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Disparities in trauma center access despite increasing utilization: Data from California, 1999–2006

Abstract

Background—While efforts have been made to address disparities in access to trauma care in the past decade, there is little evidence to show if utilization has changed. We use patient-level data to describe the changes in utilization of trauma centers in an eight-year period in California.

Methods—We analyzed all statewide trauma admissions ($n=752,706$) using the California Office of Statewide Health Planning and Discharge Patient Discharge Database from the period of 1999–2006, and determined the trends in admissions and place of care.

Results—The proportion of severe injuries admitted increased by 3.6% ($p < 0.05$), with a concomitant rise in the proportion of trauma patients admitted to trauma centers (TCs), from 39.3% (95% CI 39.0% – 39.7%) to 49.7% (49.4% – 50.0%). Within the severely injured with injury severity scores > 15 , 82.4% were treated in a TC if they resided in a county with a TC, compared to 30.8% of patients who did not live in a county with a TC. After adjustment, patients living greater than 50 miles away from a TC still had a likelihood ratio of 0.11 ($p < 0.0001$) of receiving care in a TC compared to those less than 10 miles away. Similarly, even severely injured patients not living in a county with a TC had a likelihood ratio of 0.35 ($p < 0.0001$) of being admitted to a TC compared to those residing in counties with trauma centers.

Conclusion—Admissions to TCs for all categories of injury severity are increasing. There remains, however, a large disparity in TC care depending on geographical distance and availability of a TC within county.

Keywords

trauma centers; triage; regionalization

Introduction

The implementation of regionalized trauma systems, which began after the American College of Surgeons developed criteria for trauma center designation in 1976, has been shown to reduce mortality among severely-injured patients [1–9] and improve quality of life after hospitalization. [10] A recent meta-analysis of studies regarding trauma center effectiveness concluded that regionalized trauma centers reduce trauma-related mortality by 15–20%. [1] A 2006 paper by MacKenzie et al was even more conclusive, showing a 25% reduction in mortality at level I trauma centers vs. non-level I centers after adjusting for co-morbidities and injury severity. [3] These are important findings given that injury is the most important cause of lost years of life in the United States. [1]

However, trends in trauma system utilization for injury have not been shown to be uniform; there may be gaps in access for certain segments of the population, despite evidence that designated trauma centers are associated with less inappropriate care and fewer preventable deaths for significantly injured patients. [3,4,6–8,11,12] Branas et al demonstrated that although 84% of Americans have access to a trauma center within one hour (defined by ability to reach a trauma center either by driving time or flying time via helicopter), 46.7 million persons do not have access to a level I or level II trauma center within an hour, most of whom

live in rural areas. [13] Even in urban centers, trauma center utilization can be uneven. Only 59% of seriously injured patients requiring trauma center care in non-rural areas in California were hospitalized in trauma-designated centers, despite the fact that 83% had access to such centers. Also, over 30% of all trauma deaths in the state occurred in non-trauma-designated hospitals, many of which should likely have met criteria for severe trauma and the need for care in a higher-level facility. [14] Nationally, about one-third of patients with major trauma (those with an injury severity score >15) were treated in non-trauma-designated hospitals, [15] and regional differences in processes of care and outcomes have been well-documented. [16] These data point to the existence of gaps in trauma system utilization and development.

While efforts have been made to address disparities in access to trauma care in the past decade, there is little evidence to show if utilization has changed. We use patient-level data to describe the changes in utilization of trauma centers in an eight-year period in California during the years 1999–2006 to determine if utilization has increased and also to quantify, if any, the disparities in access to trauma center care.

Methods

Study Design and Setting

This investigation is a cross-sectional population-based study utilizing the 1999–2006 data from the California Office of Statewide Health Planning and Development (OSHPD) Patient Discharge Database (PDD), a public administrative data set, [17] which contains patient-level discharge information submitted biannually by all licensed hospitals in California. In addition to patient demographics such as age, sex, county, and race/ethnicity, the database lists the principal and 24 secondary diagnoses with external cause of injury codes (E-codes) where applicable, as well as patient disposition (including death). This study protocol was approved by the Institutional Review Board of our university.

Selection of Participants

We included patients from the OSHPD PDD who were California residents with unmasked ages with acute trauma, defined by the International Classification of Disease, Ninth Revision (ICD-9) diagnosis codes 800–904.9, 910–929.9, and 950–959.9 in either the principal diagnosis or in any of the 24 secondary diagnoses in the OSHPD database. Within these visits, we excluded patients with ICD-9 codes indicating drowning, burns, bites and stings, overexertion, poisonings, foreign body, suffocation or late effects of injury. In order to limit our sample to non-minor injuries, we eliminated patients with the sole traumatic ICD-9 diagnoses of strains and sprains and contusions with intact skin surface. Though burns are considered trauma, burn patients in California are treated at burn centers that are fewer in number and more highly specialized than trauma centers; therefore, they were not used for the present analysis. We did not include scheduled admissions or admissions to non-medical acute care hospitals. Figure 1 shows the number of observations culled at each stage.

Study protocol and measurements

The OSHPD PDD reports inpatient discharge data from all California licensed hospitals as mandated by law. Hospitals are required to submit data electronically every six months; if they fail to fulfill this obligation, they are fined and could lose their license. Federally-operated hospitals, that are not licensed by the State, such as the Veterans Affairs hospitals, are not required to comply with this mandate. The OSHPD then screens the data for errors and publishes this information within 15 days of submission by the hospital through MIRCAl, the Medical Information Reporting for California system, with principal diagnoses coded according to the International Classification of Disease, 9th edition. Total charges are also recorded in the PDD and defined as charges (reported in whole dollars) for services rendered

during the length of stay for patient care at the hospital based on the hospital's full rates; hospital-based physician fees are not included in this category. [18]

Data Analysis and Outcomes

We obtained our data from OSHPD on compact discs and stored them on a secure server. We analyzed our data using SAS version 8.2 (SAS Institute, Cary, N.C.).

The key outcome studied in this paper was trauma center hospitalization (trauma center vs. non-trauma-center). In order to capture the dynamic nature of trauma center certification, we collected yearly trauma center designation status from the California Department of Health and included levels I–II trauma centers and appended each year's data to validate their current year's certification. [19] For example, our first year of data in 1999 had 36 level I–II trauma centers; 2006, our last year of data, included 42 trauma centers. Level I trauma centers must be leaders in research and education and provide comprehensive trauma care; they are required to have 24-hour availability of trauma surgeons, anesthesiologists, specialists, nurses, and resuscitation equipment. Level II trauma centers must fulfill similar criteria but do not have a 1200-admission-per-year volume requirement that level I centers have. Level III and IV centers can provide advanced trauma life support and transfer to higher levels of care. [20] Because levels III and IV centers provide much less specialized care than levels I and II and in many studies are not considered places of specialized trauma care[3,13,21], we chose to follow more conservative standards and include only levels I and II centers in our definition of trauma center for our primary analysis, although we perform a sensitivity analysis that includes all levels. Yearly trauma center status and association with patient records was verified by three of the authors in this study.

To calculate proximity to a trauma center, we used the previously described method and validated program based on the Haversine formula to calculate the shortest geographical distance between the centroid longitude/latitude of the patient's zip-code and the centroid longitude/latitude of the hospital's zip-code. [22,23] As there are no defined recommendations regarding ideal distances to nearest trauma center, we performed logit plots to verify linearity of the distance and then utilized the cut-off points of 10, 25, and 50 miles, based on prior studies [24,25] and the observed distribution of distances traveled in this California population. [26]

Finally, we computed Injury Severity Scores for all patients in the sample. An ICD-9 to ISS conversion program[27] was used to extrapolate the severity of injuries based on ICD-9 codes; if an ISS could not be determined, the record was excluded. We stratified ISS scores according to MacKenzie[3] and Long[28], and grouped records into mild (ISS = 1–4), moderate (ISS = 5–15), and severe (ISS > 15) categories.

Results

Characteristics of patients admitted to trauma centers and non-trauma centers

Out of over 31 million hospital admissions in California between 1999 and 2006, 2.4%, or 752,706, met the study criteria of acute traumatic injury. 336,621 (44.7%) of these patients were treated at a designated level I or II trauma center. Of those with injury severity scores greater than 15, 66% received care at a trauma center. The study population characteristics, categorized by those treated in a trauma center and those treated in a non-trauma center, are listed in Table 1.

Certain differences in characteristics are notable; while the largest portion of trauma patients admitted to a trauma center were within the 25–44 age category, the largest portion of trauma patients admitted to non-trauma centers were actually more elderly, in the 65–84 category. Trauma centers treated a smaller percentage of whites (52.9%) and larger percentage of blacks

(6.9%) within their patient population compared to non-trauma centers (69.9% and 3.0%, respectively). The share of poor patients as measured by the average income of the patient's zip code was higher in trauma centers than in non-trauma centers (32.1% in zip codes that are twice the federal poverty level, compared to 22.8% in non-trauma centers), whereas non-trauma centers admitted a larger percentage of patients with HMO insurance (13.5% vs. 4.6% of trauma centers).

A larger share of patients with severe injuries were seen in trauma centers (15.3% vs. 6.5% in non-trauma centers), and, accordingly, the share of trauma patients who die in the hospital was greater in trauma centers (2.7% vs. 2.0% in non-trauma centers).

A higher percentage of patients admitted to a trauma center lived within 10 miles of a trauma center (82.3% compared to 54.2% of those in non-trauma centers), and 95.6% of patients admitted to a trauma center lived in a county with a trauma center, compared to 72.2% of those admitted in non-trauma centers).

Trends in trauma center utilization

The injury severity of the patient population varied slightly during the study period. While the total number of traumas over the study period actually decreased by a small amount (Figure 1), on average, the severity increased over time, with 51.5% of injuries categorized as mild and 9.0% as severe in 1999, and 49.2% as mild and 12.6% as severe by 2006.

Along with the increasing trend in severity, Figure 2 shows that the proportion of trauma patients admitted to trauma centers also rose from 39.3% (95% CI 39.0% – 39.7%) to 49.7% (95% CI 49.4% – 50.0%) from 1999–2006. When stratified by injury severity, there was an increase in the proportion of patients admitted to a trauma center in all three categories. For mild injury, the percentage increased from 39.8% (95% CI 39.4% – 40.2%) to 45.6% (95% CI 45.1%–46.0%). For moderate injury, the rise was more marked, from 34.6% (95% CI 34.1%–35.0%) to 48.0% (95% CI 47.4%–48.5%). The change for severely injured patients was likewise robust, from 57.9% (95% CI 56.8%–58.9%) to 71.1% (95% CI 70.3%–72.0%).

Factors influencing likelihood of care at a trauma facility

While the increase in admissions to trauma centers was seen across all categories, another look at the data shows that admission to trauma centers happens differentially based on whether or not the patient resides in a county where there is a trauma system. The first panel in Table 2 lists the number and percentage of trauma patients in each category; the second panel shows the number of patients in panel 1 that had an injury severity score of 15 or higher. The third panel demonstrates the number of those in panel 2 with ISS>15 who actually received care from a level I or level II trauma facility. In other words, 82.4% of trauma patients with severe injuries were treated in a trauma center if they resided in a county with a trauma facility, compared to a substantially lower 30.8% of similarly injured patients who did not live in a county with a trauma facility. The difference in the proportions was even higher for those who died in the hospital; only 29.7% of those who were severely injured and died were treated in a level I or II trauma facility if they did not live in a county with a trauma facility. This is a stark decrease compared to 88.0% of severely injured patients who lived in a county with a trauma facility and were cared for in a trauma facility. In other words, even for the most severely injured patients who died, the disparity of trauma center care remained between those living in a county with a trauma center and those not residing in a county with a trauma center.

To test the hypothesis of decreased care due to geographic proximity, we performed univariate analyses of several variables of interest, mainly that of insurance, geographical proximity to a trauma center, and trauma center availability in county. Our multivariable regression confirmed

these findings of discrepancies of trauma center care for those with increasing geographical distance as well as living in a county without a trauma center (Table 3). Those living greater than 50 miles away from a trauma center had a likelihood ratio of 0.11 ($p<0.001$) of receiving care in a trauma facility compared with those less than 10 miles away. Injured patients living in a county without a trauma center had a likelihood ratio of 0.35 ($p<0.001$) of trauma center hospitalization compared to those living in a county with a trauma center.

The multivariable analyses also brought to light several other notable findings, including a much lower likelihood of being admitted with increasing age, with the very elderly having a likelihood ratio of 0.20 of being admitted to a trauma center compared to our base case age group of 25–44 year olds, even when controlling for injury severity. Patients with HMO insurance were less likely to be admitted than those with public or private non-HMO insurance. Other findings, such as increasing likelihood of admission to a trauma center with increasing injury severity, were expected.

Sensitivity analysis

Due to the lower level of specialized care provided by levels III and IV trauma centers, we decided to exclude them from the trauma center category in our primary analysis to more accurately reflect the state of specialized trauma care in California. We did perform a sensitivity analysis to determine if there were significant differences in our results when levels III and IV centers were included. While the proportion of trauma patients admitted to trauma centers increases to 53% compared to 50% when we include levels III and IV trauma centers in our analysis, inclusion of these centers did not significantly alter our results.

Limitations

There are several important limitations to our study. OSHPD is a well-known dataset generally regarded as a reliable dataset for population-based health services studies such as ours, [14, 29] but the PDD itself is limited due to administrative requirements regarding masking of certain identifier variables. For example, in the 2006 OSHPD publicly-available dataset, 7% of the age categories when separated into 5 groups are masked, and the 13% of the further delineation of age group into 20 groups is masked.

Second, while OSHPD does contain a transfer variable, this serves only to indicate transfer from an admitted patient to another hospital, and these records are unable to be linked. As a result, there may be a certain number of observations that reflect the same patient. Still, as long as the patterns of inter-hospital transfers have not changed significantly across this time interval (which did not), the trends of trauma center utilization would not be greatly affected. Furthermore, that patient would be present in both non-trauma and trauma center analyses and would not positively bias our findings. It has been well-documented that the initial presentation of a trauma patient to a non-tertiary care hospital is the strongest predictor of transfer, and that there is a wide variability in transfer practices. [30] In light of this, our findings are still conservative, as we are studying admitted patients (not patients in the emergency department) that should have had the time to be transferred for severe injuries.

Finally, we utilize the ISS as it is one of the more universally known scales of severity of injury. There are others, such as the Abbreviated Injury Score (AIS) and the TRISS, [31] all of which have different advantages and disadvantages, some requiring clinical information such as vital signs, which administrative databases such as OSHPD do not have. Still, the ISS has been validated and is widely accepted as a standard method of classifying injury. We recognize that there is no perfect severity injury score that can perfectly predict morbidity or mortality, and in our analysis we refrain from using previously published literature on what types of injuries require trauma-level care. [32] While this is undoubtedly a worthwhile area of research, we

limit our discussion in this setting to use ISS>15 as a proxy of severe injury where, in general, one would expect a greater need for a higher level of care. As a last point, we also do not attempt to analyze what would possibly be an over-extension of the administrative data to focus on outcomes alone, since other studies have previously demonstrated the benefits of trauma centers with more appropriate data. [3,7,33] We therefore limit our main findings to the important evaluation of who does and does not receive care in a trauma facility.

Discussion

Injury is a leading cause of death in the United States, and trauma systems mitigate morbidity and mortality stemming from injury. The proportion of trauma patients admitted to California trauma centers increased from 1999–2006, both overall and when stratified by injury severity. While some would see this as representing progress, at the same time, we found it concerning that this improvement did not affect all equally. While over three-quarters of patients with severe injuries who lived in counties with a trauma center were treated in a trauma facility, less than one-third of similar patients who did not live in a county with a trauma center did. While a fuller discussion of regionalization is beyond the scope of this paper, one would hope that severely injured patients – including those that have in-hospital mortality – would be treated in a trauma facility, especially in light of literature showing improved outcomes. [3,7,33,34] Our data also seems to support this, given that the 0.7% difference (95% CI risk difference 0.58% – 0.72%) in mortality between trauma center and non-trauma centers (with the latter having a lower percentage of deaths) was proportionately lower than the 8.8% difference (95% CI risk difference 8.70% – 8.98%) in proportion of patients treated with severe injuries. Further research is needed to identify reasons behind, and interventions addressing, these gaps in trauma care, such as the procedures for, and barriers to, ensuring appropriate transfer to a trauma center from a non-trauma center for severely ill patients.

Another important observation is the difference in patient demographics between trauma centers and non-trauma centers, which is consistent with other literature that the elderly are less likely to receive trauma center care. [35–38] The fact that older patients are taken to non-trauma centers could be due to the fact that, as seen in our data looking at ICD-9 codes as well as other literature, [36,39–43] many of these patients suffer from falls or other forms of minor trauma that are not life-threatening, but still require evaluation in a hospital. [14] Triage of elderly patients, and their proper care in trauma centers, are therefore important topics to consider in future research to address these disparities and ensure that the elderly trauma patient is being treated effectively, as treatment in a trauma center has been associated with improved outcomes. [34,44]

Further analysis is also needed to identify the reasons behind differences in insurance status between patients admitted to trauma versus non-trauma centers. We find that HMO patients, in general, were more likely to receive treatment in a non-trauma center than a trauma center for their trauma-related injuries. There are many possible explanations for this, including financial aspects of HMOs that may affect patient care or impede transfer. The literature suggests that the underinsured, including Medicaid, are often transferred preferentially to trauma centers for all levels of trauma (including those with very mild injuries), [45] and given that reimbursements from patients without commercial insurance is significantly lower than those with commercial insurance, [46,47] this may increase the financial pressures on trauma centers. If this is validated in other research, policy measures should be taken to elucidate possible interventions to prevent inappropriate transfers and also address the financial ramifications of these realities.

The findings of this study suggest that more attention be paid to identify factors that impede the treatment of trauma patients in trauma centers, specifically in areas without trauma centers

or that are further away from trauma centers. The purpose of regionalization is to concentrate expertise and resources in certain areas to provide better care to those who require it; our analysis raises concerns that, at the moment, these resources are not being delivered equitably. While we did not specifically look at the prehospital system, we recognize that delivery of care begins much earlier than arrival at the doorstep of a hospital, and that integration of care is crucial. [9,48–50] As in many states, California, while having a state Emergency Medical Services authority, is comprised of counties each with its own trauma system. Fragmentation and difficulty in ensuring inter-county hospital transfer agreements may put some counties at a disadvantage. [51] Specifically in California, the structure of Medicaid and indigent care funding (e.g., the Trauma Fund) is county-based, with no means for payment from one county to another for the care of indigent trauma patients. Further exploration into the financial arrangements, such as the need for preauthorization prior to transfers, and their influence on the care of patients may suggest that true regionalization may require consideration of a state-based funding system.

Overall, our findings are encouraging in showing that progress has been made with respect to trauma center utilization overall over the past eight years, but that there is significant disparity between injured patients – even those severely injured – who live in a county with a trauma facility and those who do not, as well as those living further away from trauma centers. If regionalization is to be successful and the benefits of trauma center care are to be equally shared across the population, much more opportunity remains in narrowing the disparities of who receives trauma center care.

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Figure 1.
Study criteria for selection of data

Figure 2.

Proportion of trauma patients admitted to trauma centers, stratified by injury severity, with 95% CI in dotted lines (total patients, 752,706; mild ISS, 382,234; moderate ISS, 291,774; severe ISS, 78,698).

Figure A1.

Proportion of patients with moderate and severe injury, hospitalized in a trauma-designated center by insurance status, 1999–2006, with confidence intervals

Figure A2.

Proportion of patients with moderate and severe injury, hospitalized in a trauma-designated center by geographical distance from patient residence to nearest trauma facility, 1999–2006, with confidence intervals

Figure A3.

Proportion of patients with moderate and severe injury, hospitalized in a trauma-designated center by availability of trauma center in county of residence, 1999–2006, with confidence intervals

Table 1

Characteristics of study sample, 1999–2006, categorized by trauma care

	Total Sample	Trauma Center (Level 1 and 2)		Non-Trauma Center	
		n	%	n	%
Total	752,706	336,621		416,085	
Age					
0–14 years old	78,843	42,580	12.6%	36,263	8.7%
15–24 years old	104,716	68,119	20.2%	36,597	8.8%
25–44 years old	174,616	105,706	31.4%	68,910	16.6%
45–64 years old	137,496	63,487	18.9%	74,009	17.8%
65–84 years old	162,407	38,490	11.4%	123,917	29.8%
85+ years old	94,628	18,239	5.4%	76,389	18.4%
Sex					
Male	361,949	195,017	57.9%	166,932	40.1%
Female	309,869	100,594	29.9%	209,275	50.3%
Not available	80,888	41,010	12.2%	39,878	9.6%
Ethnicity					
Hispanic	122,231	71,481	21.2%	50,750	12.2%
Non-hispanic	410,189	144,016	42.8%	266,173	64.0%
Not available	220,286	121,124	36.0%	99,162	23.8%
Race					
White	468,991	178,009	52.9%	290,982	69.9%
Black	35,706	23,287	6.9%	12,419	3.0%
Native American/Eskimo	699	331	0.1%	368	0.1%
Asian/Pacific Islander	19,596	6,498	1.9%	13,098	3.1%
Other/Not Available	227,714	128,496	38.2%	99,218	23.8%
Insurance type					
Public*	509,869	240,120	71.3%	269,749	64.8%
Private non-HMO	171,469	81,162	24.1%	90,307	21.7%
HMO	71,306	15,320	4.6%	55,986	13.5%

	Total Sample	Trauma Center (Level 1 and 2)		Non-Trauma Center	
		n	%	n	%
Not available	62	19	0.0%	43	0.0%
Income of Resident Zip Code**					
<FPL	4,102	2,903	0.9%	1,199	0.3%
FPL-2 * FPL	198,659	104,903	31.2%	93,756	22.5%
2 * FPL-3 * FPL	296,675	132,128	39.3%	164,547	39.5%
>3 * FPL	243,550	93,480	27.8%	150,070	36.1%
Not available	9,720	3,207	1.0%	6,513	1.6%
Injury Severity					
Mild (ISS<5)	382,234	163,568	48.6%	218,666	52.6%
Moderate (5<=ISS<=15)	291,774	121,406	36.1%	170,368	40.9%
Severe (ISS>15)	78,698	51,647	15.3%	27,051	6.5%
Disposition					
DC home	457,160	242,536	72.1%	214,624	51.6%
Transfer	24,271	13,859	4.1%	10,412	2.5%
Other	253,977	71,279	21.2%	182,698	43.9%
Died	17,298	8,947	2.7%	8,351	2.0%
Proximity to trauma hospital					
0-10mi	502,388	277,029	82.3%	225,359	54.2%
11-25mi	136,439	45,796	13.6%	90,643	21.8%
26-50mi	68,792	11,262	3.3%	57,530	13.8%
51+mi	43,363	2,119	0.6%	41,244	9.9%
Not available	1,724	415	0.1%	1,309	0.3%
MSA Status					
Metro	733,608	334,632	99.4%	398,976	95.9%
Micro	13,707	1,456	0.4%	12,251	2.9%
Rural	5,391	533	0.2%	4,858	1.2%
County of residence					
with trauma center	607,116	317,523	94.3%	289,593	69.6%
without trauma center	145,590	19,098	5.7%	126,492	30.4%

* Public: Medicare, Medi-Cal, Other Govt, Indigent, Self-pay

** e.g., year 2000 Federal Poverty Level=\$18,850 FPL calculated yearly

All differences within categories between trauma center and non-trauma center admissions are statistically significant ($p<0.001$)

Proportion of all trauma patients (first panel) with ISS > 15 (second panel) treated in a level I or II trauma facility (third panel) among the 752,706 trauma patients for the state of California, 1999–2006

Table 2

	Trauma patients		Patients with ISS > 15		Patients with ISS > 15 and who received care in trauma center		% difference between patients with ISS > 15 in counties with TC and without TC
	n	%	n	%	n	%	
ALL	752,706	100.00%	34,683	4.60%	25,479	73.50%	
Survivors	735,408	97.70%	28,396	3.90%	20,524	72.30%	
Nonsurvivors	17,298	2.30%	6,287	36.30%	4,955	78.80%	
Patients living in a county with a trauma center	622,244	82.70%	28,659	4.60%	23,626	82.40%	
Nonsurvivors	14,236	2.30%	5,298	37.20%	4,661	88.00%	51.6% (p<0.005)
Patients living in a county without a trauma center	130,462	17.30%	6,024	4.60%	1,853	30.80%	
Nonsurvivors	3,062	2.30%	989	32.30%	294	29.70%	

Table 3

Multivariable regression model of likelihood ratio of being admitted to trauma center (n=752,706)

Age		
0–14 years old	1.85	<0.0001
15–24 years old	1.28	<0.0001
25–44 years old	1.00	Reference
45–64 years old	0.66	<0.0001
65–84 years old	0.26	<0.0001
85+ years old	0.20	<0.0001
Injury Severity		
mild (ISS≤4)	1.00	Reference
moderate (ISS=5–15)	1.74	<0.0001
severe(ISS>15)	3.37	<0.0001
Insurance type		
Public	1.04	<0.0001
Private non-HMO	1.00	Reference
HMO	0.25	<0.0001
Income of Resident Zip Code		
<2*FPL	0.92	<0.0001
2*FPL–3*FPL	1.07	<0.0001
>3*FPL	1.00	Reference
Proximity to trauma hospital		
0 – 10 miles	1.00	Reference
11 – 25 miles	0.56	<0.0001
26 – 50 miles	0.28	<0.0001
> 50 miles	0.11	<0.0001
County of residence		
with trauma center	1.00	Reference
without trauma center	0.35	<0.0001
c-statistic for the model	0.78	

Table A1

Mean proportion of admissions admitted to trauma, 1999–2006, including confidence intervals

	N	%	95% CI	
Mild ISS				
1999	49,201	39.8%	39.4%	40.2%
2000	50,016	41.3%	40.9%	41.8%
2001	49,951	41.4%	40.9%	41.8%
2002	49,778	42.8%	42.4%	43.2%
2003	49,074	42.6%	42.2%	43.1%
2004	47,161	44.7%	44.2%	45.1%
2005	44,731	44.9%	44.5%	45.4%
2006	42,322	45.6%	45.1%	46.0%
Moderate ISS				
1999	37,755	34.6%	34.1%	35.0%
2000	38,036	38.0%	37.5%	38.5%
2001	37,570	37.5%	37.0%	38.0%
2002	37,775	41.2%	40.7%	41.7%
2003	36,848	42.7%	42.2%	43.2%
2004	36,184	45.2%	44.6%	45.7%
2005	34,745	47.3%	46.8%	47.8%
2006	32,861	48.0%	47.4%	48.5%
Severe ISS				
1999	8,578	57.9%	56.8%	58.9%
2000	8,902	61.9%	60.9%	62.9%
2001	9,374	62.7%	61.7%	63.7%
2002	9,788	65.3%	64.3%	66.2%
2003	10,029	65.8%	64.9%	66.7%
2004	10,568	67.8%	66.9%	68.7%
2005	10,646	70.0%	69.2%	70.9%
2006	10,813	71.1%	70.3%	72.0%
ALL				
1999	95,534	39.3%	39.0%	39.7%
2000	96,954	41.9%	41.6%	42.2%
2001	96,895	41.9%	41.6%	42.2%
2002	97,341	44.5%	44.1%	44.8%
2003	95,951	45.1%	44.8%	45.4%

	N	%	95% CI	
2004	93,913	47.5%	47.1%	47.8%
2005	90,122	48.8%	48.5%	49.1%
2006	85,996	49.7%	49.4%	50.0%