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Uninsured status may be more predictive of outcomes among the severely injured than minority race

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ABSTRACT

Aim: Worse outcomes in trauma in the United States have been reported for both the uninsured and minority race. We sought to determine whether disparities would persist among severely injured patients treated at trauma centres where standard triage trauma protocols limit bias from health systems and providers.

Methods: We performed a retrospective analysis of the 2010–2012 National Sample Program from the National Trauma Databank, which is a nationally representative sample of trauma centre performance in the United States. The database was screened for adults ages 18–64 who had a known insurance status. Outcomes measured were in-hospital mortality and post-hospital care.

Results: There were 739,149 injured patients included in the analysis. Twenty-eight percent were uninsured, and 34 percent were of minority race. In the adjusted analysis, uninsured status (OR 1.60, 1.29–1.98, $p < 0.001$) and black race (OR 1.24, 1.04–1.49, $p = 0.019$) were significant predictors of mortality. Only uninsured status was a significant negative predictor of post-hospital care (OR 0.43, 0.36–0.51, $p < 0.001$). As injury severity increased, only insurance status was a significant predictor of both increased mortality (OR 1.68, 1.29–2.19, $p < 0.001$) and decreased post-hospital care (OR 0.45, 0.32–0.63, $p < 0.001$).

Conclusion: Uninsured status is independently associated with higher in-hospital mortality and decreased post-hospital care in patients with severe injuries in a nationally representative sample of trauma centres in the United States. Increased in-hospital mortality is likely due to endogenous patient factors while decreased post-hospital care is likely due to economic constraints. Minority race is less of a factor influencing disparate outcomes among the severely injured.

Background

Disparities in outcomes for patients without insurance have been well described for many medical conditions [1–6]. The reasons for disparities are multifactorial and are likely due to challenges in access to care, decreased baseline health, and possibly differences in healthcare treatments administered [7–10].

Several studies have shown that the uninsured have increased mortality after trauma [11,12]. Increased mortality is observed in the uninsured suffering both blunt and penetrating injury, and for uninsured pediatric trauma patients [13,14]. Access to trauma centre care has been shown to contribute to increased mortality for the uninsured [15]. Additionally, the uninsured have decreased access to post-hospital care, such as skilled nursing facilities and inpatient rehabilitation, but whether or not this increases mortality or morbidity is to be determined [16].

Minority race is also associated with increased mortality after trauma [13]. Moreover, both minority race and insurance status have been recently shown to lead to increased mortality among the severely injured [17]. Similarly, racial minorities have decreased access to post-hospital care resources [16,18]. The role of minority race and uninsured status with worse outcomes after trauma remains incompletely described.

Since trauma systems are geared to minimise mortality and long-term disability in *all* severely injured patients, once a patient reaches a trauma centre, disparities should not exist. This should be particularly true for those with the most severe of injuries. The aim of this study was to use a large, representative database of level 1 and 2 trauma centre admissions in the United States to explore the relationship between disparities and injury severity among the uninsured and minority races. We hypothesised that

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disparities based on insurance status and race would be minimal for those patients who are severely injured and who are treated at level 1 and 2 trauma centres as care would be directed by standard triage protocols, thus limiting bias from hospital systems and providers.

Methods

Data source and patient population

The National Sample Program (NSP) of the National Trauma Data Bank (NTDB) was used for this study. The NSP is a nationally representative sample of one hundred level 1 and level 2 trauma centres in the United States. Selected trauma centres are weighted and stratified to adjust for patient volume and geographic differences in trauma centre density. The NSP is derived from the NTDB, which is the largest aggregate US trauma registry ever assembled, and both datasets are maintained by the American College of Surgeons and are compiled annually.

We combined the datasets for the years 2010, 2011, and 2012, to increase the sample size. Patients were included in the study if they were age 18–64 and brought to emergency room after suffering a traumatic injury. Observations were excluded if insurance status or disposition from the emergency room was not known. Patients over the age of 64 were excluded as 68 percent of patients over this age receive Medicare and only 1 percent are uninsured in the dataset used. Eleven percent of patients were excluded because of missing insurance status. We excluded mortality when calculating the outcome of post-hospital care to avoid falsely decreasing rates of post-hospital care in groups that have higher mortality. Further, in the dataset virtually every observation with the post-hospital care outcome was admitted to the hospital, so observations that were not admitted were excluded when considering this outcome to avoid falsely decreasing rates of post-hospital care. These exclusions decreased the weighted sample size by 14 percent when calculating odds ratios for the outcome post-hospital care as compared to mortality.

Injuries were categorised into three groups using injury severity scores (ISS). Injury severity score is calculated from three highest abbreviated injury scale (AIS) scores from different body regions. The three AIS scores are squared and the sum of the squares is the ISS. The maximum survivable ISS is 75.

Outcomes and variables

The primary outcomes were in-hospital mortality and post-hospital care. Post-hospitalisation care included home health services, skilled nursing facilities (SNFs), rehabilitation, and intermediate care facilities.

Demographic variables included in the analysis include age, sex, race, number of comorbidities, and insurance status. Age was stratified based on previous reports indicating increased mortality in trauma after the age of 45 [19]. Race included white, black, and "other," which included unspecified other races including non-white and non-black Hispanic, Asian, American Indian, Native Hawaiian, and Pacific Islander. We decided to not use the Charlson index to quantify comorbidities because the data was not coded in a suitable manner. Also, 75 percent of the sample had no recorded comorbidities or a single comorbidity, so we used a much simpler categorical designation. Centre characteristics included level 1 trauma centre designation, either by the American College of Surgeons or state governments, and hospital size by total number of beds. Injury characteristics included blunt versus penetrating mechanism, injury severity by the injury severity score (ISS), Glasgow coma scale (GCS), and first heart rate and blood pressure recorded in the emergency department. Hospital characteristics included total hospital length of stay, intensive care unit (ICU) length of stay, days on the ventilator, and ventilator-free days.

Comorbidities included alcoholism, ascites within 30 days of injury, esophageal varices, cirrhosis, bleeding disorder, chemotherapy within 30 days of injury, metastatic cancer, congenital anomalies, prematurity, congestive heart failure, smoking, renal failure, diabetes mellitus, "do not resuscitate" status, advanced directive limiting care, dementia, illicit drug use, hypertension, peripheral vascular disease, angina, history of myocardial infarction, history of stroke, impaired sensorium, psychiatric illness, obesity, cardiac arrest prior to arrival, respiratory disease, and steroid use.

Procedure codes were grouped into several categories. "Critical care" included intubation and mechanical ventilation, arterial and central venous lines, urinary catheter placement, chest tube, peritoneal lavage, pericardiocentesis, transfusion of blood products, and cardiopulmonary resuscitation. "Diagnostic imaging" included any imaging procedure. "Trauma surgery" included exploratory laparotomy, exploratory thoracotomy, cardiac massage, pericardiotomy, limb amputation, splenectomy, and operations involving the alimentary tract, liver, and pancreas. "Vascular surgery" included incision or excision of vessels, anastomosis or replacement of vessels, repair of vessel, surgical occlusion of vessels, and endovascular repair of vessels. "Orthopedic surgery" included open or closed reduction of dislocations or fractures, arthrocentesis, and application of ex-fixator. "Neurosurgery" included placement of intracerebral catheter, intracranial pressure monitoring, craniotomy, elevation of skull fracture, and spine fusion.

Statistical analysis

Patient characteristics were compared using the Pearson χ^2 test for categorical variables. A multivariable logistic regression was adjusted for age, sex, total number of comorbidities, race, injury severity score (only for "All ISS"), Glasgow coma scale, systolic blood pressure less than 90, normal heart rate, penetrating mechanism, requiring mechanical ventilation, and insurance status. Therefore, the adjusted analysis included the standard covariates previously advocated as necessary for reliable interpretation of the NTDB with the addition of insurance status and race [20,21].

Analysis was performed with STATA version 12 (StataCorp LP, College Station, TX). Multiple strata containing a single primary sampling unit were combined into a single, larger stratum as previously described [22]. Significance was determined to be a p value less than 0.05. All reported numbers represent weighted values. Per the Stanford Institutional Review Board (IRB), this study does not qualify as requiring IRB approval as it involves only de-identified data.

Results

A total of 739,149 weighted observations were included. Severe injuries (ISS 16–24) comprised 12.2 percent of the studied population, and extremely severe injuries (ISS over 24) comprised 8.3 percent. Roughly one quarter of the total sample was uninsured, and this proportion remained constant at all levels of injury severity. Thirty-four percent was of minority race. The uninsured were younger, more frequently male, had similar numbers of comorbidities to the insured, and more commonly black or other minority race (Table 1).

Centre-specific effects are likely to be mitigated by the survey design of the NSP (see Methods section). Both the frequency of level 1 trauma centre designation and the hospital volume by bed