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Authors
Macy, Michelle L
Zonfrillo, Mark R
Cook, Lawrence J
et al.

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Patient and Community-Level Socio-Demographic Characteristics Associated with Emergency Department Visits for Childhood Injury; A Retrospective Analysis of Data from the Pediatric Emergency Care Applied Research Network (PECARN) Core Data Project 2004–2008

Michelle L. Macy, MD, MS[1,2,3], **Mark R. Zonfrillo, MD, MSCE**[4,5], **Lawrence J. Cook, PhD**[6], **Tomohiko Funai, MS**[6], **Jason Goldstick, PhD**[2,7], **Rachel M. Stanley, MD, MHSA**[1,8], **James M. Chamberlain, MD**[9], **Rebecca M. Cunningham, MD**[1,2,10], **Robert Lipton, PhD**[1,2,11], and **Elizabeth R. Alpern, MD, MSCE**[12] **on behalf of the Pediatric Emergency Care Applied Research Network***

[1]Department of Emergency Medicine, University of Michigan Medical School, Ann Arbor, MI

[2]University of Michigan Injury Center, Ann Arbor, MI

[3]Child Health Evaluation and Research (CHEAR) Unit, Division of General Pediatrics, University of Michigan Medical School, Ann Arbor, MI

[4]Division of Emergency Medicine, Center for Injury Research and Prevention, The Children's Hospital of Philadelphia, Philadelphia, PA

[5]Department of Pediatrics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA

[6]Department of Pediatrics, University of Utah School of Medicine, Salt Lake City, UT

[9]Division of Emergency Medicine, Children's National Health System, George Washington University School of Medicine and Health Sciences

[10]Department of Health Behavior and Health Education, University of Michigan School of Public Health, Ann Arbor, MI

[12]Department of Pediatrics, Ann and Robert H. Lurie Children's Hospital of Chicago, Center for Healthcare Studies, Feinberg School of Medicine, Northwestern University, Chicago, IL

Corresponding Author: Michelle L. Macy, University of Michigan, Division of General Pediatrics, 300 North Ingalls 6C13, Ann Arbor, MI 48109-5456, Phone: 734.936.8338, Fax: 734.764.2599, mlmacy@umich.edu.

[7]Present Affiliation: Oakland University, Rochester, MI

[8]Present Affiliation: Division of Emergency Medicine, Nationwide Children's Hospital, Columbus, OH

[11]Present Affiliation: Office of Health Equity – Policy Unit, Richmond, CA

*List of PECARN steering committee members is available at www.jpeds.com (Appendix).

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Abstract

Objective—To examine pediatric emergency department (ED) visits over 5 years, trends in injury severity, and associations between injury-related ED visit outcome and patient and community-level socio-demographic characteristics.

Study design—Retrospective analysis of administrative data provided to the Pediatric Emergency Care Applied Research Network Core Data Project, 2004–2008. Home addresses were geocoded to determine census block group and associated socio-demographic characteristics. Maximum Abbreviated Injury Scale severity and Severity Classification System scores were calculated. Generalized estimating equations were used to test for associations between socio-demographic characteristics and admission or transfer among injury-related ED visits.

Results—Overall ED visits and injury-related visits increased from 2004 to 2008 at study sites. Of 2,833,676 successfully geocoded visits, 700,821 (24.7%) were injury-related. The proportion of higher severity injury-related visits remained consistent. Nearly 10% of injury-related visits resulted in admission or transfer each year. After adjusting for age, sex, payer, and injury severity, odds of admission or transfer were lower among minority children and children from areas with moderate and high prevalence of poverty.

Conclusions—Pediatric injury-related ED visits to included sites increased over the study period while injury severity, anticipated resource utilization, and visit outcomes remained stable, with low rates of admission or transfer. Socio-demographic differences in injury-related visits and ED disposition were apparent. ED-based injury surveillance is essential to understand disparities, inform targets for prevention programs, and reduce the overall burden of childhood injuries.

Keywords

pediatric; injury severity; trends; hospital admission

Injuries remain a leading cause of childhood mortality in the United States (U.S.).[1] For every injured child who dies, the U.S. Centers for Disease Control and Prevention (CDC) estimates that 25 children are hospitalized and 925 are treated in an emergency department (ED).[2] Although the CDC has documented declining rates of fatal childhood injuries,[3] national injury surveillance systems show increased pediatric ED visits for specific injuries.[4–8]

Studies have found childhood injuries to be unevenly distributed throughout the population; disparities appear to be persistent and may be widening.[9–11] In national datasets and trauma registries, children from minority racial/ethnic groups and families of lower socioeconomic status (SES) experienced higher rates of injury and injury-related mortality.[12–16] In population-based studies in Canada, community-level measures of socioeconomic disadvantage (e.g., poverty level) were associated with childhood injuries.[17, 18]

Prior studies evaluating temporal trends in the full spectrum of pediatric injury-related ED visits in the U.S. are more than 10 years old[19–21] and administrative datasets contain limited socio-demographic information. In this study, we sought to examine the burden, severity, and outcomes of pediatric injury-related ED visits in a large multicenter database compiled by the Pediatric Emergency Care Applied Research Network (PECARN). This database is unique in that visit-level address information was linked to census block group socio-demographic data. This linkage allowed us to examine the relationship between injury-related ED visits and socio-demographic characteristics at the patient and community level; analyses that would not be possible using publically available national ED datasets.[22, 23] We hypothesized that pediatric ED visits for injury would be more common among children from disadvantaged socio-economic backgrounds and that these visits would be more likely to require admission or transfer.

Methods

Investigators obtained data for this retrospective multicenter, multiyear study from the PECARN Core Data Project (PCDP), a database established from participating hospitals' administrative data.[24] We conducted analyses in 2013 using data from 2004 through 2008, the last year that full patient addresses were available. The Institutional Review Boards of all participating sites and the data-coordinating center approved this study.

We considered sites eligible for the study based on three criteria: (1) contribution of data for all study years; (2) provision of patient's home address to the dataset; and (3) assignment of International Statistical Classification of Diseases 9th Revision Clinical Modification (ICD-9-CM) E-codes for ≥80% of visits with associated ICD-9-CM codes for injury. Of the 24 EDs contributing data to the PCDP continuously from 2004 to 2008, 16 were included in analyses (Figures 1 and 2; available at www.jpeds.com). Eight sites were freestanding children's hospital EDs, 6 sites were separate pediatric EDs within a general ED, and 2 sites were general EDs. Annual pediatric ED visit numbers ranged from 10,437 to 84,301, with overall admission rates ranging from 3 to 22%. Twelve of 16 sites were recognized as Level 1 pediatric trauma centers either by the American College of Surgeons (n=10) and/or state or regional designation (n=11).

Visit Identification

ED visits by children <19 years of age were eligible for analysis. We categorized visits as injury-related based on the presence of: 1) an ICD-9-CM code for injury or poisoning (800–995) OR 2) any non-location E code (E849.x). For example, a visit with an ICD-9-CM code for limb pain (729.5) AND an E-Code for motor vehicle collision (E813x) was considered injury-related. Visits were considered non-injury-related if: the diagnosis codes were outside of 800–995 AND there was no E-code OR the only E-codes were considered "adverse effects" (E870-E879.99, E930-E949.99). ED deaths were rare in this cohort of injured children (n=400) and excluded from analyses.

Intent and mechanism of injury were determined using the CDC Matrix of E-Code Groupings.[25] We categorized unintentional injuries based on Mechanism/Cause of Injury. A separate category for "Bites and Stings" (E-codes E905 and E906) was created because we observed a large number of "Bites and Stings" visits within the "Natural/Environmental" group. For the same reason, visits with the E-code (E918) "Caught between Objects" or (E915) "Foreign Body" were included as separate categories from the "Other Specified and Classifiable" group. We grouped intentional injuries without distinguishing the mechanism of injury given small sample sizes in subgroups. Among children younger than 10 years, we grouped assault and self-inflicted injuries together due to the smaller sample size of intentional injury visits in these age groups.

We used Abbreviated Injury Scale (AIS) severity scores as a measure of injury severity. AIS severity scores are on an ordinal scale and range from 1 (minor) to 6 (untreatable). MAIS ≥2 indicates injuries of moderate and greater severity.[26] MAIS severity scores were calculated using a two-step process. First, an investigator (MRZ) certified in Abbreviated Injury Scale (AIS) scoring used the ICDMAP-90 software to map each ICD-9-CM code associated with the visit to the 1998 version of the AIS (AIS98). Second, MRZ manually re-mapped codes to the most recent AIS versions (2005 and 2008) using the AIS manual and the ICD-9-CM injury code descriptions.[26–28] Re-mapping was necessary to ensure the severity categories from the most recent AIS manual were applied to the data. This two-step process yielded the maximum AIS (MAIS) severity score value for each visit. ICD-9-CM codes with insufficient detail to be mapped were initially assigned a MAIS severity score of 9 (unknown or indeterminable severity), and that multiple imputation was used to assign severity scores. As AIS scoring does not apply to injury-related visits without trauma (eg, poisoning) or visits with E-codes but no injury-related ICD-9-CM codes, these visits were assigned a MAIS severity score of 0.

We used Severity Classification System (SCS) scores as a measure of the anticipated resource utilization for the visit. The SCS is a 5-level system in which ICD-9-CM diagnosis codes have been assigned a score related to the anticipated ED resource utilization for the care of a child with that diagnosis.[29] In our analyses, each case was assigned the maximal SCS score among all ICD-9-CM codes associated with the visit. Within the SCS, a score of 1 indicates minor illness (e.g., diaper dermatitis) and a score of 5 indicates major illness (e.g., septic shock).

Socio-Demographic Variables

Patient-level data elements within the PCDP included demographic characteristics (eg, age, sex, race, payer, home address), ICD-9-CM codes and E-codes, and visit outcome. Child age was categorized according to groups used by the CDC; <1 year, 1–4 years, 5–9 years, 10–14 years, 15–18 years.[1]

The University of Utah DIGIT Lab geocoded the address associated with each visit. Using data available from the 2000 U.S. Census,[30] we characterized each census block group in terms of four SES measures of poverty and disadvantage:[31] (1) the proportion of households that were below 150% of the poverty level; (2) the proportion of female headed households; (3) the proportion of rental properties; and (4) the proportion of the population that was non-white. We then assigned the value of each community-level SES measure to the respective visits in the dataset and determined the distribution. Because taking averages of proportions and percentages presents difficulty with interpretation, we conducted analyses and present results based on low (<25th percentile), moderate (25th to 75th percentile), and high prevalence (>75th percentile) of the four measures of community-level SES.

Emergency Department visit outcome was categorized as admission/transfer or discharged/other (including left against medical advice, left without treatment, and missing). ED visits resulting in admission or transfer were grouped as these visits represent injuries expected to require more resources than visits resulting in ED discharge or other disposition.

Analyses

Injury Visits and Socio-Demographic Characteristics—We calculated descriptive statistics to characterize the ED visits in the sample. Associations between low-severity injuries (MAIS = 1) and socio-demographic characteristics were assessed with Pearson's chi-square test. *Mechanism of Injury*. We generated age-stratified lists of the top 10 ranking mechanisms of injury among PCDP injury visits that did not result in ED death. In order to place our findings in the context of national patterns, we compared the PCDP top 10 ranking mechanisms of injury with top ranking mechanisms of non-fatal injury by age group according to the CDC Web-based Injury Statistics Query and Reporting System (WISQARS) 2004–2008.[32]

Visits over Time—We assessed for change in the number of injury-related, non-injury related, and total visits over the study period using the Cochran-Armitage Test for linear trends. We calculated the following proportions for each year of study: 1) *injury visit rate* = the number of injury-related visits divided by the total number of ED visits, 2) *injury visit admission rate* = the number of injury-related visits resulting in admission/transfer divided by the total number of injury-related visits; 3) *moderate severity injury rate* = the number of injury-related visits with MAIS ≥2 divided by the total number of injury-related visits that mapped to AIS scores of 1–6 and 4) *high anticipated resource utilization rate* = the number of injury-related visits with SCS score ≥4 divided by the total number of injury-related visits that mapped to an SCS score. Trends in proportions over the study period were assessed with Pearson's chi-square test.

Injury Visit Outcomes—ED visit outcome was compared across child characteristics and community-level SES adjusting for injury severity using a logistic model with generalized estimating equations to account for patient clustering within ED and census block group. Prevalence of poverty was the only community-level SES measure included in the final model after collinearity was identified among other census block group variables. Interactions between variables were examined. Missing values for patient age, sex, and race, payer, and AIS mapped to 9 were populated by multiple imputation using chained regressions[33, 34] as implemented in IVEWare. Records with addresses that were missing or could not be mapped to a census block were removed from the logistic model as were all patients from one site with 34% missing data for race.

Results

Of the 3,091,217 ED visits made by children <19 years old, 2,833,676 (91.7%) were successfully geocoded. One-quarter (24.7%) of the successfully geocoded visits were injury related without ED death; >90% of the injuries were unintentional based on E-codes. Patient demographic characteristics are presented in Table I. Demographics of children with geocoded addresses were similar to those with addresses that could not be geocoded.

Injury Visits and Socio-Demographic Characteristics

Children with injury-related visits were more commonly older than 4 years, male, non-Hispanic white, and privately insured compared with the non-injury-related visit group. Especially divergent were proportions of children <1 year old (5.3% vs. 21.7%) and 10 to 14 years old (24.7% vs. 13.2%) within the injury and non-injury-related visit groups, respectively. Children from higher SES census block groups accounted for a greater proportion of injury-related visits than non-injury-related visits. For example, 30.8% of injury-related visits were from census block groups with low prevalence of poverty compared with 23.1% of non-injury-related visits.

Overall, the majority of injury visits (76.9%) were for were minor injuries (MAIS = 1). When comparing minor injuries across patient and community-level characteristics, we found no differences by sex or insurance status. However, the proportion of infants <1 year old with minor injuries was lower than among children 1 year and older (57% vs. 69%, respectively). Nearly three-quarters (73%) of non-Hispanic black children had minor injuries compared with 64% of non-Hispanic children of other races. Similarly, 73% of children living in census block groups with high prevalence of poverty had minor injuries compared with 66% of children living in census block groups with low prevalence of poverty.

Mechanism of Injury

The age-stratified top 10 ranking mechanisms of injury within the PCDP represented 76% of all injury-related visits among children <1 year old and more than 80% of injury-related visits among older children. The 1st and 2nd most common mechanisms of injury were the same for the injury visits without ED death in the PCDP database and non-fatal injuries reported by the CDC.[32] “Fall” and “Struck by/Against” were the top 2 most common mechanisms of injury across all age groups. The third most common mechanism of injury differed across age group as follows: “Unspecified” for children <1 year old; “Foreign Body” for children 1–4 years old, “Motor Vehicle Traffic” for children 5–9 years old, “Overexertion” for children 10–14 years old; and “Assault” for children 15 to 18 years old. Six to nine of the age-stratified top 10 ranking mechanisms of injury in the PCDP were in common with CDC rankings (Table II; available at www.jpeds.com**).**

Visits over Time—Total ED visits to the included PECARN sites increased over the study period. Non-injury-related visits predominated, increasing at a higher rate than injury-related visits (Table III). The absolute number of injury-related visits and injury-related visits with MAIS ≥2 increased. Proportions of injury-related visits with MAIS≥2, SCS scores ≥4, and admission or transfer were consistent over time. A decrease in the proportion of injury-related visits by non-Hispanic white children was mirrored by an increase in the proportion of injury-related visits by Hispanic children. Children from the highest SES census block groups had higher proportions of injury-related visits every year (results not shown).

Injury Visit Outcomes—The majority of injury-related visits resulted in discharge (n= 686,459, 90.4%). Admission was the outcome for 62,284 visits (8.2%), 2,956 (0.4%) were transferred, and 11,641 (1.5%) were categorized as "other" ED disposition. The proportions of injury-related visits that resulted in admission or transfer varied by age group (Table IV).

Admission or transfer was associated with higher severity injuries and with higher SCS scores. Admission or transfer was less common among children from lower SES census block groups in bivariate analyses. After adjusting for age, sex, race/ethnicity, payer, severity, and resource utilization, the odds of admission or transfer remained lower among children from moderate and high poverty census block groups compared with children from low poverty census block groups (Table V).

The interaction between race/ethnicity and payer was statistically significant in relation to odds of admission or transfer. Compared with non-Hispanic white children with private insurance, non-Hispanic white children with public insurance and non-Hispanic white children with other payer/uninsured experience higher odds of admission or transfer. Similarly, non-Hispanic children of Other race across all payers experienced higher odds of admission or transfer compared with non-Hispanic white children with private insurance. In contrast, non-Hispanic black children across all payers experienced lower odds of admission or transfer compared with non-Hispanic white children with private insurance.

Discussion

In this 5-year multicenter study, we found an increase in the absolute number of injury-related visits over time although at a lower rate than the increase in non-injury related visits. Across the study period, injury-related ED visits were of similar severity and anticipated ED resource utilization. Although national declines in fatal childhood unintentional injuries have been demonstrated,[3] data from this study suggest that opportunities to prevent non-fatal childhood injuries remain. Continued primary and secondary injury prevention efforts are needed to reduce the number and severity of injuries sustained by children that require ED care. The establishment of ED-based injury surveillance systems within individual hospitals or groups of hospitals could provide information about general trends in injury-related ED visits and allow for the identification of rare or burgeoning injuries. Such data could be used to inform and prioritize injury prevention efforts in communities at local, health system, and state levels.

Finding that low proportions of injury visits required inpatient care or transfer is consistent with the literature.[8, 35, 36] It was, however, unexpected and counter to our hypothesis to find lower severity injuries and lower rates of admission or transfer after an injury-related ED visits for non-Hispanic black children compared with non-Hispanic white children and among children from areas with moderate and high prevalence of poverty compared with children from areas with low prevalence of poverty. These results are in contrast with studies that have demonstrated higher rates of severe and fatal injuries in children with lower SES.[9–18] Our study is unique in that we included all injury-related ED visits that did not result in ED death regardless of injury severity, which may contribute to the differences between our findings and those in other studies focused on severe and fatal injuries. The differences may also relate to the sample of injured children coming from a subset of hospitals that contribute data to the PCDP and not a nationally representative sample of hospitals.

Our findings raise questions about ED utilization and admission patterns following injury for children from different socio-demographic backgrounds. Although this study contributes to the literature suggesting greater ED utilization, testing, and higher admission rates among injured children coming from higher SES backgrounds,[21, 37, 38] further exploration into the underlying reasons for these disparities is needed. One potential explanation for these findings is that parents of children from higher SES areas may be more likely to self-refer or be referred to trauma centers for care of higher severity injuries, whereas low income families may live close to the study sites and seek care at trauma centers for minor injuries. If this is a contributing factor to our findings, our patient cohort may amplify SES differences because the majority of included PECARN EDs are pediatric trauma centers. Studies of parental decision-making are needed to determine if our findings are a function of barriers to access, discretionary ED utilization, referral patterns for injury-related ED care, or other factors.

We found higher proportions of injured children had private insurance compared with non-injured children and that among injury-related visits, non-Hispanic black children with private, public, and no insurance were less likely to be admitted than non-Hispanic white children with private insurance after adjusting for available measures of injury severity, anticipated ED resource utilization, child demographic characteristics and community-level measures of poverty and disadvantage. Other studies examining healthcare utilization following an injury and insurance status have demonstrated mixed results.[39–41] Prospectively collected information from clinicians and parents at the time of admission decision making would be helpful in determining underlying reasons for the observed relationships.

There is potential to utilize the ED for injury surveillance and to promote primary, secondary, and tertiary injury prevention.[12, 42–48] The increase in the annual number of injury visits with high rates of ED discharge implies that there are large numbers of children who do not gain access to injury prevention programs offered exclusively in inpatient settings. The variation in admission and transfer following injury visits across racial/ethnic groups and community-level prevalence of poverty suggest a need for surveillance systems to track all childhood injury visits to EDs, not just those resulting in admission. Such injury surveillance would allow for the identification of modifiable factors in the community to reduce the number and severity of childhood injuries that receive ED care and may bring to light provider biases in management of injuries. Community and ED-based interventions targeted to high-risk populations represent additional opportunities to reduce childhood injuries.

The primary limitation to this research was the lack of a population-based cohort. Without the ability to determine information about injured children who sought care in other settings, died at the scene of their injury or in another ED, the number and severity of childhood injuries were likely underestimated. We also acknowledge that PECARN sites are not nationally representative in terms of geographic distribution or ED type, which limits the generalizability of our findings to the community ED settings where the majority of children in the U.S. receive emergency care.[35] The majority of ED visits in the PCDP were made to pediatric EDs in freestanding children's hospitals and/or Level 1 pediatric trauma centers. We expect this sampling bias to skew our results toward more severely injured children. Third, the data available for these analyses reflect a timespan that started more than 10 years ago (accounting for the time that full addresses were included in the database) and there is potential for changes in the epidemiology of injury-related ED visits in more recent years. In 2009, the PCDP transitioned to collecting patient ZIP code instead of full patient addresses in order to reduce the risks to study subjects associated with collection of personal data and thus preventing our ability to conduct these analyses using more recent years of data. Future studies could test for associations between ED visits for injury and ZIP code level socio-demographic characteristics. Fourth, ICD-9-CM and E-codes may not have been used consistently across hospitals but we cannot estimate the direction of this potential bias. In addition, because the PCDP dataset contains only ED disposition we did not know the final outcomes of patients receiving inpatient care. Finally, caution is needed when interpreting AIS and SCS as these scores depend upon the presence ICD-9-CM codes. The ICD-9-CM codes selected for any individual encounter may not comprehensively reflect the actual nature or severity of injuries sustained. among injured children treated in EDs, inform targets for prevention programs, and reduce the overall burden of childhood injuries.

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Abbreviations

AIS	Abbreviated Injury Scale
CDC	Centers for Disease Control and Prevention
ED	emergency department
ICD-9-CM	International Statistical Classification of Diseases 9th Revision Clinical Modification
MAIS	Maximum Abbreviated Injury Scale
PECARN	Pediatric Emergency Care Applied Research Network
PCDP	PECARN Core Data Project
SCS	Severity Classification System
SES	socioeconomic status
U.S	United States

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Appendix

Members of PECARN at the time of network approval for the parent study include:

Steering Committee—N. Kuppermann, MD (PECARN Steering Committee Chair, University of California Davis Medical Center, Sacramento, CA); E. Alpern, MD, MSCE (The Children's Hospital of Philadelphia, Philadelphia, PA); J. Chamberlain, MD (Children's National Medical Center, Washington, DC); J. M. Dean, MD, MBA (University of Utah/Primary Children's Medical Center, Salt Lake City, UT); M. J. Gerardi, MD (Atlantic Health System/Morristown Memorial Hospital/Goryeb Children's Hospital, Morristown, NJ); J. Goepp, MD (University of Rochester/Strong Memorial Hospital, Rochester, NY); M. Gorelick, MD (Medical College of Wisconsin/Children's Hospital of Wisconsin, Milwaukee, WI); J. Hoyle, MD (Helen DeVos Children's Hospital, Michigan State University School of Medicine, Grand Rapids, MI); D. Jaffe, MD (Washington University School of Medicine/St. Louis Children's Hospital in St. Louis, MO); C. Johns, MD (Children's National Medical Center, Washington, DC); N. Levick, MD, MPH (Children's Hospital of New York/Columbia University, New York, NY); P. Mahajan, MD, MPH, MBA (Children's Hospital of Michigan, Detroit, MI); R. Maio, DO, MS (University of Michigan, Ann Arbor, MI); K. Melville, MD (Calvert Memorial Hospital, Prince Frederick, MD); S. Miller*, MD (Children's Hospital of New York/Columbia University, New York, NY); D. Monroe, MD (Howard County Medical Center, Columbia, MD); R. Ruddy, MD (Cincinnati Children's Hospital Medical Center, Cincinnati, OH); R. Stanley, MD, MHSA (University of Michigan, Ann Arbor, MI); D. Treloar, MD, MS (University of Michigan, Ann Arbor, MI); M. Tunik, MD (Bellevue Hospital Center, New York, NY); and A. Walker, MD (The Johns Hopkins Hospital, Baltimore, MD).

*deceased

MCHB/EMSC liaisons—D. Kavanaugh MSW, LCSW-C (Senior Program Manager, HRSA/ MCHB Emergency Medical Services for Children); and H. Park, MPH (Acting Chief, Division of Research Office of Epidemiology and Research, HRSA/MCHB Emergency Medical Services for Children, Rockville, MD).

Central Data Management and Coordinating Center—J. M. Dean, MD, MBA (University of Utah/Primary Children's Medical Center, Salt Lake City, UT); R. Holubkov, PhD (University of Utah/Primary Children's Medical Center, Salt Lake City, UT); S. Knight, MSTAT (Intermountain Medical Center, Salt Lake City, UT); and A. Donaldson, MS (University of Utah Intermountain Injury Control Research Center, Salt Lake City, UT).

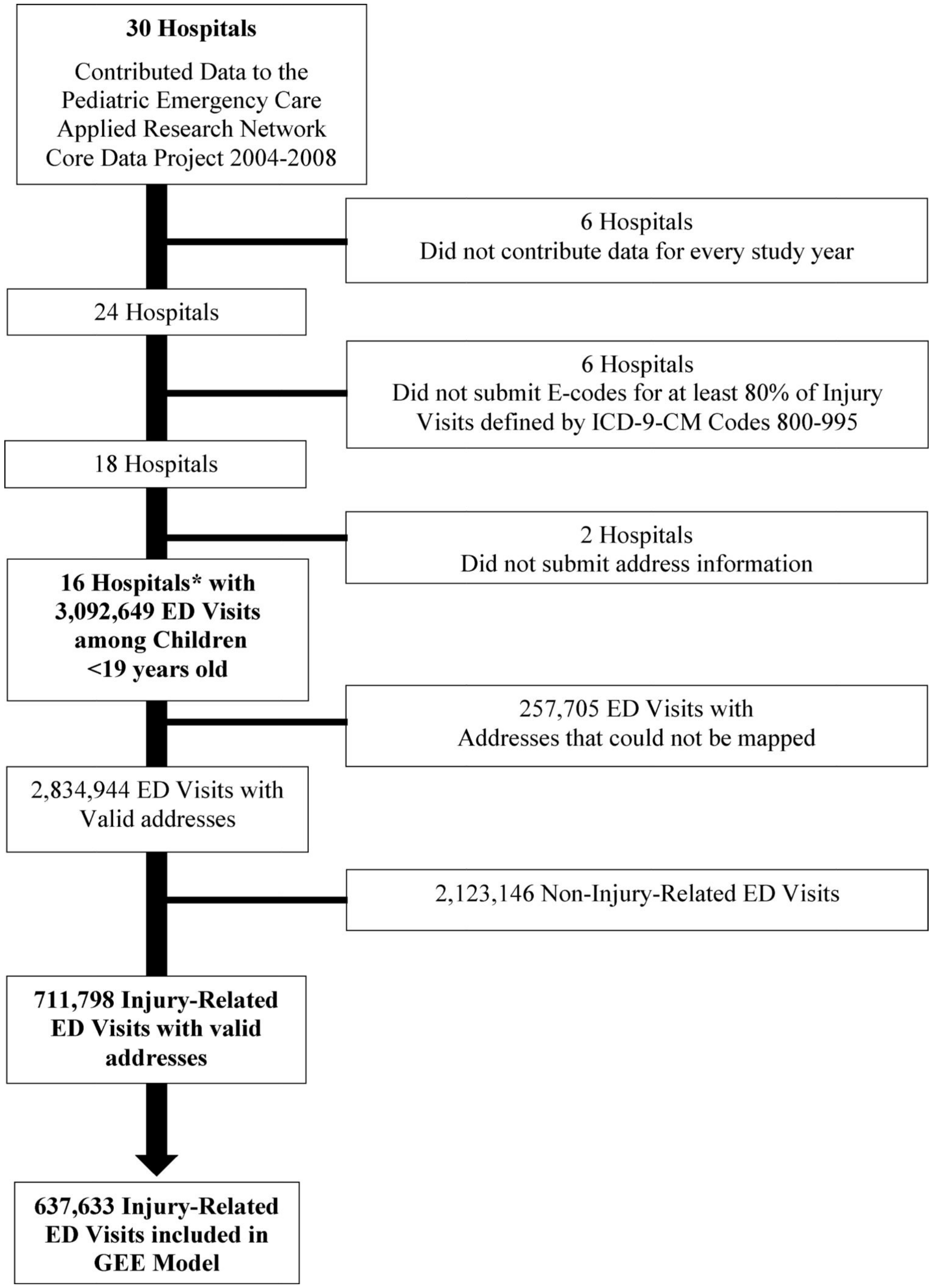

Figure 1.

Hospital and Visit Selection

*Characteristics of Hospitals Included in Analysis, presented in order from highest to lowest number of ED visits in the study period

Hospital Number	Free-Standing Children's Hospital	Level 1 Pediatric Trauma Center	Total ED Visits N	ED Visits for Injury n (%)	ED Visits Resulting in Admission n (%)
1	X	X	383,694	87,964 (22.9)	83,947 (21.9)
2	X	X	356,357	78,649 (22.1)	57,093 (16.0)
3	X	X	353,699	90,719 (25.6)	48,588 (13.7)
4	X	X	274,062	67,467 (24.6)	38,040 (13.9)
5	X	X	267,535	45,216 (16.9)	28,558 (10.7)
6	X	X	206,357	49,864 (24.2)	49,919 (24.2)
7	X	X	201,964	53,394 (26.4)	32,884 (16.3)
8		X	179,295	51,599 (28.8)	20,515 (11.4)
9		X	168,539	36,718 (21.8)	10,842 (6.4)
10			127,335	34,718 (27.3)	22,214 (17.4)
11	X	X	119,752	26,187 (21.9)	22,782 (19.0)
12			108,221	42,567 (39.3)	6,409 (5.9)
13		X	101,430	31,280 (30.8)	17,236 (17.0)
14			100,318	27,215 (27.1)	7,496 (7.5)
15			84,926	18,190 (21.4)	6,878 (8.1)
16		X	57,733	21,986 (38.1)	13,207 (22.9)

Table 1

Sample Characteristics

	Injury visits n = 763,340 n (%)	Non-Injury visits n = 2,327,877 n (%)	All visits n = 3,091,217 n (%)
Patient Characteristics			
Age, years			
<1	40,504 (5.3)	505,113 (21.7)	545,617 (17.7)
1–4	233,889 (30.6)	834,569 (35.9)	1,068,458 (34.6)
5–9	175,915 (23.1)	424,570 (18.2)	600,485 (19.4)
10–14	188,593 (24.7)	307,502 (13.2)	496,095 (16.1)
15–18	124,439 (16.3)	256,123 (11.0)	380,562 (12.3)
Sex			
Male	450,034 (59.0)	1,209,081 (51.9)	1,659,115 (53.7)
Female	313,246 (41.0)	1,118,651 (48.1)	1,431,897(46.3)
Unknown or missing	60 (<0.1)	145 (<0.1)	204 (<0.1)
Race/Ethnicity			
Non-Hispanic White	299,424 (39.2)	670,218 (28.8)	969,642 (31.4)
Non-Hispanic Black	226,407 (29.7)	766,624 (32.9)	993,031 (32.1)
Hispanic	75,439 (9.9)	364,459 (15.7)	439,898 (14.2)
Non-Hispanic Other Race	38,685 (5.1)	121,540 (5.2)	160,225 (5.2)
Unknown or missing	123,385 (16.2)	405,036 (17.4)	528,421 (17.1)
Payer Type			
Private	342,557 (44.9)	755,254 (32.4)	1,097,811 (35.5)
Public	355,518 (46.6)	1,384,314 (59.5)	1,739,832 (56.3)
Uninsured/Other	57,688 (7.6)	146,360 (6.3)	204,048 (6.6)
Unknown or missing	7,577 (1.0)	41,949 (1.8)	49,526 (1.6)
Hospital Characteristics			
Hospital Type			
Pediatric ED/Children's Hospital	499,284 (65.4)	1,664,136 (71.5)	2,163,420 (70.0)
Pediatric ED within General ED	194,299 (25.5)	524,959 (22.6)	719,258 (23.3)
General ED	69,757 (9.1)	138,782 (6.0)	208,539 (6.8)
Level 1 Pediatric Trauma Center			
Yes	640,708 (83.9)	2,029,709 (87.2)	2,670,417 (86.4)
No	122,632 (16.1)	298,168 (12.8)	420,800 (13.6)
Census Block Group Socio-Demographic Characteristics*			
	n = 700,821	n = 2,132,855	n = 2,833,676
Households in Poverty			
Low Prevalence	30.8%	23.1%	25.0%
Moderate Prevalence	46.2%	51.2%	50.0%

	Injury visits n = 763,340 n (%)	Non-Injury visits n = 2,327,877 n (%)	All visits n = 3,091,217 n (%)
High Prevalence	23.0%	25.7%	25.0%
Female Headed Household			
Low Prevalence	31.1%	23.0%	25.0%
Moderate Prevalence	45.7%	51.1%	49.8%
High Prevalence	23.2%	25.8%	25.2%
Non-White Population			
Low Prevalence	30.0%	23.4%	25.0%
Moderate Prevalence	47.5%	50.8%	50.0%
High Prevalence	22.5%	25.9%	25.0%
Rental Properties			
Low Prevalence	29.7%	23.4%	25.0%
Moderate Prevalence	48.8%	50.4%	50.0%
High Prevalence	21.6%	26.2%	25.0%

[*] The difference between the overall n and the n listed below the Census Block Group Socio-Demographic Characteristics equals the number of visits where address was missing or could not be mapped to a census block group.

First and fourth quartile thresholds for each census block group measure of SES were as follows:

Poverty: Low Prevalence (Quartile 1): <11.3% of households in census block group had income <150% of poverty level; High Prevalence (Quartile 4): ≥ 40.8% of households in census block group had income <150% of poverty level.

Female Headed Household: Low Prevalence (Quartile 1): <10.5% of households in census block group had female head, High Prevalence (Quartile 4): >29.9% of households in census block group had female head.

Non-White Population: Low Prevalence (Quartile 1): <15.8% of population in census block group was non-white, High Prevalence (Quartile 4): >91.0% of population in census block group was non-white

Rental Properties: Low Prevalence (Quartile 1): <24.5% of properties in census block group were rental properties; High Prevalence (Quartile 4): >62.3% of properties in census block group were rental properties.

Abbreviation: ED = Emergency Department.

Table 2

Rank of Injury-Related ED Visits by Mechanism of Injury

	Mechanism of Injury	Rank in PCDP	% of Injury Visits within Age Group	Rank from CDC Leading Causes of Non-Fatal Injury*
Children <1 year old (n = 42,221)	Fall	1	39.53	1
	Struck by/Against	2	7.65	2
	Unspecified	3	6.39	11
	Fire/Burn	4	4.42	4
	Foreign Body	5	4.13	5
	Motor Vehicle Traffic	6	3.87	10
	Poisoning	7	3.25	12
	Intentional	8	2.26	13
	Bite/Sting	9	2.21	3
	Overexertion	10	2.20	9
Children 1–4 years old (n = 237,325)	Fall	1	36.23	1
	Struck by/Against	2	13.61	2
	Foreign Body	3	5.07	4
	Bite/Sting	4	4.93	3
	Poisoning	5	4.15	10
	Overexertion	6	3.82	6
	Unspecified	7	3.73	9
	Cut Pierce	8	3.61	5
	Fire/Burn	9	3.21	8
	Motor Vehicle Traffic	10	2.98	11
Children 5–9 years (n = 178,433)	Fall	1	33.44	1
	Struck by/Against	2	17.79	2
	Motor Vehicle Traffic	3	6.16	7
	Cut Pierce	4	5.19	3
	Bite/Sting	5	4.50	5
	Other Pedal Cyclist	6	3.56	4
	Foreign Body	7	3.26	8
	Overexertion	8	3.02	6
	Unspecified	9	2.45	11
	Caught Between Objects	10	2.26	N/A
Children 10–14 years (n=190,767)	Fall	1	24.97	1
	Struck by/Against	2	22.35	2
	Overexertion	3	7.04	3
	Motor Vehicle Traffic	4	6.93	8
	Assault	5	5.78	7

	Mechanism of Injury	Rank in PCDP	% of Injury Visits within Age Group	Rank from CDC Leading Causes of Non-Fatal Injury*
	Cut Pierce	6	5.00	4
	Other Pedal Cyclist	7	3.26	5
	Unspecified	8	2.62	6
	Bite/Sting	9	2.53	9
	Caught Between Objects	10	1.59	N/A
Children 15–18 years (n=126,246)	Struck by/Against	1	20.54	1
	Fall	2	14.98	2
	Assault**	3	11.66	5
	Motor Vehicle Traffic	4	11.02	4
	Overexertion	5	8.61	3
	Cut Pierce	6	5.23	6
	Self-Inflicted**	7	3.09	16
	Unspecified	8	2.90	7
	Bite/Sting	9	1.87	9
	Poisoning	10	1.54	12

*According to the CDC Web-based Injury Statistics Query and Reporting System (WISQARS) 2004–2008[32]

Top 10 mechanisms of injury in CDC rankings not represented in the PCDP top 10 rankings include the following:

<1 year old: CDC rank 6 other specified, CDC rank 7 cut/pierce, CDC rank 8 inhalation/suffocation;

1–4 year old: CDC rank 7 other specified;

5–9 year old: CDC rank 9 other transportation, CDC rank 10 dog bite;

10–14 year olds: CDC rank 10 other transport,

15–18 year old: CDC rank 8 other specified, 10 other transport.

**Assault and self-inflicted injuries among 15–18 year olds in CDC rankings included additional detail regarding injury mechanism: CDC rank 5 other assault/(struck by/against), CDC rank 16 self-harm/(poisoning), CDC rank 19 self-harm/(cut/pierce).

Table 3

Emergency Department Visits, Injury Visit Severity and Injury Visit Outcome over Study Period

	Total	2004	2005	2006	2007	2008	p-value
Number of Visits							
All ED Visits, n	3,091,217	551,914	608,421	619,243	649,440	662,199	
Injury Visits, n (%)	763,340 (25.1)	149,137 (27.5)	151,243 (25.3)	150,917 (24.7)	154,952 (24.3)	157,091 (24.0)	< 0.001†
Injury Visit Severity Scores							
MAIS score 1–6,* n	677,785	132,509	134,522	134,005	137,972	138,778	
MAIS score ≥2, n (% of visits with AIS 1–6)	156,840 (23.1)	30,185 (22.8)	30,659 (22.8)	30,968 (23.1)	32,516 (23.7)	32,475 (23.4)	<0.001†
SCS score^ 1–5, n	734,708	144,733	144,733	144,023	146,191	151,322	
SCS score ≥ 4, n (% of visits with SCS 1–5)	79,526 (10.8)	15,157 (10.5)	15,689 (10.9)	16,602 (10.5)	16,602 (11.2)	16,717 (11.1)	0.098†
Injury Visit Outcomes							
Discharge/Other, n (%)	698,100 (91.5)	137,562 (92.2)	138,781 (91.8)	137,589 (91.2)	141,437 (91.3)	142,731 (90.9)	
Admission/Transfer, n (%)	65,240 (8.6)	11,575 (7.8)	12,462 (8.2)	13,328 (8.8)	13,515 (8.7)	14,360 (9.1)	< 0.001†

† Analyzed using Cochran-Armitage test for linear trends.

^ 28,727 (3.7%) injury visits did not map to an SCS score.

* 85,555 (11.2%) had an MAIS score of zero because the AIS system does not pertain to injury-related ICD-9-CM codes that are not the result of trauma (e.g., poisonings) or the visits that were included based only on the presence of an E-code. MAIS scores of 9 were imputed with values of 1 through 6.

Abbreviations: ED = Emergency Department, MAIS = maximum abbreviated injury scale, SCS = severity classification system

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Table 4

Proportion of Injury Visits with Admission or Transfer by Demographic Characteristics

Variable	Category	% Admission or Transfer n = 65,240°
Age, years	<1	16.7%
	1–4	8.5%
	5–9	8.9%
	10–14	8.7%
	15–18	11.1%
Sex	Female	9.2%
	Male	9.8%
Race/Ethnicity	Non-Hispanic White	11.1%
	Non-Hispanic Black	7.3%
	Hispanic	7.9%
	Non-Hispanic Other Race	12.6%
Payer Type	Private	9.9%
	Public	9.2%
	Uninsured/Other	9.5%
Maximum AIS Score	1	4.0%
	2	16.8%
	3/4/5/6	76.9%
	0*	17.6%
SCS Score	1	2.4%
	2	2.6%
	3	7.6%
	4/5	40.7%
	SCS could not be mapped	8.6%
Poverty	Low Prevalence	9.9%
	Moderate Prevalence	10.2%
	High Prevalence	7.6%
Female Headed Household	Low Prevalence	11.4%
	Moderate Prevalence	9.3%
	High Prevalence	7.2%
Non-White Population	Low Prevalence	13.6%
	Moderate Prevalence	8.1%
	High Prevalence	6.8%
Rental Properties	Low Prevalence	11.9%
	Moderate Prevalence	9.0%

Variable	Category	% Admission or Transfer n = 65,240°
	High Prevalence	7.1%

*Visits with injury-related ICD-9-CM codes that are not the result of trauma (e.g., poisonings) or the visits that were included based only on the presence of an E-code had MAIS scores of zero.

°Missing values for patient age, sex, race, payer and AIS mapped to 9 were imputed.

Abbreviations: ED = Emergency Department, AIS = abbreviated injury scale, SCS = severity classification system

Table 5

Injury-Visits Resulting in Admission or Transfer and Associations with Socio-Demographic Characteristics

Variable	Category	Adjusted[^] Odds Ratio of Admission or Transfer n = 627,751[°]
Age, years	<1	1.38 (1.33, 1.43)
	1–4	REF
	5–9	1.05 (1.03, 1.08)
	10–14	1.01 (0.99, 1.04)
	15–18	1.28 (1.25, 1.31)
Sex	Male	REF
	Female	0.97 (0.95, 0.98)
Maximum AIS Score	1	REF
	2	3.13 (3.06, 3.21)
	3/4/5/6	16.54(15.61,17.53)
	0[*]	2.33 (2.25, 2.41)
SCS Score	1	REF
	2	0.87 (0.80, 0.95)
	3	1.63 (1.49, 1.77)
	4/5	6.37 (5.83, 6.96)
	Did not map to SCS	1.68 (1.52, 1.85)
Poverty	Low Prevalence	REF
	Moderate Prevalence	0.89 (0.85, 0.93)
	High Prevalence	0.80 (0.75, 0.84)
Race/Ethnicity and Payer		
Non-Hispanic White	Private	REF
	Public	1.11 (1.08, 1.15)
	Other /Uninsured	1.25 (1.18, 1.33)
Non-Hispanic Black	Private	0.87 (0.84, 0.90)
	Public	0.92 (0.89, 0.95)
	Other /Uninsured	0.76 (0.70, 0.83)
Hispanic	Private	0.98 (0.92, 1.03)
	Public	0.97 (0.93, 1.01)
	Other /Uninsured	0.84 (0.77, 0.91)
Non-Hispanic Other Race	Private	1.12 (1.06, 1.18)
	Public	1.23 (1.16, 1.30)
	Other /Uninsured	1.72 (1.55, 1.90)

[^] Adjusted with generalized estimating equations to account for patient clustering within ED and census block group and adjusting for variables presented in table.

[°] Excludes visits with missing addresses or addresses that could not be mapped to a census block and visits for all patients from one site with 34% missing data for race.

* Visits with injury-related ICD-9-CM codes that are not the result of trauma (e.g., poisonings) or the visits that were included based only on the presence of an E-code had MAIS scores of zero.

Abbreviations: ED = Emergency Department, AIS = abbreviated injury scale, SCS = severity classification system