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The Association Between Insurance Status and Emergency Department Disposition of Injured California Children

Anna Chen Arroyo, **N. Ewen Wang, MD**, **Olga Saynina, MA**, **Jay Bhattacharya, MD, PhD**, and **Paul H. Wise, MD, MPH**
Stanford University School of Medicine (ACA), the Division of Emergency Medicine, Department of Surgery (NEW), the Center for Primary Care and Outcomes Research, Department of Medicine (OS, JB, PHW), the Center for Policy Outcomes and Prevention, Department of Pediatrics (OS, PHW), and the Center for Health Policy, Freeman-Spogli Institute for International Studies (PHW), Stanford University School of Medicine, Stanford, CA, USA.

Abstract

Objectives—This study examined the relationship between insurance status and emergency department (ED) disposition of injured California children.

Methods—Multivariate regression models were built using data obtained from the 2005 through 2009 California Office of Statewide Health Planning and Development (OSHPD) datasets for all ED visits by injured children younger than 19 years of age.

Results—Of 3,519,530 injury-related ED visits, 52% were insured by private, and 36% were insured by public insurance, while 11% of visits were not insured. After adjustment for injury characteristics and demographic variables, publicly insured children had a higher likelihood of admission for mild, moderate, and severe injuries compared to privately insured children (mild injury adjusted odds ratio [AOR] = 1.36; 95% confidence interval [CI] = 1.34 to 1.39; moderate and severe injury AOR = 1.34; 95% CI = 1.28 to 1.41). However, uninsured children were less likely to be admitted for mild, moderate, and severe injuries compared to privately insured children (mild injury: AOR = 0.63; 95% CI = 0.61 to 0.66; moderate and severe injury: AOR = 0.50; 95% CI = 0.46 to 0.55). While publicly insured children with moderate and severe injuries were as likely as privately insured children to experience an ED death (AOR = 0.91; 95% CI = 0.70 to 1.18), uninsured children with moderate and severe injuries were more likely to die in the ED compared to privately insured children (AOR = 3.11; 95% CI = 2.38 to 4.06).

Conclusions—Privately insured, publicly insured, and uninsured injured children have disparate patterns of ED disposition. Policy and clinical efforts are needed to ensure that all injured children receive equitable emergency care.

INTRODUCTION

Despite recent policy efforts to expand insurance coverage for children living in the United States,[1] 7.3 million children, or 9.8% of children younger than 18 years, remain uninsured.[2] Previous studies have shown that uninsured children have higher in-hospital[3] and trauma mortality rates than insured children.[4,5] However, whether uninsured children receive disparate levels of care in the initial stages of clinical management remains unclear. Here, we investigated the relationship between insurance status and disposition from the emergency department (ED) for injured children.

Contact for correspondence and reprints: N. Ewen Wang, MD ewen@stanford.edu.

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Injury is the leading cause of death for all children 1 year of age and older[6,7] and the ED is the initial location where acute severely injured children will typically receive care, with an estimated 9.2 million pediatric ED visits for unintentional injuries annually.[8] The ED often is the first point of definitive care for injury, receiving ambulance transports from the site of injury and providing stabilization, management, and disposition, including admission of patients for further care. It has been shown that in addition to clinical factors, insurance status influences ED disposition of injured patients; specifically, uninsured patients are significantly less likely to be hospitalized than privately insured patients, regardless of injury severity.[9,10] However, this relationship has not been specifically studied in the pediatric population. The objective of our study was to investigate the association between insurance status and severity-adjusted ED disposition of injured children using multivariate regression models on California administrative databases from 2005 to 2009.

METHODS

Study Design

This was a retrospective observational study of all ED visits by children younger than 19 years of age residing in California for the 2005 through 2009 period. This study was approved by our institution’s human subjects review committee.

Study Setting and Population

The study population included all California ED visits by children younger than 19 years of age from January 1, 2005 through December 31, 2009. We excluded visits with county codes indicating out-of-state residency. We adapted the Centers for Disease Control and Prevention (CDC) recommended definition for initial injury visits to ED for use with the National Hospital Ambulatory Medical Care Survey-ED[11] as our inclusion criteria. The CDC define a visit as an initial injury ED visit if either a first-listed International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) injury diagnosis based on the Barell matrix,[12] or a first-listed valid external cause-of-injury code (E-code) based on the recommended framework for external causes of injury,[13] is present. We adapted the CDC criteria by including patients with valid E-codes in any of five listed fields, since the majority of first-listed E-codes indicated location of injury instead of mechanism. Moreover, we did not include patients with first-listed ICD-9-CM diagnoses of late effects of injury, foreign bodies, poisoning, toxic effects, and unspecified effects of external causes. We also did not include patients with E-codes of air and space injuries, poisonings, iatrogenic causes, foreign bodies, adverse effects, late effects, bites/stings, or natural or environmental causes.

Since children with mild injuries are clinically very different from children with more severe injuries.[14,15] we subdivided our study population into two subgroups: children with mild injuries (N = 3,161,224), and children with moderate and severe injuries (N = 50,605). These categories were defined by Injury Severity Scores (ISS), further discussed in the Study Protocol. The outcome of interest for mildly injured children was hospital admission. Because moderately and severely injured children have a risk of death, the outcomes of interest for these children were hospital admission as well as death in the ED.

Study Protocol

We used a linked version of the private California Office of Statewide Health Planning and Development patient discharge dataset (OSHPD-PDD)[16] and ED dataset (OSHPD-ED)[17] from 2005 through 2009. These databases consist of required data for each patient submitted quarterly by all California licensed hospitals and EDs. Reported data include patients’ demographic information, diagnostic information, disposition, and expected source of payment.

Emergency department disposition was categorized as: 1) discharged home, 2) admission to the hospital, 3) death, or 4) other (including skilled nursing facilities). Rural status was defined as whether or not the patient's county of residence was a member in the California Regional Council of Rural Counties.[18] Insurance status was categorized as: 1) no insurance or self-pay; 2) public or government insurance; 3) private insurance, including Health Maintenance Organization (HMO) plans; or 4) other, including disability insurance. Distance from patient residence to the nearest acute hospital was calculated as the shortest geographic straight-line distance between the centroid of the patient's zip code and the centroid of the hospital's zip code, according to the methods of Phibbs and Luft.[19] Because distances were based on calculations based on zip codes of residence and not on definitive address locations, they were categorized as: 0 through 5 miles, 6 through 10 miles, and greater than 10 miles. For the annual median household income categories based on zip codes, we used the federal poverty line of $18,850 for a family of four in 2004.[20]

Mechanism and intent of injury was determined by E-codes using the CDC recommended framework of E-code groupings for presenting injury mortality and morbidity data.[21] Intent of injury was categorized as 1) unintentional, 2) intentional (self-harm), and 3) assault.

Injury severity scores (ISS) were calculated by the translation of ICD-9-CM diagnoses using the ICD Programs for Injury Categorization developed by Clark et al.[22] Records were then stratified into the following categories: mild injury (ISS < 9), moderate injury (9 ≤ ISS ≤ 15), and severe injury (ISS > 15).[23,24]

Data Analysis

Univariate analyses were initially conducted in the two population subgroups (mild injuries and moderate/severe injuries) to assess the association of each variable with ED disposition. Based on the univariate results, we then constructed two models, one model for each subgroup. Our first model assessed children with mild injury, testing the association between ED disposition of discharge home versus hospital admission using a logistic regression model. Children with mild injury who died were excluded from this model and analyzed separately.

Our second model assessed the population of children with moderate and severe injury (children at some risk of death), testing the association between ED disposition of discharge home, hospital admission, and ED death. For our second model, we constructed a multinomial logistic regression model according to the method of Glonek and McCullagh[25] and McCullagh Nelder[26] because we had more than one categorical outcome variable of interest.

We used a direct model building strategy and included variables that were shown in the literature to be associated with injury outcome a priori. We ran a univariate analysis with all these variables, and then we included only those variables that were significant in the univariate analysis. Basic assumptions were met, including absence of strong multicollinearity for both models. Because of our large sample size, we were able to avoid model overfitting by maintaining an events-to-covariate ratio much greater than the standard ratio of 20:1.[27]

We calculated adjusted odds ratios (AOR) with 95% confidence intervals (CI) for all the analyses. We determined statistical significance using an alpha level of < 0.005. After creation of our models, we assessed specific interaction terms (sex and injury intent, race and injury intent, and sex and firearm injury mechanism) since these variables have previously been associated in the literature.[28,29] We also conducted separate sensitivity analyses by adding the following excluded visits back into the models: 1) visits with mild injury resulting in death, 2) visits with no ISS score, and 3) visits with missing injury intent and injury mechanism. Data analysis was performed using SAS/STAT software, version 9.0 (SAS Institute Inc., Cary, NC), and STATA SE software, version 10.1 (Stata Corporation, College Station, TX).

RESULTS

There were 11,986,392 pediatric ED visits in California from 2005 through 2009, and 3,519,530 injury-related pediatric ED visits were included in our study population. Overall, there were more injury-related ED visits by male children (61%); non-Hispanic white, and Hispanic children (39%; 39%); children living in an urban county (90%); and children living within five miles of an acute care hospital (88%) (Table 1). Of note, the patients in approximately half of the visits in our study population were privately insured, over a third were publicly insured, and approximately 10% were uninsured.

The vast majority of visits resulted in discharge home (3,326,450 visits; 94.5%), a small percentage resulted in hospital admission (133,420 visits; 3.7%), and proportionally very few visits resulted in ED death (1,340 visits; 0.04%). A small percentage of visits resulted in discharges to skilled nursing facilities and other rehabilitation facilities (58,320 visits, 1.66%). Most of the study population had mild injuries (89%), and were discharged to home (96%). Of the mild injury visits resulting in admission, approximately 40% had a length of stay of 0 to 1 days only (data not shown). There was a small percentage of visits for severe injuries (10,818 visits; 0.3%), and the majority of these patients were admitted to the hospital (86%). We were unable to calculate ISS on 8.7% of our sample since these records had only E-codes indicative of injury but no ICD-9-CM injury diagnostic code. Adolescents 15 to 18 years of age compared to other age categories had a higher proportion of severe injury-related visits (47%).

The most common types of injury included open wounds, superficial injuries/contusions, and fractures/dislocations. The most common identifiable mechanism of injury presenting to the ED was fall (1,144,049 visits; 33%). Although motor vehicle collisions and firearms were only a small portion of the overall visits (236,190 visits, 7%; and 10,716 visits, 0.3%,, respectively), they contributed to a greater proportion of severe injury visits (37% and 11%, respectively).

Of the ED visits with E-codes and no ICD-9-CM diagnostic codes indicative of injury (ED visits with unclassifiable severity), the demographic distribution remained fairly similar to that of the entire study population, but there was a higher proportion of visits for children less than 1 year of age, female children, and children with intentional injuries (Table 1).

Model One: Likelihood of admission for children with mild injuries

Since children should not die from mild injury, and the vast majority did not die, we constructed a logistic regression model comparing ED disposition of admission versus discharge for visits by children with mild injury. The c-statistic for the logistic regression model was 0.712. Univariate analysis showed a number of demographic and injury factors that were related to hospital admission from the ED (Table 2). After adjustment, we found that the major determinant of admission was intent of injury. Certain mechanisms of injury (drowning, firearm, machinery, suffocation, and motor vehicle traffic) also increased the likelihood of admission compared to the mechanism of falls (Table 2). Other factors increasing the likelihood of admission were Hispanic ethnicity, Asian race, and residence further than five miles from the hospital. Children with public insurance had a higher likelihood of admission than privately insured children. In contrast, children lacking insurance had a decreased likelihood of admission compared to privately insured children. Girls had a decreased likelihood of admission compared to boys, as did children living in rural areas compared to those living in urban areas. Trend analysis demonstrated decreased likelihood of admission for each subsequent year of the study, and the sensitivity analyses showed no qualitative change in our results (data available on request). All of the interaction terms tested were not statistically significant and were not included in either of the final models.

Model Two: Likelihood of hospital admission or death for children with moderate and severe injuries

The Vuong's closeness test showed that our model was a significant improvement over a reduced base model (chi-square statistic = 588943, p-value < 0.005). After adjustment, children with more lethal mechanisms, severe injuries, and intentional injuries had a higher likelihood of admission compared to their respective peers (Table 3). Children with public insurance were more likely to be admitted for moderate and severe injuries, compared to privately insured children. In contrast, children with no insurance were less likely to be admitted than privately insured children. Similar to visits for mild injuries, girls and children living in rural areas had a decreased likelihood of admission compared to their respective peers. After adjustment, black or African American race and median household income were no longer associated with hospital admission as they were in univariate analysis (See Data Supplement Table 1 for univariate analyses). Trend analysis showed decreased likelihood of admission over the last two study years.

Death, an uncommon ED disposition, was associated most profoundly and appropriately with severe injury and lethal mechanisms (Table 3). The risk of ED death for different injury mechanisms mirrored the lethality of the mechanism, with the adjusted risk of ED death from "firearm" mechanism magnitudes greater than the risk of ED death from falls. Also, children younger than 15 years of age were more likely to experience an ED death compared to children older than 15 years of age (Table 3). While children with public insurance were as likely as privately insured children to experience an ED death, children with no insurance had an increased likelihood of ED death compared to children with private insurance. Other categories of race/ethnicity, median household income, and rural residence were not associated with ED death. Trend analysis performed over the study period showed no statistical significance.

Emergency department deaths comprised a very small proportion of children with mild injury visits (482 visits; 0.02% of mild injury visits), and injury visits with unclassifiable severity (391 visits; 0.13% of unclassified injury visits), but the number of ED deaths from mild injuries was still more than the number of ED deaths from severe injuries. Although these patients were excluded from the regression analysis, we analyzed this group separately (see Data Supplement). The majority of these deaths were in older adolescents (365 visits; 42%); and with injury mechanisms of firearm (203 visits; 23%), motor vehicle traffic (206 visits; 24%), drowning (213 visits; 24%), and suffocation (75 visits; 9%). Thirteen percent of these deaths were in African American youth; nearly 40% were in Hispanic youth. Nine percent of these deaths occurred in rural youth. There was a fairly equal distribution of these deaths across insurance status among children with mild or unclassified injuries.

DISCUSSION

In this population study, we found that even after controlling for injury characteristics, distance to the nearest acute hospital, and other demographic factors, uninsured California children were less likely to be admitted to the hospital than privately insured children for all levels of injury severity. Additionally, we found that even after adjustment for injury characteristics and other demographic factors, children without insurance had an increased likelihood of ED death for moderate and severe injuries compared to privately insured children.

In the adult population, the uninsured have been found to have a decreased likelihood to undergo certain procedures, such as revascularization for a myocardial infarction,[30] suggesting that insurance status may influence clinical decision-making. Although the ED is legally obligated to evaluate, stabilize, and treat all patients with emergency medical conditions, hospital admission is not required. Thus, variations in practice may be influenced by non-clinical factors.[31,32] In our study, we stratified by injury severity and mechanism, in an attempt to better characterize the relationship between insurance status and ED disposition for children with injury. In addition to race/ethnicity and income variables, we also adjusted for distance of residence from acute care hospital and rural/urban residence, because of documented disparities in injury deaths in inner city urban children (where many hospitals are situated) and rural children.[33,34]

The medical necessity of hospital admission for mild injury is not clearly evident. An increased likelihood of admission for publicly insured children could be related to ED physician comfort with disposition planning, and the ability of a patient to follow-up as an outpatient. An ED physician could be comfortable discharging privately insured children home with timely follow-up care with the primary care physician; however, he or she might admit publicly insured children with comparable injuries because of lack of reliable follow-up care.[35,36] Of note, a large percentage of these admissions had a length of stay less than one day, consistent with the clinical practice of observation of patients to ensure improvement and follow-up. While it must be noted that physicians may be more inclined to admit even mildly injured privately insured patients because of assurance of payment for services, conversely, the decreased likelihood of admission for uninsured children with mild injuries compared to privately insured children could reflect a choice not to admit because of inability to pay. Thus, the ED disposition decision of hospital admission for mild injuries could be based on physician's discrimination, and/or patient preference, rather than medical necessity. Alternatively, this variation in the likelihood of admission for mild injuries could be due to the influence of neighborhood and societal factors, as children living in low-income neighborhoods are more likely to be uninsured than insured.[37] Moreover, children living in low-income neighborhoods have been found to experience a higher incidence of injury and more lethal mechanisms of injury,[38] and to have unmet health care needs.[39]

Admission of moderately and severely injured patients to the hospital for further care would be presumed more of a medical necessity. Selassie et al. studied an entire population of patients with injury who presented to South Carolina EDs between 1996 and 2000, and found that regardless of injury severity, uninsured patients were significantly less likely to be hospitalized than privately insured patients.[9] Our study, approximately 10 years later in California with a focus on children, has similar findings, which may very well indicate inequitable treatment based on ability to pay.

The death of a child in the ED is tragic. While a child could be brought to the ED after dying outside of the hospital or in extremis, an ED death could also be a lost opportunity to save a child's life, with interventions occurring minutes to hours too late. Although relatively few children died in the ED from injury, these visits may represent sentinel cases warranting additional scrutiny. ED visits represent the public's initial interaction and possible entry into the hospital health care system, in particular for acute injury. Our findings suggest that insurance status may affect appropriate initial access to medical care, stabilization, management, and thus, outcome for injured pediatric patients.

Other studies have shown increased injury mortality among the uninsured compared to the insured in both adult and pediatric populations.[4,5,31,40-42] Although it is unclear why uninsured patients should have higher mortality after controlling for injury severity, this finding is consistent with several recent studies that found that uninsured pediatric trauma patients had a higher risk of death after adjustment for injury severity.[4,5] A lack of insurance has been associated with decreased utilization of medical care, lack of preventative services, and increased pre-existing conditions in adults[43-46] and children.[39,47-52] Pre-existing conditions in the adult population have been shown to increase mortality after trauma even after controlling for age and other demographic factors.[30,42,53-57] This may suggest that uninsured and insured children have different patterns of health care seeking behaviors, or that uninsured children have pre-existing conditions that predispose them to worse outcomes when an acute incident occurs. It is also important to consider that this finding could be secondary to disparate access to and quality of medical care for injury, specifically prehospital or ED care. Further studies are needed to examine transitions from prehospital settings to ED and in-hospital care, transfers from the ED, and other benchmarks of quality of care.

We investigated the effect of insurance status because it is one of the few non-clinical factors that can and has been altered by public policy in recent years, with the enactment of the Children's Health Insurance Program Reauthorization Act (CHIPRA) of 2009.[1] CHIPRA not only has expanded the eligibility for insurance coverage for vulnerable children, but also includes measures to increase enrollment of eligible uninsured children using financial incentives for states. While these policy efforts may decrease the number of children lacking insurance, children who are undocumented or who do not enroll will still lack insurance even after this policy is fully enacted. Moreover, there will still be children with public insurance and private insurance. Thus, our findings suggesting that there may be insurance-related differences in the ED disposition of acutely injured children are significant even in the midst of health policy reform, and emphasizes the necessity for all injured children to receive equitable ED care.

LIMITATIONS

Our findings should be interpreted with some caution. First, our study does not establish a causal relationship between lack of insurance and increased mortality in the ED. Second, our data reflect the experience of only one state, and injury-related patterns of ED use may vary by region. However, California has a large, diverse population and is home to approximately one in eight of the children in the United States, and our findings may therefore suggest practice and policy-related challenges of relevance to other areas of the United States. Third, it should also be noted that our analyses were performed in part on statewide, administrative datasets, which suffer from variations in coding and lack clinical detail. It is possible that there may have been coding errors, as we found visits with injuries categorized as mild but with an ED disposition of death. When we investigated these cases (Data Supplement), we primarily found visits by patients with fatal mechanisms of injury, whom we postulate, were likely to be "dead on arrival" (thus perhaps less attention was given to diagnosis and coding of these diagnoses). In addition, there may have been an inconsistency in recording insurance status in ED records; but these coding errors should be distributed randomly across insurance categories, and should not affect the uninsured disproportionately, as our findings suggest. Even with these limitations, the administrative datasets offer a total population perspective, and have been used successfully in a series of prior health outcome studies.[58,59] Fourth, the number of ED deaths was relatively small and the clinical presentation of these children could vary based on local practices. An ED disposition of death could represent patients who have essentially died in the field but were transported to an ED and declared dead on arrival. Although different emergency medical services systems may have different policies in regards to declaring the death of child outside of the hospital versus in the ED, these policies should not affect the uninsured disproportionately, as our findings suggest. Fifth, we did not adjust for comorbidities, which could potentially affect injury outcome. However, the pediatric population is generally healthy at baseline, so we do not believe this significantly affects our findings. Finally, a large portion of deaths from injury occur outside of the hospital,[60,61] and therefore, were not included in our analyses. Uninsured children may potentially have a different threshold for seeking care than insured children, and may have died outside the hospital at a greater rate than insured children. If this were the case, then the selection bias could account for the decreased likelihood of admission for uninsured children with moderate or severe injuries. However, this selection bias could not account for the increased likelihood of ED death for uninsured children with moderate or severe injuries, since the bias is in the opposite direction than we observe. Moreover, our focus was on ED care rather than prehospital care.

CONCLUSIONS

We found that uninsured California children with severe injuries were less likely to be admitted and more likely to die in the ED compared to privately insured California children, even after controlling for injury characteristics and demographic factors. These findings suggest that non-clinical factors may be influencing patterns of ED disposition and outcomes among injured children in California. Enhanced policy efforts should be made to ensure that access to quality emergency care is equitably available to all injured children.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographics of study population: California children presenting to the emergency department with injury from 2005-2009

Characteristics	All Injuries		Mild Injury		Moderate Injury		Severe Injury		Unclassifiable Severity	
			ISS <9		9 ≤ ISS ≤ 15		ISS > 15		Only injury E-code present; No ICD-9-CM injury code	
	# of Visits	%	# of Visits	%	# of Visits	%	# of Visits	%	# of Visits	%
Number of Visits	3,519,530	100	3,161,224	--	39,787	--	10,818	--	307,701	--
Age										
<1 year	395,771	11	329,569	10	4,193	11	1,418	13	60,591	20
1-4 years	639,925	18	555,676	18	5,224	13	984	9	78,041	25
5-9 years	711,732	20	652,111	21	6,164	15	1,214	11	52,243	17
10-14 years	884,333	25	824,839	26	9,066	23	2,059	19	48,369	16
15-18 years	887,769	25	799,029	25	15,140	38	5,143	48	68,457	22
Sex										
Female	1,369,530	39	1,205,762	38	10,858	27	3,050	28	149,860	49
Male	2,147,268	61	1,953,004	62	28,904	73	7,759	72	157,601	51
Not Available	2,732	0.1	2,458	0.1	25	0.1	9	0.1	240	0.1
Race/Ethnicity										
White	1,361,265	39	1,234,413	39	15,757	40	3,930	36	107,165	35
Black or African-American	290,208	8	256,350	8	3,265	8	982	9	29,611	10
Hispanic	1,388,853	39	1,241,609	39	15,849	40	4,472	41	126,923	41
Asian	153,391	4	135,717	4	1,755	4	530	5	15,389	5
American Indian or Alaska Native	13,152	0.4	11,813	0.4	122	0.3	28	0.3	1,189	0.4
Other or Not Available	312,661	9	281,322	9	3,039	8	876	8	27,424	9
Insurance Status										
Private or HMO Insurance†	1,826,338	52	1,657,485	52	19,936	50	4,972	46	143,945	47
Public or Government Insurance†	1,260,220	36	1,116,570	35	15,969	40	4,900	45	122,781	40
No Insurance/Self pay	379,120	11	339,079	11	3,321	8	797	7	35,923	12
Other†	53,843	2	48,081	2	561	1	149	1	5,052	2
Not Available	9	<0.1	9	<0.1	0	0	0	0	0	0

Characteristics	All Injuries		Mild Injury		Moderate Injury		Severe Injury		Unclassifiable Severity	
			ISS <9		9 ≤ ISS ≤ 15		ISS > 15		Only injury E-code present; No ICD-9-CM injury code	
	# of Visits	%	# of Visits	%	# of Visits	%	# of Visits	%	# of Visits	%
Rural Status										
Rural	338,554	10	305,112	10	3,578	9	919	8	28,945	9
Urban	3,180,976	90	2,856,112	90	36,209	91	9,899	92	278,756	91
Disposition										
Home	3,326,450	95	3,042,198	96	13,304	33	918	8	270,030	88
Admitted	133,420	4	71,169	2	25,102	63	9,300	86	27,849	9
Died in ED	1,340	<0.1	482	<0.1	212	1	255	2	391	0.1
Other	58,320	2	47,375	1	1,169	3	345	3	9,431	3
Distance: Residence to Nearest Acute Hospital										
0-5 miles	3,087,831	88	2,773,919	88	33,948	85	9,149	85	270,815	88
6-10 miles	279,065	8	251,008	8	3,652	9	1,011	9	23,394	8
>10 miles	144,410	4	128,899	4	2,078	5	622	6	12,811	4
Not Available	8,224	0.2	7,398	0.2	109	0.3	36	0.3	681	0.2
Annual Median Household Income *										
<100% Federal Poverty Line (FPL)	10,671	0.3	9,395	0.3	121	0.3	44	0.4	1,111	0.4
100-200% FPL	897,900	26	800,860	25	10,240	26	2,971	27	83,829	27
200-300% FPL	1,386,288	39	1,242,857	39	15,419	39	4,320	40	123,692	40
>300% FPL	1,151,938	33	1,042,778	33	13,102	33	3,237	30	92,821	30
Not Available	72,733	2	65,334	2	905	2	246	2	6,248	2
Major Injury Categories										
Fracture/Dislocation	652,637	19	622,401	20	26,729	67	3,507	32	--	--
Muscle Sprain	445,161	13	445,017	14	137	0.3	7	0.1	--	--
Intracranial/Nervous System	80,547	2	73,158	2	3,479	9	3,910	36	--	--
Abdomen/Thorax	10,318	0.3	3,838	0.1	4,223	11	2,257	21	--	--
Open Wounds	933,661	27	932,113	29	1,216	3	332	3	--	--
Blood Vessel	686	<0.1	275	<0.1	276	0.7	135	1	--	--
Superficial/Contusion	709,566	20	709,116	22	384	1	66	0.6	--	--

Characteristics	All Injuries		Mild Injury		Moderate Injury		Severe Injury		Unclassifiable Severity	
			ISS <9		9 ≤ ISS ≤ 15		ISS > 15		Only injury E-code present; No ICD-9-CM injury code	
	# of Visits	%	# of Visits	%	# of Visits	%	# of Visits	%	# of Visits	%
Crushing	14,005	0.4	12,330	0.4	1,593	4	82	0.8	--	--
Other/Not Available	672,949	19	362,976	11	1,750	4	522	5	307,701	100
Mechanism of Injury^										
Fall	1,144,049	33	1,099,604	35	12,922	32	2,216	20	29,307	10
Cut	238,514	7	235,239	7	1,387	3	267	2	1,621	0.5
Firearm	10,716	0.3	7,162	0.2	2,262	6	1,174	11	118	<0.1
Motor Vehicle Traffic	236,190	7	194,838	6	7,884	20	3,989	37	29,479	10
Pedal (Bike)	90,853	3	87,279	3	1,813	5	339	3	1,422	0.5
Pedestrian	4,117	0.1	3,780	0.1	168	0.4	54	0.5	115	<0.1
Struck	737,216	21	716,896	23	5,067	13	923	9	14,330	5
Drowning	4,290	0.1	702	<0.1	26	0.1	10	0.1	3,552	1
Machinery	3,446	0.1	3,191	0.1	102	0.3	10	0.1	143	<0.1
Suffocation	6,361	0.2	704	<0.1	20	0.1	24	0.2	5,613	2
Other Transportation	42,350	1	38,422	1	2,301	6	528	5	1,099	0.4
Other/Not Available	1,027,860	29	799,228	25	6,100	15	1,399	13	221,133	72
Intent of Injury										
Unintentional	3,093,655	88	2,796,890	88	32,162	81	8,185	76	256,418	83
Intentional	39,844	1	14,146	0.4	104	0.3	62	1	25,532	8
Assault	123,407	4	108,869	3	4,999	13	1,811	17	7,728	3
Other/Not Available	262,624	7	241,319	8	2,522	6	760	7	18,023	6

ISS = Injury Severity Score, ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification, E-code =external cause of injury code, HMO = Health Maintenance Organization.

†Private insurance: commercial insurance, preferred provider organizations (PPO), automobile medical insurance, exclusive provider organizations, and health maintenance organizations (HMO). Public insurance: Medicare, Medicaid, federal or Title V programs. Other insurance: disability insurance, Veterans' Affairs plan, and workers' compensation health claims.

*Annual Median Household income based on zip code of residence, using the 2004 Federal Poverty Line of $18,850 for a family of four.

^Mechanism of injury categories are not mutually exclusive and may include classifiable external cause of injury codes (e-code) in any of the five fields

Table 2

Predictors of hospital admission for children with mild injury seen in California emergency departments, 2005-2009

Characteristics	Unadjusted Odds Ratio (95% CI)		Adjusted Odds Ratio* (95% CI)	
Age				
<1 year	0.53	(0.52, 0.55)	0.69	(0.66, 0.71)
1-4 years	0.52	(0.50, 0.53)	0.76	(0.74, 0.78)
5-9 years	0.67	(0.65, 0.68)	0.96	(0.94, 0.99)
10-14 years	0.56	(0.55, 0.57)	0.75	(0.73, 0.76)
15-18 years	REF	--	REF	--
Sex				
Male	REF	--	REF	--
Female	0.90	(0.88, 0.91)	0.80	(0.79, 0.82)
Race/Ethnicity				
White	REF	--	REF	--
Black/African-American	1.10	(1.07, 1.13)	0.96	(0.93, 0.99)
Hispanic	1.21	(1.19, 1.23)	1.19	(1.17, 1.22)
Asian	1.21	(1.17, 1.26)	1.28	(1.23, 1.34)
Other	1.20	(1.16, 1.24)	1.16	(1.12, 1.21)
Annual Median Household Income^				
<100% Federal Poverty Line (FPL)	REF	--	REF	--
100-200% FPL	0.86	(0.76, 0.98)	0.93	(0.81, 1.07)
200-300% FPL	0.83	(0.73, 0.94)	0.93	(0.81, 1.07)
>300% FPL	0.83	(0.73, 0.94)	1.05	(0.91, 1.20)
Distance: Residence to Nearest Acute Hospital				
0-5 miles	REF	--	REF	--
6-10 miles	1.05	(1.02, 1.08)	1.07	(1.04, 1.10)
>10 miles	1.09	(1.05, 1.13)	1.10	(1.06, 1.15)
Insurance Status				
Private Insurance	REF	--	REF	--
Public Insurance	1.39	(1.37, 1.41)	1.36	(1.34, 1.39)
No Insurance	0.84	(0.82, 0.86)	0.63	(0.61, 0.66)
Rural Status				
Urban	REF	--	REF	--
Rural	0.72	(0.70, 0.74)	0.73	(0.70, 0.75)
Mechanism of Injury				
Fall	REF	--	REF	--
Cut	1.55	(1.51, 1.59)	0.66	(0.63, 0.68)
Firearm	16.42	(15.5, 17.3)	4.75	(4.43, 5.09)
Motor Vehicle Traffic	2.49	(2.43, 2.55)	2.47	(2.41, 2.54)
Pedal (Bike)	1.43	(1.37, 1.48)	1.36	(1.31, 1.42)

Characteristics	**Unadjusted Odds Ratio (95% CI)**		**Adjusted Odds Ratio* (95% CI)**	
Pedestrian	2.74	(2.39, 3.13)	2.67	(2.33, 3.06)
Struck	0.50	(0.48, 0.51)	0.36	(0.35, 0.37)
Drowning	5.53	(4.36, 6.99)	5.11	(3.98, 6.55)
Machinery	3.15	(2.71, 3.66)	3.15	(2.70, 3.66)
Suffocation	18.55	(15.7, 21.9)	3.05	(2.92, 3.19)
Other Transportation	2.98	(2.86, 3.11)	1.44	(1.15, 1.80)
Other	0.43	(0.41, 0.45)	0.39	(0.38, 0.41)
Intent of Injury				
Unintentional	REF	--	REF	--
Intentional	33.99	(32.8, 35.3)	55.19	(52.4, 58.1)
Assault	2.80	(2.72, 2.88)	4.45	(4.26, 4.64)
Undetermined	3.79	(3.36, 4.28)	2.01	(1.69, 2.38)

Discharged = 3,042,198 visits; admission = 71,169 visits, total = 3,113,367 visits

REF = reference variable,

*The adjusted model includes the following variables: age, sex, race/ethnicity, annual median household income, distance from residence to nearest acute hospital, insurance status, rural status, mechanism of injury, and intent of injury. The c-statistic for the logistic regression model was 0.712.

^Income based on zip code of residence, using the 2004 Federal Poverty Line of $18,850 for a family of four.

Trend analysis for all injuries by year showed later years with decreasing likelihood of admission.

Table 3

Predictors of a) hospital admission and b) ED death for children with moderate and severe injury seen in California emergency departments, 2005-2009

Characteristics	**Hospital Admission** Adjusted Odds Ratio* (95% CI)		**ED Death** Adjusted Odds Ratio* (95% CI)	
Injury Severity				
Moderate	REF	--	REF	--
Severe	5.02	(4.61, 5.47)	12.91	(10.39, 16.05)
Age				
<1 year	1.04	(0.96, 1.13)	3.79	(2.42, 5.93)
1-4 years	1.13	(1.05, 1.22)	4.05	(2.83, 5.80)
5-9 years	1.22	(1.14, 1.31)	2.01	(1.37, 2.95)
10-14 years	1.10	(1.03, 1.17)	1.62	(1.20, 2.18)
15-18 years	REF	--	REF	--
Sex				
Male	REF	--	REF	--
Female	0.74	(0.71, 0.78)	0.74	(0.58, 0.95)
Race/Ethnicity				
White	REF	--	REF	--
Black/African-American	0.98	(0.89, 1.08)	0.85	(0.59, 1.22)
Hispanic	1.07	(1.01, 1.13)	0.96	(0.74, 1.25)
Asian	1.11	(1.00, 1.24)	0.84	(0.46, 1.54)
Other	1.08	(0.97, 1.19)	1.46	(0.95, 2.25)
Annual Median Household Income^				
<100% Federal Poverty Line (FPL)	REF	--	REF	--
100-200% FPL	0.81	(0.53, 1.25)	0.58	(0.16, 2.09)
200-300% FPL	0.80	(0.52, 1.22)	0.51	(0.14, 1.81)
>300% FPL	0.86	(0.56, 1.31)	0.42	(0.12, 1.52)
Distance: Residence to Nearest Acute Hospital				
0-5 miles	REF	--	REF	--
6-10 miles	1.02	(0.95, 1.11)	1.48	(1.04, 2.11)
>10 miles	1.10	(0.99, 1.21)	1.38	(0.88, 2.17)
Insurance Status				
Private Insurance	REF	--	REF	--
Public Insurance	1.34	(1.28, 1.41)	0.91	(0.70, 1.18)
No Insurance	0.50	(0.46, 0.55)	3.11	(2.38, 4.06)
Rural Status				
Urban	REF	--	REF	--
Rural	0.79	(0.73, 0.86)	0.77	(0.51, 1.15)
Mechanism of Injury				
Fall	REF	--	REF	--

Characteristics	Hospital Admission Adjusted Odds Ratio* (95% CI)		ED Death Adjusted Odds Ratio* (95% CI)	
Cut	6.08	(4.98, 7.41)	89.61	(44.9, 179.0)
Firearm	6.63	(5.58, 7.87)	513.9	(287.1, 919.9)
Motor Vehicle Traffic	3.84	(3.58, 4.12)	58.48	(37.55, 91.07)
Pedal (Bike)	1.00	(0.90, 1.10)	0.71	(0.10, 5.32)
Pedestrian	3.17	(2.14, 4.69)	65.73	(25.55, 169.1)
Struck	0.62	(0.58, 0.66)	1.80	(0.94, 3.47)
Drowning	3.04	(1.13, 8.22)	<0.01	(<0.01, >999)
Machinery	0.43	(0.27, 0.69)	16.48	(3.67, 74.03)
Other Transportation	2.14	(1.94, 2.37)	7.69	(3.38, 17.46)
Other	0.67	(0.57, 0.79)	2.69	(0.63, 11.58)
Intent of Injury				
Unintentional	REF	--	REF	--
Intentional	3.18	(1.65, 6.13)	2.63	(0.80, 8.62)
Assault	1.22	(1.11, 1.35)	0.79	(0.52, 1.19)
Undetermined	1.79	(1.19, 2.68)	4.64	(2.16, 9.96)

Discharged = 14,222 visits; admission = 34,402 visits; death = 467 visits; total = 49,091 visits.

REF = Reference variable

*The adjusted model includes the following variables: age, sex, race/ethnicity, annual median household income, distance from residence to nearest acute hospital, insurance status, rural status, mechanism of injury, and intent of injury. The Vuong's closeness test showed that our model was a significant improvement over a reduced base model, with a chi-square statistic = 588943, p-value < 0.005.

^Income based on zip code of residence, using the 2004 Federal Poverty Line of $18,850 for a family of four.

Trend analysis for all injuries by year showed later years with decreasing likelihood of admission and death.