilization more adequately for enrolled individuals.

The final 2 years of our study period spanned the COVID-19 pandemic, leading to additional barriers in health care access across our study groups. This likely affected all populations, biasing our findings toward the null. We performed an additional subset analysis of health care utilization, comparing health care use for index hospitalizations before and after March 13, 2020. Rates of primary care and ED visits did not vary significantly between the coverage groups at 30 days or 12 months, except for an increase in PCP visits at 30 days for MI patients (Supplementary Appendix Table 4, <http://links.lww.com/TA/D990>). There was an increase in telehealth utilization during the COVID pandemic at both 30 days and 12 months for both the MI and RI patients but not uninsured (Supplementary Appendix Table 5, <http://links.lww.com/TA/D990>). A major challenge in considering the effect of COVID-19 results in the lack of clear distinction between “COVID phases,” as different waves manifested varying restrictions and changes in individual behavior, not always proportional to the disease impact. Our prolonged 12-month follow-up likely helps mitigate for these temporal pandemic trends.

We were also not able to assess the difference between planned and unplanned readmissions, with planned readmissions successfully facilitated by retroactive Medicaid enrollment. In addition, we were able to report rates of Medicaid sustainment but not adjust for utilization during the periods of time that the patient did not maintain insurance status, which would bias the differences between our RI and uninsured groups toward the null. Our inclusion of multiple comparisons also increases the probability of false-positive findings in our study. Finally, the low number of patients with PRO data reports serves as a significant limitation to our understanding of the downstream impact of insurance enrollment. Efforts to collect PRO data are ongoing and limited by patient and collection factors.

CONCLUSION

Trauma patients enrolled in emergency Medicaid were more likely to use health care beyond their index hospitalization than patients who remained uninsured, with higher rates of not

only ED visits and hospitalizations but also specialist outpatient clinics, up to 1 year out from their traumatic injury. Health care utilization resembled that of previously insured Medicaid patients. Hospital admission for traumatic injury provides an important opportunity to connect patients to resources such as insurance that can have lasting financial and physical benefits. However, insurance alone is not sufficient to address the many social and economic pressures that individuals experience.

AUTHORSHIP

D.N.H., E.E., A.T.C., O.I.R., A.U.M., D.J.L., L.M.K., and E.J.K. contributed in the literature search. D.N.H., E.E., J.S.H., A.T.C., O.I.R., A.U.M., M.K.D., M.J.S., P.M.R., L.M.K., and E.J.K. contributed in the study design. D.N.H., E.E., A.T.C., O.I.R., A.U.M., D.J.L., J.R., M.J.S., and E.J.K. contributed in the data collection. D.N.H., E.E., J.S.H., A.T.C., O.I.R., L.M.K., and E.J.K. contributed in the data analysis. D.N.H., E.E., A.T.C., D.J.L., M.K.D., M.J.S., N.D.M., P.M.R., L.M.K., and E.J.K. contributed in the data interpretation. D.N.H., E.E., J.S.H., J.R., and E.J.K. contributed in the writing of the article. D.N.H., E.E., J.S.H., A.T.C., O.I.R., A.U.M., D.J.L., M.K.D., J.R., M.J.S., N.D.M., P.M.R., L.M.K., and E.J.K. contributed in the critical revision.

DISCLOSURE

Conflicts of Interest: Author Disclosure forms have been supplied and are provided as Supplemental Digital Content (<http://links.lww.com/TA/D991>). I, Elinore J. Kaufman, attest on behalf of all authors that we had full access to the data of the study, conducted all data analyses independently from the funding entity, and take complete responsibility for the integrity and accuracy of the data reported in the manuscript.

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