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The Epidemiology of Inpatient Pediatric Trauma in United States Hospitals 2000 to 2011

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Abstract

Background—This study provides important updates to the epidemiology of pediatric trauma in the United States.

Methods—Age-specific epidemiologic analysis of the Healthcare Cost and Utilization Project's Nationwide Inpatient Sample, representing 2.4 million pediatric traumatic injury discharges in the US from 2000 to 2011. We present yearly data with overlying loess smoothing lines, proportions of common injuries and surgical procedures, and survey-adjusted logistic regression analysis.

Results—From 2000 to 2011 there was a 21.7% decline in US pediatric trauma injury inpatient discharges from 273.2 to 213.7 admissions per 100,000. Inpatient case-fatality decreased 5.5% from 1.26% (95% CI 1.05–1.47) to 1.19% (95% CI 1.01–1.38). Severe injuries accounted for 26.5% (se=0.11) of all discharges in 2000 increasing to 31.3% (se=0.13) in 2011. The most common injury mechanism across all age groups was motor vehicle crashes (MVCs), followed by assaults (15–19 years), sports (10–14), falls (5–9) and burns (<5). The total injury-related, inflation-adjusted cost was \$21.7 billion, increasing 56% during the study period.

Conclusions—The overall rate of inpatient pediatric injury discharges across the United States has been declining. While injury severity is increasing in hospitalized patients, case-fatality rates are decreasing. MVCs remains a common source of all pediatric trauma.

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Keywords

Trauma; Injury; Epidemiology; Pediatric; Public Health

1. Introduction

In the United States (US) trauma is the leading cause of death in children over age one [1]. Each year, one in four American children suffers an injury requiring urgent clinical care, leading to over 8.7 million hospital visits with an estimated annual treatment cost of \$350 billion [1,2]. Recent estimates rank US death rates from pediatric trauma double those of the United Kingdom, Sweden, Italy, and several other developed nations [3], with unintentional trauma accounting for over 90% of pediatric trauma-related deaths [4].

Epidemiological analyses can help inform clinicians, researchers, and policy-makers about interventions, treatments, and control measures. Informed by clinical and population health studies, Sweden and Germany have reduced pediatric injury deaths by over 50% through the implementation of cost-effective prevention strategies such as expanded pre-school services and mandatory swim training [5]. While the US has certainly implemented its own prevention strategies [6], there is still more that can be done to reduce pediatric trauma.

A number of recent US epidemiologic studies have harnessed the power of large national registries [7,8,9] to explore the incidence and impact of traumatic injuries in pediatric populations [10,11,12]. Such efforts are typically restricted to specific injury types [13,14,15] or causes of pediatric trauma [16,17,18]. Studies that do investigate pediatric trauma more broadly largely obtain data from single institutions [19], single states [20], or by aggregating the data of other studies [21]. Additionally, the few that have indeed analyzed national trauma registries have included far fewer study years [22,23]. While these are informative, they do not comprehensively capture the broad and fluid nature of inpatient pediatric traumatic injury across the US. The most recent large-scale longitudinal overview of pediatric trauma was conducted at the state level and examined data from 1989 to 1999 [24].

In this study, we attempt to update the descriptive epidemiology of pediatric inpatient trauma care in the US. We construct a comprehensive population-based multi-year analysis of childhood trauma care across the US by analyzing data from the Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS), a nationally-representative database for all pediatric traumatic injury hospital discharges between 2000 and 2011. In particular, we track recent trends in mechanisms of injury, severity of injury, cost of care, and the role of teaching hospitals and trauma centers in the treatment of those injuries. Using this extensive database, we aim to renew, and in some cases challenge, the existing understanding of the scope of inpatient pediatric injuries and the best methods to improve outcomes.

2. Methods

2.1 Data Sources and Designs

Data were obtained from the US Agency for Healthcare Research and Quality (AHRQ) HCUP NIS for years 2000–2011. The NIS is a 20% weighted sample of the HCUP State Inpatient Database, itself a census of all hospital discharges in a state. It is representative of all US community hospitals (non-federal, general, and specialty hospitals, including public hospitals and academic medical centers). A complete census of discharges for each sampled hospital is included in the database. To obtain accurate estimates, analyses must account for complex survey methods by applying weights and adjusting for clustering.

Survey-adjusted point estimates and standard errors for individual years were verified against estimates obtained from a publicly available HCUP online query system [25]. Inclusion criteria were patients 0 to 19 years old discharged with primary diagnoses of traumatic injury. Although the American College of Surgeons Committee on Trauma uses an age cut-off of 15 to define “pediatric” [26], we chose an age cut-off of twenty to allow for comparisons with the older teenage sub-group. Traumatic injury discharges were identified using principle or first-listed ICD 9th edition [27] diagnosis codes for acute injury 800–904.9, 909.4, 909.9, 910–994.9, 995.5–995.59, and 995.80–995.85. As noted in the HCUP documentation, the ICD-9-CM coding guidelines define principal diagnosis as “that condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care” [28]. Discharge codes for “late effect” primary diagnoses (ICD 905.0–909.9), insect bites (910.4, 910.5, 911.4, 911.5, 912.4, 912.5, 913.4, 913.5, 914.4, 914.5, 915.4, 915.5, 916.4, 916.5, 917.4, 917.5, 919.4, 919.5), poisonings (960.0–964.9, 965.00–965.02, 965.09, 965.1, 965.4, 965.5, 965.61, 965.69, 965.7–969.0, 969.00–969.09, 969.70–969.73, 969.1–969.7, 967.0–967.9, 969.79, 969.8–980.9, 970.81, 970.89, 981, 982.0–985.9, 986, 987.0–989.7, 989.81–989.89, 989.9, 990, 991.0–995.2, 995.20–995.29, 995.3, 995.4), anaphylaxis (995.60–995.69, 995.7), and additional miscellaneous diagnoses (e.g. malignant hyperthermia, systemic inflammatory response syndrome, malfunctioning cardiac devices, 995.86–996.00) were removed.

Injury severity was quantified using the ICD-derived Injury Severity Score (ICISS) [29] and categorized as severe vs. non-severe. ICISS scores are defined as the probability of patients surviving their injuries (from 0 to 1) and are calculated in two steps. First, survival risk ratios (SRRs) for each injury diagnosis in a data set are “...calculated as the ratio of the number of times a given ICD-9 code occurs (in surviving patients) to the total number of occurrences of that code.” Second, the ICISS for an individual patient is calculated as “the product of all the survival risk ratios for each of an individual patient’s injuries” [30]. An ICISS cut-off of less than 0.94 was used to categorize patients with the most severe injuries [31]. This identifies patients with a 6% or greater probability of dying, and has performed well in previous analyses, returning an odds ratio of 6.75 (95% CI 6.48, 7.03) in a multivariate logistic regression analysis of trauma mortality [32]. Other prevalent scoring tools such as the IPPS [33], ISS [34], and TRISS [35] were not applicable given dataset constraints.

To control for non-traumatic injury diagnoses, a Charlson comorbidity index (CCI) score [36] was calculated. Because of the very high proportion of patients without CCI conditions,

the score variable was heavily skewed and so was categorized into an indicator variable for patients with a CCI greater than 2. Primary ICD-9 codes were categorized according to the Barell matrix, an injury diagnosis matrix tool used to standardize the classification of ICD-9 injury codes according to 12 nature-of-injury columns and 36 body-location rows [37,38]. We used the HCUP Clinical Classification Software system to categorize procedure codes.

Because NIS does not contain an explicit variable for trauma center designation, data on 2,040 US trauma centers were obtained from the American Trauma Society (ATS) website [39,40]. Data were then matched by name and address to 3,706 HCUP-sampled US hospitals in the study data set, yielding 1,038 hospitals present in both ATS and NIS. The hospitals were assigned trauma center level designations 1 to 5 as reported by the ATS, but were not classified by pediatric trauma center designation. Hospitals that did not match were assumed to be non-trauma centers. Notably, 1,573,134 (se=73,824) or approximately 65.7% of hospital discharges were missing sufficient information to code trauma center status.

Teaching hospitals were identified by an NIS variable. Costs were based on hospital-submitted charges for each discharge. These charges were converted to costs with the AHRQ HCUP cost-to-charge ratio files using the group weighted average cost-to-charge ratio variable. Costs were then adjusted for inflation and standardized to 2010 US dollars based on the all-item average yearly consumer price index obtained from the Bureau of Labor Statistics [41].

2.2 Analyses

Statistical analysis consisted of survey-adjusted counts, proportions, means, standard errors, and 95% confidence intervals. Annual rates were calculated using US census data obtained from the AHRQ as part of the HCUP family of data products. We analyzed yearly data with overlying loess smoothing lines (locally-weighted polynomial regression) and assessed strength and statistical significance of the beta coefficient for bivariate linear association between year and annual incidence rates. We conducted a survey-adjusted logistic regression analysis for the effect of year on the odds of in-hospital death with control variables for age, gender, weekday vs. weekend admission, injury severity, trauma-center status, teaching-hospital status, and Charlson index score. This was done to track changes in trauma outcomes over time not explained by changes in hospital admissions patterns. We used the R “survey” package [42] to adjust for the complex sampling design of NIS and conduct analyses, and we tested for the assumption of linearity of the year variable and controlled for year-to-year variability in the survey results using an approach recommended by the Centers for Disease Control and Prevention [43,44]. Trends in certain variables over time—including injury incidence and mortality—were assessed by aggregating and comparing data from the first half of the study period (2000–2005) to the second half (2006–2011). This method was preferable to regression analysis as there were relatively few data points, making the results less susceptible to annual variance than they would have been had we, for example, compared data from the first and last years of the study. A complete set of notes and code to reproduce or adapt our methods are available upon request.

3. Results

Between 2000 and 2011 there were 2,395,402 (se=104,728) inpatient traumatic injury admissions in the US for children and teenagers aged 0 to 19. The proportion of female admissions was 31.7% (sd=0.2%). There was a 21.7% decline in the mean annual rate of inpatient traumatic injury admissions from the first 6 years of the study compared to the second 6 years, from 273.2 admissions per 100,000 population to 213.7. There was no significant interaction between US region and year. The mean age of a child discharged for a traumatic injury remained constant at 11.2 years (se=0.12) throughout the study period. In total, there were 29,662 (se=1998) inpatient deaths due to traumatic injury for an overall inpatient case-fatality rate of 1.24% (se=0.04). There was a 5.5% decrease in case-fatality rate between the first half of the study period and the second half.

The proportion of discharges classified as severe for all pediatric age groups was 29.5% (se=0.57). This increased annually during the study period, from 26.5% (se=0.11) in 2000 to 31.3% (se=0.13) in 2011. The 15-to-19-year-old age group accounted for a large proportion of severe injuries (39.1%, se=0.66; Figure 1). By contrast, the proportion of severe injuries in children younger than five years old was 25.2% (se=0.54), for ages 5 to 9 was 18.9% (se=0.61), and for ages 10 to 14 was 22.9% (se=0.66).

1,653,997 (se=100912) trauma discharges were from teaching hospitals, accounting for 69.4% (se=1.5%). Of those, 32.2% (se=0.74) were categorized as severe; at non-teaching hospitals, the proportion of “severe” injuries was only 22.9% (se=0.61). 1.5% (se=0.06) of pediatric traumatic injury discharges from teaching hospitals resulted in death, compared to 0.6% (se=0.05) from non-teaching hospitals.

590,680 (se=79,228) discharges were coded as either Level 1 or 2 trauma centers. Discharges from these centers were approximately 40% more likely (OR=1.36, 95% CI 1.2–1.5) to be categorized as severe and approximately 50% more likely to result in fatality (OR=1.48, 95% CI 1.28–1.71).

Extremity fractures were the single most common injury type among all pediatric injury discharges with sufficient data to characterize them according to the Barell matrix (818,996/2,003,273 = 40.9%). The most common Barell classifications for severe injuries were coded as “internal organs” of the “head and neck,” which is a classification consistent with traumatic brain injury (TBI).

There were 323,696 (se=17,164) hospital discharges for diagnoses explicitly classified as TBI using Barell matrix categories. In children under five, TBI accounted for a larger proportion of hospital discharges than for other age groups, while this percentage also increased over the study period (Figure 2).

Primary injury E-code information was available for 1,580,662 pediatric traumatic injury discharges across US hospitals between 2003 to 2011. The most common injury mechanism for both severe and non-severe traumatic injuries for all age groups was motor vehicle crashes (MVCs; Table 1 and Figure 3).

Among severe injuries, transportation-related causes predominated, with unarmed assault accounting for 14,838 (3.0%) and assault with a firearm for 13,717 (2.8%) (Table 1). After MVCs, other frequent severe injury mechanisms varied by age group. Burns and abuse were the second and third most common causes of severe traumatic injury in children under the age of 5. Falls and injuries due to animals were second and third for children ages 5 to 9. Sport-related injuries were the second for children ages 10 to 14, and assaults, including penetrating injuries, were the second most common cause of severe traumatic injury for 15 to 19 year olds. (Figure 3).

A total of 516,378 procedures were listed for discharged pediatric trauma patients during the study period. The most common procedures for the most severely injured children involved the treatment of hip and femur fractures. Neurosurgical procedures were also common (Table 2).

The average length of stay for an injured child was 3.6 days (95% CI 3.5–3.7). For severely injured children, the average length of stay increased to 6.7 days (95% CI 6.5–6.9).

In a survey logistic model for the association of study variables with inpatient mortality, injury severity was overwhelmingly predictive of inpatient mortality (Table 3). Male gender as well as higher comorbidity scores were both associated with increased mortality. The model also indicated that, after adjusting for age, gender, injury severity, and comorbidity, the previously described bivariate association of inpatient deaths with Level 1 or 2 trauma centers was attenuated. There was evidence of a modest decrease in year-to-year inpatient mortality during the study period.

The total US inpatient pediatric traumatic injury-related hospital costs for this time period was \$21.69 billion (95% CI 20.4, 23.0). These annual costs increased 55.9% from the first half of the study period to the second (Figure 4).

4. Discussion

4.1 General Discussion

Large administrative database studies have the potential to both reinforce and refine our understanding of trauma incidence and trends. Our results indicate that the epidemiology of pediatric trauma has evolved over the decade of this study. From 2000 to 2011, national pediatric trauma admission rates decreased. This trend parallels a decrease in MVCs [45]—the most common cause of both severe and non-severe pediatric traumatic injury—suggesting a potential correlation between MVC and pediatric trauma rates. In addition to improved car design, increased use of child safety seats, and reductions in drunk driving [46,47], seat belt usage also increased from 71% to 84% between 2000 and 2011 [48]. Continued emphasis and improvements in vehicle and road safety may further decrease the rate of childhood traumatic injury.

While pediatric trauma inpatient discharges have decreased, the proportion of severe injuries has increased. These trends have previously been captured in statewide studies [24,49], but to our knowledge, this is the first descriptive study capturing these trends nationally. While

incidence of MVCs, including pedestrian injuries, have declined over recent decades, they continue to account for the most severely injured children admitted to US hospitals. In this study, the top five causes of severe all-age pediatric injury were all related to MVCs, and MVCs were the top cause in each age group.

Despite a relative increase in severe injuries admitted to inpatient care, pediatric traumatic case-fatality rates decreased from 2000 to 2011. Similar results have been observed for all-age samples, during the same time period [50], although this analysis is the first to document it in a nationally representative pediatric population-based sample. These trends may reflect the continued advancement in pediatric critical care services [51] and strengthening of trauma systems nationally [52].

Given limitations in our ability to reliably identify trauma centers, our results on trauma center status must be interpreted cautiously. The fatality rates at those Level 1 and 2 trauma centers which we identified were significantly higher than at non-Level 1 or 2 trauma center hospitals. However, the proportion of the severely injured treated at such trauma centers was much higher and, after adjusting for age, gender, injury severity, and comorbidities, there was a decrease in the association between mortality and Level 1 and 2 trauma center designation. While this finding is generally consistent with other published reports showing decreased trauma center mortality rates after adjustment for injury severity [53,54], we can offer no firm conclusions on a definitive benefit of trauma center care in children. We note a 2007 study reporting that trauma centers provided a survival advantage more than four times greater for adults compared with children [20]. By contrast, our data suggest a benefit of trauma center care in children on par with—but not exceeding—the benefit previously noted in adults [32]. Beyond in-hospital mortality, others have also reported on significant reductions in death rates within one year of discharge from a trauma center [53], data unobtainable with NIS.

While MVCs remain the most important cause of pediatric trauma, assaults, including knife and gunshot wounds, were the second most common mechanism of severe injury in 15-to-19-year-olds. These results are consistent with prior studies [50,55] and highlight an important public health challenge.

Orthopedic injuries were the most common injury requiring hospitalization, accounting for over 40% of diagnoses. This was consistent with previous reports [20]. Hip and femur fractures were the most common diagnoses requiring surgery in the inpatient setting for childhood trauma, and while fractures of the arm, hand, clavicle, lower leg, and foot, were more commonly injured [56,57], they likely required fewer admissions and acute operations, accounting for our findings.

Over 15% of pediatric hospital discharges were due to TBI. In children under five, TBIs were especially common, accounting for roughly one-quarter of all hospitalizations and increasing over most of the study period. This increase in TBI is consistent with other studies [58,59], and is of concern given the correlation between childhood TBI and psychiatric disorders and/or reduced educational achievement in adulthood, even in children who appear to fully recover from their injuries [60].

Falls are a leading cause of TBI [61] and are especially common in children under five. After age five, TBI—as a percentage of trauma-related hospitalization—decreases to roughly 12%, then slowly rises into adolescence. This is consistent with other studies, suggesting that after children perfect gross motor skills, fall rates decline, until sports and driving become a renewed source of TBI in adolescence [62].

4.2 Limitations

There are inherent limitations to using cross-sectional observational data to capture injury trends. NIS relies on ICD-9 discharge data and cannot identify readmissions, nor do these data capture patients treated and released from emergency departments or outpatient facilities. Thus, declining pediatric inpatient discharge rates may be reflective of fewer admissions, rather than fewer injuries—though we suspect that the aforementioned preventive strategies and safety improvements may also be contributing. Also, the data relies on state agency reporting and is subject to individual coder variation and error [63]. Furthermore, our identification of trauma centers was limited by state restrictions on releasing hospital identifiers, variably spelled hospital identifying information, etc. and related results are best approximations. With respect to costs, NIS data reflects only direct hospital costs, thus underestimating the true economic burden of pediatric traumatic injuries, which also includes indirect factors such as future disability and parental lost wages.

We limited much of our analyses to the dichotomous outcome of fatality, which we considered to be the result of most importance for both treatment and prevention. But, it is also important to consider in a more nuanced fashion dispositions for children and adolescents who survive to discharge. In particular, future studies can and should look specifically at discharges to skilled nursing or intermediate care facilities. Our initial exploratory tabulations indicate this could represent a not inconsiderable proportion of child and adolescent trauma discharges, and we plan to pursue that issue. We do not, though, believe this issue biases the results we present here.

Lastly, we dichotomized injury severity into severe vs. less severe both as a way to capture injury acuity and to address inherent problems with injury severity score as a continuous variable [64]. Dichotomizing a continuous variable like ICSS can result in the loss of important information, and our choice of 0.94 as the cut off for severe vs. non-severe injury, while not arbitrary, is subject to debate [65]. While dichotomization erases inter-categorical differences, both the traditional and ICD-derived injury severity score behave poorly as a continuous variable, with some authors recommending, “for statistical or analytical purposes the ISS/NISS should not be considered a continuous variable.” [64]. ICSS behaves similarly poorly as a continuous variable. We found statistical manipulations like log, square root and inverse logit transformations to be unhelpful and chose to dichotomize. This approach also allowed us to calculate informative statistics based on probabilities, like odds ratios. Despite this, in the absence of national clinical registries, NIS is one of the most important and comprehensive resources on health care delivery in the US, enabling accurate and generalizable information to be captured without the degree of selection bias that limits single-institution database studies.

4.3 Conclusions

This analysis represents a comprehensive portrait of inpatient pediatric trauma in the US based on recently available data, and highlights the importance of continued commitment to pediatric injury prevention by caregivers and policy-makers. Despite an increase in the proportion of trauma discharges classified as severe, the rate of inpatient hospitalization from pediatric traumatic injury is declining, as are inpatient case-fatality rates. External causes of traumatic injury vary considerably by age group, each with distinct injury mechanisms. MVCs remain a common source of pediatric trauma for all ages, but changes in behavior and vehicle safety standards in recent years may be helping to mitigate this danger. Falls remain a significant cause of childhood trauma, and TBIs contribute to both pediatric mortality and significant long-term morbidity, demonstrating an increasing need for primary prevention and control.

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Figure 1.
Annual proportion of trauma discharges classified as severe (by age group). Ages 0–19,
United States, 2000–2011.

Figure 2. Percentage of annual traumatic injury discharges classified as TBI, by age group. United States hospitals, 2000–2011.

Under 5	5 to 9 Years	10 to 14 Years	15 to 19 Years
Motor Vehicle 13,816 (15.8)	Motor Vehicle 22,475 (45.4)	Motor Vehicle 23,464 (47.4)	Motor Vehicle 135,735 (50.1)
Burn 11,090 (12.7)	Fall 3,455 (7.0)	Sports 2,145 (4.3)	Assault 27,497 (10.2)
Abuse 8,649 (9.9)	Animal 1,347 (2.7)	Off Road 1,918 (3.9)	Off Road 12,482 (4.6)
Assault 6,881 (7.9)	Burn 1,277 (2.6)	Bike 2,078 (2.8)	Fall 8,599 (3.2)
Fall 6,726 (7.7)	Bike 1,207 (2.4)	Assault 1,120 (2.3)	Bike 5,491 (2.0)
Foreign Body 6,044 (6.9)	Poison 679 (1.4)	Fall 1,116 (1.5)	Sports 5,297 (2.0)
Machinery 2,218 (2.5)	Struck 626 (1.3)	Burn 1,064 (1.4)	Other 4,452 (1.6)

Figure 3.
Frequency (Percent) Most Common Severe Injury Mechanisms by Age Group, Traumatic
Injury Inpatient Discharges. Ages 0–19, United States, 2000–2011.

Figure 4. Inflation-adjusted annual cost of pediatric trauma care (in billions of US dollars). Traumatic injury hospital discharges. Ages 0–19, United States, 2001–2011

Table 1

Most Frequent E Codes, Count (and Percentage of Total), All Traumatic Injury Inpatient Discharges and Severe (ICISS < 0.94) Traumatic Injury Inpatient Discharges. Ages 0–19, United States hospitals, 2000–2011.

All Injuries			Severe Injuries	
1	MVC Passenger (E812.1)	74,147 (4.6)	MVC Passenger (E812.1)	42,905 (8.8)
2	Fall from Height (E884.9)	72,450 (4.5)	MVC Driver (E812.0)	25,863 (5.3)
3	Bicycle Accident (E826.1)	52,917 (3.3)	MVC Driver Loss of Control (E816.0)	24,146 (5.0)
4	Fall from Slipping or Tripping (E885.9)	52,813 (3.3)	MVC Pedestrian (E814.7)	23,328 (4.8)
5	Fall from Playground (E884.0)	52,710 (3.3)	MVC Passenger Loss of Control (E816.1)	21,671 (4.4)
6	MVC Pedestrian (E814.7)	50,153 (3.1)	Unarmed Assault (E966.0)	14,838 (3.0)
7	Sports Injury (E917.0)	47,845 (3.0)	Assault with Firearm (E965.4)	13,717 (2.8)
8	Unspecified Fall (E888.9)	44,151 (2.7)	Bicycle Accident (E826.1)	13,312 (2.7)
9	MVC Driver (E812.0)	42,677 (2.6)	MVC Passenger Unspecified Accident (E819.1)	11,678 (2.4)
10	MVC Driver Loss of Control (E816.0)	38,000 (2.4)	Fall from Height (E884.9)	11,165 (2.3)

Table 2

Frequency and Percent, Top 10 procedure codes, severe traumatic injury discharges. Ages 0–19, United States, 2000–2011.

Rank	Description	Frequency (Percentage of Total)
1	Treatment; fracture or dislocation of hip and femur	45,610 (8.8)
2	Suture of skin and subcutaneous tissue	41,894 (8.1)
3	Respiratory intubation and mechanical ventilation	39,591 (7.6)
4	Other OR therapeutic nervous system procedures	22,831 (4.4)
5	Debridement of wound; infection or burn	22,560 (4.3)
6	Skin graft	22,461 (4.3)
7	Incision and excision of CNS	20,001 (3.8)
8	Incision of pleura; thoracentesis; chest drainage	19,629 (3.8)
9	Other fracture and dislocation procedure	17,349 (3.3)
10	Treatment; facial fracture or dislocation	17,016 (3.2)

Table 3

Results of multivariable logistic regression model for association of level 1 or 2 trauma center status with injury-related mortality, controlling for gender, age, injury severity and Charlson Comorbidity Index score. Traumatic injury hospital discharges. Ages 0–19, United States, 2000–2011.

Variable	Mortality Odds Ratio (95% CI)
Year	0.971 (0.959, 0.982)
Female	0.935 (0.878, 0.996)
Level 1 or 2 Trauma	1.205 (1.091, 1.331)
Severe Injury	109.134 (89.694, 132.787)
Charlson	1.119 (1.035, 1.210)
Age Group	0.995 (0.961, 1.030)