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Insurance status predicts survival for trauma patients undergoing urgent intervention

*Annie Falor, MD, Dennis Kim, MD, Scott Bricker, MD, Angela Neville, MD, Frederic Bongard, MD, Brant Putnam, MD, and David Plurad, MD**

Division of Trauma–Acute Care Surgery and Surgical Critical Care, Department of Surgery, Harbor-UCLA, Medical Center, Torrance, California

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ABSTRACT

Background: The purpose of this study was to investigate the relationship between insurance status and outcomes for trauma patients presenting without vital signs undergoing urgent intervention.

Materials and methods: The National Trauma Data Bank was queried for patients presenting with a systolic blood pressure equal to zero and a Glasgow Coma Scale score of three ("clinically dead"), who underwent urgent thoracotomy and–or laparotomy (UTL). Insured patients were compared with uninsured (INS [–]) patients.

Results: There were 18,171 patients presenting clinically dead having a payment source documented. INS (–) patients were more likely to undergo UTL (5.4% [416–7704] *versus* 2.7% [285–10,467], 1.481 [1.390–1.577], <0.001). Out of 689 patients who underwent UTL and meeting inclusion criteria, 416 (60.4%) were INS (–). Patients with insurance demonstrated a significantly greater survival (9.9% [27–273] *versus* 1.7% [7–416], 5.878 [2.596–13.307] $P < 0.001$). Adjusting for mechanism, race, age, injury severity, and comorbidities, insured status was independently associated with survival.

Conclusions: The presence of health insurance is independently associated with survival in trauma patients presenting with cardiovascular collapse who undergo urgent surgical intervention.

1. Introduction

The number of uninsured (INS [–]) Americans is increasing [1]. Lack of insurance is known to predispose to worse outcomes for a variety of conditions [2]. Studies have demonstrated an independent association between INS (–) status and mortality in trauma patients despite younger age and less severe injury [3]. It has been suggested that this might be secondary to resource allocation, wherein treatments are provided based on the patient's ability to pay. Similarly, poor preinjury health associated with INS (–) status is considered important. The purpose of this study was to examine outcomes in trauma patients presenting with cardiovascular collapse (clinically dead) that undergo urgent surgical intervention. Our hypothesis is that insurance status continues to be independently associated with outcome disparities despite similar, early, lifesaving interventions.

2. Materials and methods

The National Trauma Data Bank (NTDB) was queried for all patients presenting with a systolic blood pressure equal to zero and a Glasgow Coma Scale score of 3 (clinically dead) who

* *Corresponding author*. Division of Trauma–Acute Care Surgery and Surgical Critical Care, Harbor-UCLA Medical Center, 1000 W. Carson St. Box 42, Torrance, CA 90502. Tel.: +1 310 222 8228; +1 (310) 320-8968.
E-mail address: dsplurad@yahoo.com (D. Plurad).

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underwent either urgent laparotomy and/or thoracotomy (UTL) with a documented payment variable. The NTDB is managed by the American College of Surgeons (ACS) and contains >5 million total records thereby representing the largest repository of trauma inpatient data in the United States. Submission of data is a requirement for all ACS trauma centers and data points are verified on entry by the trauma center registrar.

UTL was defined as a thoracotomy and–or laparotomy performed within the first hour of arrival. Insured patients (INS [+]) were those with a known source of hospital compensation on admission. This group had a "payment" variable that included "commercial insurance" (auto, liability, or other commercial), "Blue cross–Blue shield," "government" (CHAMPUS, military), "Medicaid–Medicare," "managed care organization," and "other" (pending, charity, and worker's compensation). The INS (–) group included patients with no external source of hospital compensation on admission. This group had a "payment" variable classified as "no charge," "none" or "self-pay."

Data collected included age, gender, ethnicity, mechanism of injury, injury severity, and presence of comorbidities (coronary artery disease, congestive heart failure, history of cardiac surgery, chronic drug or alcohol abuse, hypertension, diabetes mellitus, or psychiatric disorder). Prehospital interventions studied included administration of intravenous fluid, cardiopulmonary resuscitation (CPR), and/or placement of a thoracostomy tube. Transfers to or from the reporting trauma center were excluded.

We initially analyzed all patients admitted clinically dead having a documented payment variable to determine if insurance status was associated with a disparity in the provision of UTL as a lifesaving procedure. Subsequently, we analyzed only those who underwent UTL to determine if insurance status was independently associated with survival after this procedure by adjusting for significant variables.

It is possible that a number of INS (–) patients applied for Medicaid during hospitalization and were discharged with insurance. Therefore, we are unable to determine the insurance status on admission in patients classified as Medicaid since the NTDB reports patient data on discharge. Inclusion of all Medicaid patients in analysis could lead to a survival bias in favor of the INS (+) because only patients who live to be evaluated for the coverage would eventually receive the benefit. However, it is very likely that a patient classified as a Medicaid recipient dying in <24 h of admission had the benefit on presentation because it would be very unlikely that coverage could be applied for and approved in these cases. Therefore, we excluded all other Medicaid recipients from analysis because it would be impossible to determine coverage status at the time of admission. Because not all of the population of interest had a payment source documented, we compared patients with and without a payment variable to determine if these groups were similar and, therefore, we could feel justified in extrapolating our findings to the entire study group.

Results are expressed as mean ± standard deviation, percentages, odds ratios (ORs) with 95% confidence intervals (CIs), *P* values, or raw data, where indicated. Analysis was performed using χ^2 or *t*-test where applicable, and a *P* value <0.05 was considered statistically significant. Multiple logistic regressions were used to analyze survival differences based on insurance status. Patient data were adjusted for age, sex, comorbidities, and several other factors known to affect outcomes after trauma [4]. Analysis was performed using SPSS for Windows version 20 (IBM, Chicago, IL).

3. Results

There were 24,488 patients presenting clinically dead after trauma. Of those, 18,171 (74.2%) had a payment source documented. Of these patients, the INS (+) group had an overall lower mean injury severity score (ISS; 23.5 ± 21.5 *versus* 25.8 ± 22.7, <0.001) and was less likely to undergo UTL (2.7% [285/10,467] *versus* 5.4% [416–7704], 0.463 [0.398–0.539], <0.001). To examine the association of insurance status with survival after urgent intervention, the 689 (3.8%) patients undergoing UTL and meeting inclusion criteria were further analyzed as our primary study group. To determine if our findings would be applicable to all patients undergoing UTL, we compared these patients with patients undergoing UTL who did not have a documented payment variable ($n = 338$) (Table 1). There was no significant difference in gender, mean age, incidence of multitrauma (ISS ≥ 16), mechanism of injury, rate of admission to a level 1 center, or mortality.

There were 58 of 701 INS (+) patients (8.3%) classified as Medicaid recipients, where 46 (79.3%) of them died within 1 d of admission. These patients were classified as INS (+), whereas the remaining 12 (20.7% or 1.7% of the initial study population of 701) were excluded from the study. Of the 689 study patients undergoing UTL and meeting inclusion criteria, 416 (60.4%) were INS (–). Most of the INS (–) patients (364 [87.5%]) were classified as "self-pay." The INS (–) group was more likely to be of non-Caucasian race with fewer comorbidities. Age was similar. Blunt mechanisms of injury (mainly motor vehicle collisions) were significantly higher in the INS (+) group. Despite this, mortality was not related to mechanism of injury (blunt 234/242 [96.7%] *versus* penetrating 421/447 [94.2%], $P = 0.146$, not shown in tables). The INS (+) patients undergoing UTL had a higher mean ISS (33.7 ± 20.6 *versus* 29.5 ± 20.8, 0.011). There was no significant difference between the INS (+) *versus* INS (–) groups for the rate of prehospital intervention to include CPR, infusion of intravenous fluids, and thoracostomy tube placement. INS (+) patients were more likely to be admitted to a level 1 trauma center and survive to the operating room (Table 2). After controlling for gender, race, age, injury severity, admission to a level 1 center, and mechanism of injury, INS (+) status independently predicted survival (OR 9.708 [95% CI 3.769–26.203], $P < 0.001$; Table 3).

4. Discussion

The association between health insurance status and outcomes is both relevant and timely [5]. The Patient Protection and Affordable Care Act is intended to expand quality coverage to a greater number of patients at low costs. Revisions to current federal and state programs, along with

Table 1 – NTDB trauma patients undergoing urgent intervention after cardiovascular collapse having a documented payment variable *versus* an unknown payment variable ($n = 1027$).

Variable	Payment source known ($n = 689$)	Payment source unknown ($n = 338$)	*P* value	OR/mean difference	95% CI
Gender (male)	581 (84.3%)	290 (85.8%)	0.3910.387	0.0.965	0.902 to 1.027
Mean age	33.3 (+16.4)	31.8 (+14.5)	0.164	1.458	−0.605 to 3.522
Blunt injury	242 (35.1%)	102 (30.2%)	0.087	1.175	0.971 to 1.424
ISS ≥ 16	557 (80.8%)	276 (81.7%)	0.623	0.983	0.915 to 1.054
Level 1 center	279 (40.5%)	155 (45.9%)	1.124	0.888	0.766 to 1.025
Survival	34 (4.9%)	17 (5.0%)	0.477	0.998	0.689 to 1.988

sweeping systems changes, will increase efficiency. As the full law is gradually introduced, continued review of the effects of coverage on health status is required [6].

The present study demonstrates that health insurance status independently predicts survival in trauma patients presenting clinically dead who undergo lifesaving attempts. Although health insurance has been shown to be predictive of survival in trauma patients overall [3,7,8], the present study establishes this in fatally injured patients requiring immediate lifesaving intervention likely occurring before payment status in known.

Previous studies have suggested that INS (–) trauma patients are allocated fewer resources than their INS (+) counterparts, thus contributing to a mortality disparity [8]. By studying the current cohort of patients, we presumably remove any possible treatment bias on the part of the clinician based on insurance status, as there is most likely insufficient time to determine payer status before urgent intervention. Furthermore, significant resource utilization is "front loaded" and is likely the main determinant of survival. This study also shows that the incidence of the three most common documented prehospital procedures (CPR, infusion of intravenous fluids, and thoracostomy tube placement) did not differ based on health insurance status. Furthermore, INS (–) patients were more likely to undergo UTL than INS (+) patients when presenting with cardiovascular collapse. Although this may be because of the higher ISS in the INS (+) patients who present clinically dead, the INS (–) patients who actually underwent UTL had a significantly lower mean ISS. This would suggest that INS (–) patients are treated more often, and more aggressively, and that the provision of lifesaving measures appears to be nondiscriminatory with regards to insurance status in this population.

If INS (–) patients appear to be treated equally when presenting in extremis, the disparity in survival must be explained through other variables. This study noted that the presence of comorbidities was independently predictive of survival, which appears counter-intuitive. Although this may indicate that INS (+) patients are "sicker" at baseline, it may also represent a higher incidence of "known," and more importantly, "treated" medical problems. Alternatively this phenomenon may simply represent bias toward identification of preexisting comorbidities or development of comorbidities whist admitted in severely injured patients who survive more often (i.e., "survivors get complications"). There has also been considerable literature regarding the health effects of

Table 2 – INS (+) *versus* INS (–) trauma patients undergoing urgent intervention after cardiovascular collapse ($n = 689$).

Variable (n (%)/mean ± SD)	INS (+) ($n = 273$)	INS (–) ($n = 416$)	*P* value	OR/mean diff.	95% CI
Demographics					
Male gender (581 [84.3%])	219 (80.2%)	362 (87.0%)	0.016	0.922	0.860 to 0.988
Mean age (31.8 [±20.8])	34.4 (±18.3)	32.5 (±15.0)	0.149	1.285	−0.667 to 4.380
Level 1 center admission (279 [40.5%])	130 (47.6%)	149 (35.8%)	0.002	1.329	1.112 to 1.590
Comorbidities (37 [5.4%])	21 (7.7%)	16 (3.8%)	0.028	2.000	1.063 to 3.764
Ethnicity					
African–American (308 [44.7%])	94 (34.4%)	214 (51.4%)	1		
Caucasian (227 [32.9%])	121 (44.3%)	106 (25.5%)	<0.001	1.699	1.398 to 2.065
Hispanic (105 [15.2%])	30 (11.0%)	75 (18.0%)	0.805	1.024	0.907 to 1.155
Other (49 [7.1%])	28 (10.3%)	21 (5.0%)	<0.001	2.568	1.524 to 4.328
Mechanism/severity					
Blunt (242 [35.1%])	124 (45.5%)	118 (28.4%)	<0.001	1.601	1.301 to 1.957
Mean ISS (31.2 [±20.8])	33.7 (±20.6)	29.5 (±20.8)	0.011	4.351	0.943 to 7.424
Prehospital procedures					
CPR (240 [34.8%])	96 (35.2%)	144 (34.6%)	0.882	1.016	0.825 to 1.251
IV fluid (144 [20.9%])	59 (21.6%)	86 (20.4%)	0.710	1.058	0.788 to 1.421
Thoracostomy (160 [23.2%])	64 (23.4%)	96 (23.1%)	0.800	1.016	0.770 to 1.340
Emergency department disposition					
Operating room (245 [35.6%])	114 (41.8%)	131 (31.5%)	0.006	1.326	1.086 to 1.619
Survivors (34 [4.9%])	27 (9.9%)	7 (1.7%)	<0.001	5.878	2.596 to 13.307

IV fluid = intravenous fluid; SD = standard deviation.

Table 3 – Independent predictors of survival in trauma patients undergoing urgent intervention after cardiovascular collapse.

Variable	OR	95% CI	P value
Health insurance status (+)	9.708	3.769–26.203	<0.001
Any comorbidity	11.491	3.769–35.038	<0.001
Survival to OR	5.683	2.275–14.197	<0.001
Prehospital CPR	0.156	0.049–0.494	0.002

Other variables entered: gender, race, age, injury severity, mechanism, and admission to a level 1 center.

socioeconomic status as represented by the presence of insurance [7,9–11]. Nutritional deficiencies, increased alcohol and drug use, and chronic social as well as environmental stress are but a few of the proposed socioeconomic factors that may predispose to poor outcomes among the INS (–) patients. Differences in access to care and physiological differences have also been implicated as reasons for the disparate outcomes among the INS (–) patients [3,7].

Our study shows a statistically significant racial disparity with the INS (–) patients more likely being non-Caucasian. Although a complete understanding of the socioeconomic variables associated with survival in this population is beyond the scope of this study, our findings suggest that these survival differences are more likely related to preexisting patient factors as opposed to rationing of life-saving interventions based on insurance status. Another potential confounding variable is the increased incidence of blunt injury in the INS (+) group leading to worse survival after traumatic arrest. Despite this supposition, the INS (+) group displayed a markedly enhanced survival. However, because all patients presented essentially dead, any discussion regarding which group of patients are "more ill" becomes irrelevant. This is supported by the finding that a blunt *versus* penetrating mechanism of injury was not associated with mortality as stated in the Results section. In addition, a blunt *versus* penetrating mechanism of injury was entered into logistic regression and was not found to be independently associated with mortality.

Many patients may apply for Medicaid during hospitalization; therefore, it was difficult to determine who had this coverage at admission. To address this, we made the assumption that those patients that ultimately died in <1 d and being listed as a Medicaid recipient likely had the benefit on admission knowing that they would most likely have not qualified and been given the coverage in that short period of time. We excluded all other Medicaid patients. Ultimately, Medicaid patients represented only 8.3% of the population and it became necessary to exclude only 1.7% of the patients presenting with insurance. Simply excluding all Medicaid patients does not change the findings of our study, as health insurance continues to independently predict survival (9.196 [95% CI 3.792–22.301], $P < 0.001$, not shown in tables).

The NTDB is a convenience sample of information submitted on a voluntary basis by trauma centers electing to pursue ACS verification, which may have introduced selection bias. Nonetheless, large multi-institutional databases, such as the NTDB, are useful to study populations that are too small to be studied using single center data despite the fact that the data points may be more detailed. Because desperate interventions are relatively rare for trauma patients presenting without vital signs, this population would be best studied using the NTDB. However, the NTDB is limited insofar as it provides limited user-level information on patients that do not survive to discharge or have an initial hospital stay.

Although not all patients of interest had insurance data documented, most of them did (74.2%). To address this limitation, we compared those with and without documentation of a payment variable and found these groups to be similar. Therefore, our findings are likely applicable to the population overall, despite missing data. In addition, there is no documentation that shows the actual time interval from admission to intervention, other than a thoracotomy and/or laparotomy occurred in the first hour of arrival. By selecting this definition of "urgent" intervention, we eliminate those patients who were likely so moribund that they were not offered intervention but were not so healthy that they survived a procedure >1 h after admission. Although the NTDB is not optimal for all study populations, our current hypothesis is well assessed by this dataset.

5. Conclusions

Despite similar initial treatment intensity for patients arriving clinically dead, INS (+) trauma patients continue to demonstrate a significant survival advantage. It is highly unlikely that this survival advantage is because of rationing of care based on ability to pay. The presence of health insurance is either the source of, or a marker for, enhanced overall preinjury wellness making it more likely that a trauma patient would ultimately survive with urgent intervention after lethal injury. Additional studies are needed to further explore the impact of socioeconomic, cultural, and system or provider related bias on outcomes after trauma.

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