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Effect of the COVID-19 pandemic on health insurance coverage among trauma patients: a study of six level I trauma centers

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ABSTRACT

Background Increased unemployment during the COVID-19 pandemic has likely led to widespread loss of employer-provided health insurance. This study examined trends in health insurance coverage among trauma patients during the COVID-19 pandemic, including differences in demographics and clinical characteristics by insurance type.

Methods This was a retrospective study on adult patients admitted to six level 1 trauma centers between January 1, 2018 and June 30, 2020. The primary exposure was hospital admission date: January 1, 2018 to December 31, 2018 (Period 1), January 1, 2019 to March 15, 2020 (Period 2), and March 16, 2020 to June 30, 2020 (Period 3). Covariates included demographic and clinical variables. χ^2 tests examined whether the rates of patients covered by each insurance type differed between the pandemic and earlier periods. Mann-Whiney U and χ^2 tests investigated whether patient demographics or clinical characteristics differed within each insurance type across the study periods.

Results A total of 31 225 trauma patients admitted between January 1, 2018 and June 30, 2019 were included. Forty-one per cent (n=12 651) were admitted in Period 1, 49% (n=15 258) were from Period 2, and 11% (n=3288) were from Period 3. Percentages of uninsured patients increased significantly across the three periods (Periods 1 to 3: 15%, 16%, 21%) (p_{trend}=0.02); however, there was no accompanying decrease in the percentages of commercial/privately insured patients (Periods 1 to 3: 40%, 39%, 39%) (p_{trend}=0.27). There was a significant decrease in the percentage of patients on Medicare during the pandemic period (Periods 1 to 3: 39%, 39%, 34%) (p<0.01).

Discussion This study found that job loss during the COVID-19 pandemic resulted in increases of uninsured trauma patients. However, there was not a corresponding decrease in commercial/privately insured patients, as may have been expected; rather, a decrease in Medicare patients was observed. These findings may be attributable to a growing workforce during the study period, in combination with a younger overall patient population during the pandemic.

Level of evidence Retrospective, level III study.

INTRODUCTION

COVID-19 was declared a global pandemic by the WHO on March 11, 2020.[1] The rapid spread of the virus has had widespread impacts on almost all aspects of daily life in the USA. In response to evidence of community transmission, on March 16, 2020, the White House announced a nationwide "social distancing" order,[2 3] and individual states issued stay-at-home orders according to their infection rates.[4] These measures have resulted in drastic increases in unemployment. In April 2020, 20.5 million Americans lost their jobs, and in this single month, the unemployment rate increased by 10.3% to a final rate of 14.7%, the largest single-month increase since the Bureau of Labor Statistics began tracking unemployment trends in 1948.[5–7] US Census Bureau reports published in January 2019 and September 2020 estimated that during 2018 and 2019, 55.2% and 55.4% of the US population, respectively, was covered by employer-provided health insurance,[8–10] making it likely that increases in unemployment have resulted in large numbers of Americans losing their health insurance.

Specific states have also reported similar trends to those seen in the USA overall, including the four states housing the six level 1 trauma centers included in this study.[11] Colorado (containing three of the six centers) unemployment rates remained steady between January 2018 and February 2020 (2.5% to 3.3%), after which they rose to 5.2% (March 2020), 12.2% (April 2020), 10.2% (May 2020), and 10.6% (June 2020). Missouri (containing one center) unemployment rates were steady between January 2018 and February 2020 (3.0% to 3.5%), after which they rose to 3.9% (March 2020), 10.2% (April 2020), 10.1% (May 2020), and 7.8% (June 2020). Kansas (containing one center) unemployment rates were steady between January 2018 and March 2020 (2.8% to 3.4%), after which they rose to 11.9% (April 2020), 10.0% (May 2020), and 7.5% (June 2020). Finally, Texas (containing one center) unemployment rates remained steady between January 2018 and February 2020 (3.5% to 4.0%), after which they rose to 5.1% (March 2020), 13.5% (April 2020), 13.0% (May 2020), and 8.4% (June 2020).

Using 3.5 years of prepandemic data from four of the level 1 trauma centers included in this study, we previously found that the most commonly used insurance types among a subgroup of trauma patients were Medicare (35%), commercial/private insurance (35%), and Medicaid (10%), and this group had an uninsured rate of 13%.[12] However, trauma admission volumes have declined during the pandemic, and the types of injuries have shifted, for example, the rates of motor vehicle collisions have

decreased because of stay-at-home orders.[13–16] Because insurance status among trauma patients is affected by patient characteristics, such as socioeconomic status, age, and race,[17–19] and shifts in the types of injuries may have altered the demographics of this patient population during the pandemic, it is likely that a corresponding shift in health insurance coverage has also occurred in the trauma patient population.

The aim of this study was to examine trends in health insurance used among trauma patients before and during the COVID-19 pandemic, including investigating whether the demographics and clinical characteristics of patients using each insurance type have shifted.

METHODS

This was a retrospective study on adult patients aged 18 or older admitted with traumatic injuries to six level 1 trauma centers between January 1, 2018 and June 30, 2020. All patients admitted to the trauma service during the study period were included, and study data were from the facilities' trauma registries.

The primary outcome was insurance type used during the hospital stay, categorized as uninsured (including the trauma registry values "none" and "self-pay"), Medicaid, Medicare, commercial/private, other government-provided insurance (including the value "other gov" and military/Tricare), and other (including the value "other," worker's compensation, and charity). Patients were considered to have used a particular type of insurance if it was their primary or secondary payment method (information on secondary insurance was available at four of the six sites); thus, a single patient may be included in the tallies for multiple insurance types (eg, one patient with both private insurance and Medicare is counted as having both of these insurance types). The primary exposure variable was hospital admission date, which was grouped into three periods: January 1, 2018 to December 31, 2018 (Period 1), January 1, 2019 to March 15, 2020 (Period 2), and March 16, 2020 to June 30, 2020 (pandemic period, Period 3). Other variables collected on patients were age, race, sex, Injury Severity Score (ISS), comorbidities, cause of injury, positive alcohol screen at admission, positive illicit/recreational drug screen at admission, discharge destination, total hospital length of stay (HLOS), and intensive care unit (ICU) LOS. Of note, because of the shorter duration of Period 3 compared with the other study periods, the maximum HLOS and ICU LOS during Period 3 was limited to the length of that period or 107 days. Additionally, because the only data source used in this study was the trauma registries, without supplementary or missing data filled in via chart review, many patients had missing data on one or more variable,

most notably race, cause of injury, and discharge destination; this means that row numbers may not add up to the totals at the top of the columns in tables 1–5 for some variables. Because of issues surrounding patient privacy, all patient ages above 89 (n=2002, 6%) were blinded prior to analyses and were not included in statistics that report on age. Comorbidities were evaluated using the Charlson Comorbidity Index (CCI), which assigns patients a score based on age and specific chronic comorbidities and aims to predict a patient's risk of mortality posthospitalization; this score is often used as a measure of the overall comorbidity burden in a patient.[20–22] Because of the way the CCI incorporates age into the total score, the blinded patient ages in the data did not affect calculation of this variable.

Statistical methods

The percentages of patients using each insurance type were calculated for each study period, and χ^2 tests were used to identify whether there were any differences between study periods. Cochran-Armitage trend tests were used to detect trends in insurance status rates across all three time periods. Mann-Whiney U and χ^2 tests were used to investigate whether patient demographics or clinical characteristics differed within each insurance type across the study periods, aiming to analyze whether the composition of the populations using each insurance type shifted during the pandemic. A significance level of $\alpha = 0.05$ and SAS 9.4 were used to conduct all statistical analyses. This study was approved by expedited review and granted waivers of HIPAA and consent by the Institutional Review Boards of each of the six participating trauma centers.

RESULTS

The study population included 31 225 trauma patients admitted between January 1, 2018 and June 30, 2019 (table 1). Forty-one per cent (n=12 651) were admitted in 2018 (Period 1), 49% (n=15 286) were from 2019 and prepandemic 2020 (Period 2), and 11% (n=3288) were admitted during the pandemic (Period 3). In the overall study population, commercial/private was the most commonly used insurance type (40%, n=12 385), followed by Medicare (38%, n=11 932), Medicaid (12%, n=3734), other government insurance (4%, n=1204), and other insurance types (2%, n=668). Of the total study population, 16% (n=4921) were uninsured.

The percentages of uninsured patients and those using Medicare differed significantly between the Period 3 and the earlier study periods. The percentage of uninsured patients increased significantly across the three study periods (Periods 1 to 3:

Table 1 Insurance utilization among trauma patients admitted in 2018, 2019 and the prepandemic 2020 period, and the pandemic period

	All	Period 1	Period 2	Period 3	P value	P$_{trend}$ value
	n=31 225	n=12 651 (41%)	n=15 286 (49%)	n=3288 (11%)		
Uninsured	4921 (16%)	1839 (15%)*†	2395 (16%)*‡	687 (21%)†‡	**<0.01**	**0.02**
Medicaid	3734 (12%)	1528 (12%)	1821 (12%)	385 (12%)	0.82	0.70
Medicare	11 932 (38%)	4926 (39%)*	5893 (39%)†	11 113 (34%)*†	**<0.01**	0.61
Commercial/private	12 385 (40%)	5071 (40%)	6024 (39%)	1290 (39%)	0.46	0.27
Other government	1204 (4%)	478 (4%)	602 (4%)	124 (4%)	0.74	0.47
Other	668 (2%)	290 (3%)	328 (2%)	50 (1%)	0.06	0.46

P values show the overall p value for the insurance type across the three time periods, and p values meeting the significance threshold of p<0.05 are emphasized in bold.
Symbols show which two-way comparisons were significant at p<0.05. Total numbers of patients in the rows may not add up to the column totals because patients are included more than once if they used multiple types of insurance.
Period 1 is January 1, 2018 to December 31, 2018, Period 2 is January 1, 2019 to March 15, 2020, and Period 3 is March 16, 2020 to June 30, 2020.

Table 2 Differences in demographics and clinical characteristics by time period among uninsured patients

	All	Period 1	Period 2	Period 3	
	n=4921	n=1839 (37%)	n=2395 (49%)	n=687 (14%)	P value
Demographics					
Age (median (IQR))	35 (27–48)	34 (27–47)	35 (27–48)	36 (27–48)	0.37
Race					0.55
White	2572 (56%)	977 (56%)	1230 (55%)	365 (58%)	
Black	1284 (28%)	485 (18%)	640 (29%)	159 (25%)	
Other	756 (16%)	286 (16%)	362 (16%)	108 (17%)	
Sex					0.61
Male	3705 (75%)	1371 (75%)	1810 (76%)	524 (76%)	
Female	1216 (25%)	468 (25%)	585 (24%)	163 (24%)	
Clinical variables					
ISS (median (IQR))	5 (2–13)	5 (2–12)	5 (2–13)	5 (2–14)	0.09
Charlson Comorbidity Index score (median (IQR)), range	0 (0–0), 0–7	0 (0–0), 0–5	0 (0–0), 0–7	0 (0–1), 0–6	0.47
Cause of injury					**<0.01**
Fall	1003 (20%)	366 (20%)	497 (21%)	140 (21%)	
Motor vehicle collision	1518 (31%)	599 (33%)*	747 (31%)†	172 (25%)*†	
Assault/GSW/stabbing/self-inflicted	1161 (24%)	419 (23%)*	557 (23%)†	185 (27%)*†	
Bike/sport/other vehicle*	486 (10%)	172 (9%)*	227 (10%)†	87 (13%)*†	
Other†	730 (15%)	276 (15%)	357 (15%)	97 (14%)	
Positive alcohol screen at admission	1235 (25%)	462 (25%)*	569 (24%)†	204 (30%)*†	**<0.01**
Positive drug screen at admission	1084 (22%)	364 (20%)*†	552 (23%)*	168 (25%)†	**0.01**
Discharge destination					0.16
Home/home health	3289 (68%)	1247 (71%)	1581 (67%)	461 (68%)	
Assisted living‡	166 (4%)	67 (4%)	79 (3%)	20 (3%)	
Death/hospice	225 (5%)	76 (4%)	119 (5%)	30 (4%)	
Other§	1127 (23%)	379 (21%)	580 (25%)	168 (25%)	
Total hospital length of stay, days (median (IQR), range)	2 (1–4), 0–322	2 (1–5), 0–322*†	2 (1–4), 0–194*	2 (1–4), 0–46†	**<0.01**
ICU length of stay, days (median (IQR), range)¶	2 (1–4), 1–68	2 (1–4), 1–68*	2 (1–5), 1–53†	2 (1–3), 1–31*†	**<0.01**

P values show the overall p value across the three time periods, and p values meeting the significance threshold of p<0.05 are emphasized in bold. Symbols show which two-way comparisons were significant at p<0.05.
Period 1 is January 1, 2018 to December 31, 2018, Period 2 is January 1, 2019 to March 15, 2020, and Period 3 is March 16, 2020 to June 30, 2020.
*Other vehicles include all-terrain vehicles, boats, snowmobiles, and motorized scooters.
†Other includes animal bite, burns, construction injuries, crush injuries, electrical injuries, exposure, lightning strike, machinery collisions, and those classified as "other" in the trauma registry.
‡Assisted living includes assisted living, skilled nursing facility, inpatient rehab facility, long-term acute care, and nursing home.
§Other discharge destinations include leaving against medical advice, court/law enforcement, and psychiatric unit.
¶Includes only patients with ICU length of stay ≥1 day.
GSW, gunshot wound; ICU, intensive care unit; ISS, Injury Severity Score.

15%, 16%, 21%) (p<0.01, p_{trend}=0.02), with each subsequent period having a significantly higher rate of uninsured patients than the previous one. The percentage of patients using Medicare was significantly lower during Period 3 (34%) than during both Period 1 (39%) and Period 2 (39%) (p<0.01). There was no evidence of a downward trend in Medicare across the three periods (p_{trend}=0.61); rather, this reduction was present only during the pandemic period. The percentage of patients on Medicaid was not significantly different during Period 3 than in earlier periods, remaining steady at 12% across all three time periods (p=0.82, p_{trend}=0.70). The rates of commercial/private insurance coverage were also steady across the study periods (Periods 1 to 3: 40%, 39%, 39%) (p=0.46, p_{trend}=0.24).

Of note, only significant differences between Period 3 and earlier study periods are mentioned in the text below; all values and comparisons are shown in tables 2–5.

Uninsured

Uninsured patients had a median age of 35 years, and a majority were white (56%) and men (75%) (table 2). The median ISS was 5 (major trauma is typically defined as ISS ≥15),[23] and the

median CCI score was 0. The most common cause of injury in uninsured patients was a motor vehicle collision (car or motorcycle) (31%), followed by assault or a self-inflicted wound (24%); 25% had a positive alcohol screen at admission, and 22% had a positive drug screen. The most common discharge destination among these patients was home (68%), after a median HLOS of 2 days and a median ICU LOS (if applicable) of 2 days.

Among uninsured patients, there were significant differences between the pandemic and earlier study periods in cause of injury, positive alcohol and drug screens, HLOS, and ICU LOS. Patients during Period 3 were significantly less likely to have a motor vehicle collision as their cause of injury (Periods 1 to 3: 33%, 31%, 25%) and significantly more likely to have an assault or self-inflicted wound (Periods 1 to 3: 23%, 23%, 27%) or a bike/sport/other vehicle collision (Periods 1 to 3: 9%, 10%, 13%) as their cause of injury (p<0.01). Thirty per cent of uninsured patients admitted during Period 3 had a positive alcohol screen at admission, which was a significant increase from both Period 1 (25%) and Period 2 (24%) (p<0.01). Similarly, 25% of uninsured patients had a positive drug screen during Period 3, which was significantly higher than the 20% in Period 1 and

Table 3 Differences in demographics and clinical characteristics by time period among patients with Medicaid

	All	Period 1	Period 2	Period 3	
	n=3734	n=1528 (41%)	n=1821 (49%)	n=385 (10%)	P value
Demographics					
Age (median (IQR))	42 (28–57)	41 (28–56)*	43 (29–58)*	44 (27–58)	**0.02**
Race					0.16
White	2468 (70%)	1025 (71%)	1202 (69%)	241 (67%)	
Black	554 (16%)	229 (16%)	265 (15%)	60 (17%)	
Other	528 (15%)	189 (13%)	279 (16%)	60 (17%)	
Sex					**0.05**
Male	2144 (57%)	912 (60%)*	1010 (55%)*	222 (58%)	
Female	1590 (43%)	616 (40%)*	811 (45%)*	163 (42%)	
Clinical variables					
ISS (median (IQR))	5 (4–10)	5 (2–10)	5 (4–10)	6 (4–10)	0.16
Charlson Comorbidity Index score (median (IQR), range)	0 (0–2), 0–10	0 (0–1), 0–8*†	0 (0–2), 0–10*	0 (0–2), 0–8†	**<0.01**
Cause of injury					**0.01**
Fall	1408 (38%)	538 (36%)*	719 (40%)*	151 (40%)	
Motor vehicle collision	913 (25%)	418 (28%)*	412 (23%)*	83 (22%)	
Assault/GSW/stabbing/self-inflicted	666 (18%)	265 (18%)	331 (18%)	70 (18%)	
Bike/sport/other vehicle*	392 (11%)	174 (12%)*	176 (10%)*	42 (11%)	
Other†	329 (9%)	118 (8%)*	176 (10%)*	35 (9%)	
Positive alcohol screen at admission	716 (19%)	304 (20%)	344 (19%)	68 (18%	0.56
Positive drug screen at admission	702 (19%)	282 (18%)	335 (18%)	85 (22%)	0.22
Discharge destination					**<0.01**
Home/home health	2481 (68%)	1052 (71%)*†	1190 (66%)*	239 (63%)†	
Assisted living‡	692 (19%)	265 (18%)	351 (19%)	76 (20%)	
Death/hospice	106 (3%)	39 (3%)	54 (3%)	13 (3%)	
Other§	388 (11%)	128 (9%)*†	206 (11%)*	54 (14%)†	
Total hospital length of stay, days (median (IQR), range)	3 (1–6), 0–174	3 (1–6), 0–174	3 (1–6), 0–105	3 (1–5), 0–82	0.73
ICU length of stay, days (median (IQR), range)¶	3 (2–5), 1–87	3 (2–6), 0–87	3 (2–5), 0–45	3 (2–6), 0–48	0.93

P values show the overall p value across the three time periods, and p values meeting the significance threshold of p<0.05 are emphasized in bold. Symbols show which two-way comparisons were significant at p<0.05.

Period 1 is January 1, 2018 to December 31, 2018, Period 2 is January 1, 2019 to March 15, 2020, and Period 3 is March 16, 2020 to June 30, 2020.

*Other vehicles include all-terrain vehicles, boats, snowmobiles, and motorized scooters.

†Other includes animal bite, burns, construction injuries, crush injuries, electrical injuries, exposure, lightning strike, machinery collisions, and those classified as "other" in the trauma registry.

‡Assisted living includes assisted living, skilled nursing facility, inpatient rehab facility, long-term acute care, and nursing home.

§Other discharge destinations include leaving against medical advice, court/law enforcement, and psychiatric unit.

¶Includes only patients with ICU length of stay ≥1 day.

GSW, gunshot wound; ICU, intensive care unit; ISS, Injury Severity Score.

the 23% in Period 2 (p=0.01). Total HLOS and ICU LOS were significantly shorter during Period 3 among uninsured patients (both p<0.01). However, the median HLOS and ICU LOS values were identical for the three periods (2 days), and the statistically significant difference is thus attributable to the longer maximum HLOS and ICU LOS during Periods 1 and 2. This difference is likely an artifact of the shorter length of Period 3 (3.5 months); a full examination of this point is included in the discussion section.

Medicaid

The median age of Medicaid patients was 42 years, and a majority were white (70%) and men (57%) (table 3). The median ISS was 5, and the median CCI score was 0. The most common cause of injury was a fall (38%), followed by a motor vehicle collision (18%). Nineteen per cent of Medicaid patients had a positive

alcohol screen, and 19% had a positive drug screen. Most patients were discharged home (68%) after a median HLOS of 3 days and a median ICU LOS of 3 days.

Among patients using Medicaid insurance, only two variables were significantly different between Period 3 and earlier study periods: CCI score and discharge destination. Charlson Comorbidity Index scores showed a distribution that skewed slightly higher in Period 3 (median score 0, IQR 0 to 2, range 0 to 8) than in Period 1 (median score 0, IQR 0 to 1, range 0 to 8) (p<0.01), but there was no significant difference between Period 3 and Period 2. A significantly smaller percentage of patients were discharged home (63%) and a significantly larger percentage were discharged to other destinations (14%) during Period 3 compared with Period 1 (71% and 9%, respectively) (p<0.01), but again, there were no significant differences in discharge destination when comparing Period 3 to Period 2.

Table 4 Differences in demographics and clinical characteristics by time period among patients with Medicare

	All	Period 1	Period 2	Period 3	
	n=11 932	n=4926 (41%)	n=5893 (49%)	n=11 113 (9%)	P value
Demographics					
Age (median (IQR))	76 (69–83)	77 (69–83)	76 (69–83)	76 (69–83)	0.37
Race					0.78
White	10 591 (90%)	4368 (90%)	5240 (91%)	983 (91%)	
Black	431 (4%)	175 (4%)	217 (4%)	39 (4%)	
Other	696 (6%)	304 (6%)	332 (6%)	60 (6%)	
Sex					0.82
Male	5100 (43%)	2122 (43%)	2505 (42%)	473 (43%)	
Female	6832 (57%)	2804 (57%)	3388 (58%)	640 (57%)	
Clinical variables					
ISS (median (IQR))	9 (5–10)	9 (5–10)	9 (5–10)	9 (5–10)	0.06
Charlson Comorbidity Index score (median (IQR), range)	4 (3–5), 0–10	4 (3–5), 0–9*	4 (3–5), 0–10*	4 (3–5), 0–10	**0.03**
Cause of injury					0.26
Fall	10 043 (85%)	4111 (84%)	4987 (85%)	945 (85%)	
Motor vehicle collision	842 (7%)	385 (8%)	393 (7%)	64 (6%)	
Assault/GSW/stabbing/self-inflicted	172 (2%)	76 (2%)	81 (1%)	15 (1%)	
Bike/sport/other vehicle*	412 (4%)	164 (3%)	207 (4%)	41 (4%)	
Other†	402 (3%)	163 (3%)	197 (3%)	42 (4%)	
Positive alcohol screen at admission	556 (5%)	254 (5%)	249 (4%)	53 (5%)	0.07
Positive drug screen at admission	374 (3%)	107 (2%)*†	207 (4%)*‡	60 (5%)†‡	**<0.01**
Discharge destination					**<0.01**
Home/home health	4344 (37%)	1725 (35%)*	2159 (37%)†	460 (41%)*†	
Assisted living‡	6366 (54%)	2708 (56%)*	3148 (54%)†	510 (46%)*†	
Death/hospice	860 (7%)	339 (7%)*	422 (7%)†	99 (9%)*†	
Other§	289 (2%)	109 (2%)*	139 (2%)†	41 (4%)*†	
Total hospital length of stay, days (median (IQR), range)	4 (3–6), 0–77	4 (3–6), 0–77	4 (3–6), 0–71	4 (2–6), 0–33	0.33
ICU length of stay, days (median (IQR), range)¶	3 (2–4), 1–52	3 (2–4), 1–52*†	3 (2–4), 1–43*	2 (2–4), 1–28†	**<0.01**

P values show the overall p value across the three time periods, and p values meeting the significance threshold of p<0.05 are emphasized in bold. Symbols show which two-way comparisons were significant at p<0.05.
Period 1 is January 1, 2018 to December 31, 2018, Period 2 is January 1, 2019 to March 15, 2020, and Period 3 is March 16, 2020 to June 30, 2020.
*Other vehicles include all-terrain vehicles, boats, snowmobiles, and motorized scooters.
†Other includes animal bite, burns, construction injuries, crush injuries, electrical injuries, exposure, lightning strike, machinery collisions, and those classified as "other" in the trauma registry.
‡Assisted living includes assisted living, skilled nursing facility, inpatient rehab facility, long-term acute care, and nursing home.
§Other discharge destinations include leaving against medical advice, court/law enforcement, and psychiatric unit.
¶Includes only patients with ICU length of stay ≥1 day.
GSW, gunshot wound; ICU, intensive care unit; ISS, Injury Severity Score.

Medicare

The median age of Medicare patients was 76 years, and a majority were white (90%) and women (57%) (table 4). The median ISS was 9, and the median CCI score was 4. Most Medicare patients had a fall (85%) as their cause of injury, 5% had a positive alcohol screen at admission, and 3% had a positive drug screen. The most common discharge destination was an assisted living facility (54%), after a median HLOS of 4 days and a median ICU LOS of 3 days.

Among Medicare patients, there were significant differences in between Period 3 and earlier study periods in positive drug screen, discharge destination, and ICU LOS. A significantly larger percentage of Medicare patients had a positive drug screen at admission during Period 3 (Periods 1 to 3: 2%, 4%, 5%) (p<0.01). The median ICU LOS was slightly shorter during Period 3 (Periods 1 to 3: 3 days, 3 days, 2 days), although the

statistical significance of this result is likely a result of the shorter length of Period 3, similar to among uninsured patients.

Commercial/private

The median age of patients with commercial/private insurance was 53 years, and a majority were white (85%) and men (58%) (table 5). The median ISS was 9, and the median CCI score was 1. Most patients had a fall (43%) or motor vehicle collision (33%) as their cause of injury, 13% had a positive alcohol screen at admission, and 8% had a positive drug screen. Most patients with commercial/private insurance were discharged home (63%) after a median HLOS of 3 days and a median ICU LOS of 3 days.

Among those patients using commercial/private insurance, there were significant differences between Period 3 and earlier study periods in age, ISS, CCI score, cause of injury, and positive

Table 5 Differences in demographics and clinical characteristics by time period among patients with commercial insurance

	All	Period 1	Period 2	Period 3	
	n=12 385	n=5071 (41%)	n=6024 (49%)	n=1290 (10%)	P value
Demographics					
Age (median (IQR))	53 (34–68)	52 (32–66)*†	54 (35–69)*	54 (35–69)†	<0.01
Race					0.16
White	10 118 (85%)	4173 (85%)	4884 (84%)	1061 (85%)	
Black	780 (7%)	297 (6%)	411 (7%)	72 (6%)	
Other	1052 (9%)	444 (9%)	495 (9%)	113 (9%)	
Sex					0.12
Male	7145 (58%)	2898 (57%)	3469 (58%)	778 (60%)	
Female	5239 (42%)	2173 (43%)	2554 (42%)	512 (40%)	
Clinical variables					
ISS (median (IQR))	9 (4–13)	9 (4–13)*	9 (4–13)†	9 (5–14)*†	<0.01
Charlson Comorbidity Index score (median (IQR)), range	1 (0–3), 0–10	1 (0–3), 0–9*†	1 (0–3), 0–10*	1 (0–3), 0–9†	<0.01
Cause of injury					<0.01
Fall	5265 (43%)	2008 (40%)*†	2667 (45%)*	590 (46%)†	
Motor vehicle collision	4090 (33%)	1848 (37%)*†	1852 (31%)*	390 (30%)†	
Assault/GSW/stabbing/self-inflicted	508 (4%)	200 (4%)	250 (4%)	58 (5%)	
Bike/sport/other vehicle*	1592 (13%)	653 (13%)	787 (13%)	152 (12%)	
Other†	869 (7%)	338 (7%)	437 (7%)	94 (7%)	
Positive alcohol screen at admission	1573 (13%)	661 (13%)*	711 (12%)†	201 (16%)*†	<0.01
Positive drug screen at admission	1019 (8%)	361 (7%)*†	511 (9%)*‡	147 (11%)†‡	<0.01
Discharge destination					0.16
Home/home health	7750 (63%)	3188 (64%)	3779 (63%)	783 (61%)	
Assisted living‡	3351 (27%)	1352 (27%)	1646 (28%)	353 (28%)	
Death/hospice	477 (4%)	185 (4%)	228 (4%)	64 (5%)	
Other§	633 (5%)	256 (5%)	297 (5%)	80 (6%)	
Total hospital length of stay, days (median (IQR), range)	3 (2–6), 0–206	3 (2–6), 0–103	3 (2–6), 0–206	3 (2–6), 0–45	0.97
ICU length of stay, days (median (IQR), range)¶	3 (2–5), 1–86	3 (2–5), 1–46	3 (2–5), 1–86	2 (1–4), 1–41	0.06

P values show the overall p value across the three time periods, and p values meeting the significance threshold of p<0.05 are emphasized in bold. Symbols show which two-way comparisons were significant at p<0.05.
Period 1 is January 1, 2018 to December 31, 2018, Period 2 is January 1, 2019 to March 15, 2020, and Period 3 is March 16, 2020 to June 30, 2020.
*Other vehicles include all-terrain vehicles, boats, snowmobiles, and motorized scooters.
†Other includes animal bite, burns, construction injuries, crush injuries, electrical injuries, exposure, lightning strike, machinery collisions, and those classified as "other" in the trauma registry.
‡Assisted living includes assisted living, skilled nursing facility, inpatient rehab facility, long-term acute care, and nursing home.
§Other discharge destinations include leaving against medical advice, court/law enforcement, and psychiatric unit.
¶Includes only patients with ICU length of stay ≥1 day.
GSW, gunshot wound; ICU, intensive care unit; ISS, Injury Severity Score.

alcohol and drug screens. Patients with commercial insurance were significantly older during Period 3 (median age: 54 years), but only when compared with Period 1 (median age: 52 years) (p<0.01). Patients admitted during Period 3 had an ISS distribution that skewed significantly higher (median ISS: 9, IQR 5 to 14) than in Period 2 (median ISS: 9, IQR 4 to 13) (p<0.01). Patients admitted during Period 3 were significantly more likely to have a fall (Period 1: 40%, Period 3: 46%) as their cause of injury and significantly less likely to have a motor vehicle collision (Period 1: 37%, Period 3: 30%) as their cause of injury (p<0.01). Sixteen per cent of patients admitted during Period 3 had a positive alcohol screen, which was significantly higher than the 12% seen in Period 2 (p<0.01), and 11% had a positive drug screen, which was significantly higher than the percentages seen in both Period 1 (7%) and Period 2 (9%) (p<0.01).

Online supplemental table 1 shows differences in demographics and clinical characteristics among patients using other government-provided insurance and other insurance types.

DISCUSSION

This study investigated differences in health insurance utilization among trauma patients during the 2020 COVID-19 pandemic as compared with the previous 2 years, as well as how demographics and clinical characteristics of patients using each type of insurance have shifted during the pandemic. The results showed a clear trend of increasing rates of uninsured patients, reaching a high during the pandemic period of mid-March through June 2020. However, the results showed two unexpected findings: the rates of individuals covered by private insurance did not decline during the pandemic, and a smaller percentage of patients used Medicare during the pandemic period than in the previous 2 years.

The finding showing no change in the rates of patients with private insurance during the pandemic seems counterintuitive, as a decrease in privately insured patients would be expected to accompany the observed increase in uninsured individuals. However, it is possible that this finding is the result of a growing workforce during the study period, with participation in the labor force increasing as a percentage of the total population between the beginning of 2018 and the onset of the pandemic in early 2020.[11] This trend of a growing workforce and increasing numbers of individuals acquiring employer-provided insurance over time may have somewhat dampened the effect of unemployment on the rates of privately insured patients.

The finding showing significantly lower rates of Medicare patients during the pandemic seems to contradict US Census

Bureau findings that the proportion of adults aged 65 and older (ie, the Medicare population) is steadily growing.[24] However, the decline in Medicare utilization during the pandemic period seen here reflects a changing makeup of the trauma patient population at the six participating level 1 trauma centers that does not reflect the data in the US population.[24] The percentage of study participants age 65 and over was significantly lower during the pandemic than in both 2018 and 2019/prepandemic 2020 (Periods 1 to 3: 42%, 43%, 41%) (p=0.01). Thus, this finding reflects the changing demographics of the patient population rather than a shift in insurance utilization.

The increasing percentage of uninsured patients found here is consistent with the large-scale job loss, and corresponding loss of employer-provided health insurance, reported during the pandemic period, both in the US overall and in the four states containing the trauma centers participating in this study.[9–11 25–27] In addition, our results showing an upward trend in uninsured patients across all three study periods agrees with recent reports by the US Census Bureau showing that between 2018 and 2019, the number of Americans that lacked coverage for any part of the year increased by ~1 million.[8–10] In the USA overall, the loss of coverage affected certain groups disproportionally: compared with whites, much higher rates of Black and Hispanic Americans lacked coverage in 2019.[27] The results of this study show fluctuations in the percentage of uninsured individuals by race (eg, among Blacks, uninsured rates were 18% in Period 1, 29% in Period 2, and 25% in Period 3), but there were no significant increases that reflected the results reported among the overall US population.

The results here also did not show higher percentages of patients on Medicaid during the pandemic, which might be expected as individuals transition off employer-provided insurance;[26] however, it is possible that because of the lengthy Medicaid approval process (requiring 45 to 90 days after application receipt),[28] individuals may experience a period of no insurance before obtaining Medicaid coverage. More recent studies that included data through the end of August 2020 showed that Medicaid caseloads have risen an average of 8% to 10% in 14 states, with the highest upticks occurring in July and August.[26] Therefore, more recent data from the later pandemic period may show upward trends in Medicaid utilization among the trauma population at the six sites included here.

Seemingly noteworthy findings were the significantly shorter hospital and ICU LOS during the pandemic period among uninsured patients. Recent studies have shown shorter HLOS and ICU LOS among hospitalized patients during the pandemic, perhaps reflecting competing priorities and bed shortages in hospitals treating high volumes of patients with COVID-19 disease, as well as a desire to reduce exposure of patients without COVID-19 disease to hospital transmission of the virus.[29–31] However, the results here should not be misinterpreted; the median HLOS and ICU LOS were identical prior to and during the pandemic among uninsured patients (2 days), with the significantly longer maximum HLOS and ICU LOS accounting for the statistically significant difference. It should be noted that patients are not entered into the trauma registries at the six participating sites until hospital discharge, and thus, all patients included from the pandemic period had a maximum possible HLOS of 107 days, or the total length of Period 3. Therefore, our findings here do not have the ability to make conclusions about hospital or ICU LOS that previous studies have found.

Strengths and limitations

One limitation of the study was the use of trauma registry data. Variables that were unavailable in the registry but may be of interest in future studies are prehospital residence, including homelessness, and socioeconomic status (eg, total household income, employment status), as these two variables are closely tied to health insurance coverage. In addition, the trauma registries contained missing data for some patients on select variables, specifically race, cause of injury, and discharge destination; future work may consider supplementing trauma registry data with electronic medical record review, where feasible. However, the use of trauma registry data did allow for a large population size, including all trauma patients admitted to six level 1 trauma centers across four states. Future studies may also benefit from updated data, as some of the effects of the pandemic, such as increases in Medicaid coverage, may be seen more clearly in the latter half of 2020.

CONCLUSION

The results of this study confirm that the COVID-19 pandemic, and its accompanying job losses, has resulted in a significant increase in uninsured trauma patients. Although findings in the overall US population in 2018 and 2019 showed that loss of health insurance affected certain groups disproportionally, the results here did not show this effect, as health insurance loss seemed to affect all demographics equally at the centers included in this study. The increase in uninsured patients was not accompanied by a reduction in privately insured patients, as may have been expected, but there was a significant reduction in Medicare patients. These latter findings may be attributable to a growing workforce during the study period and a younger patient population during the pandemic.

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