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U.S. Pediatric Trauma Patient Unplanned 30 Day Readmissions

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Abstract

Purpose—We sought to determine readmission rates and risk factors for acutely injured pediatric trauma patients.

Methods—We produced 30-day unplanned readmission rates for pediatric trauma patients using the 2013 National Readmission Database (NRD).

Results—In U.S. pediatric trauma patients, 1.7% had unplanned readmissions within 30 days. The readmission rate for patients with index operating room procedures was no higher at 1.8%. Higher readmission rates were seen in patients with injury severity scores (ISS) = 16–24 (3.4%) and ISS ≥ 25 (4.9%). Higher rates were also seen in patients with LOS beyond a week, severe abdominal and pelvic region injuries (3.0%), crushing (2.8%) and firearm injuries (4.5%), and in patients with fluid and electrolyte disorders (3.9%). The most common readmission principal diagnoses were injury, musculoskeletal/integumentary diagnoses and infection. Nearly 39% of readmitted patients required readmission operative procedures. Most common were operations on the musculoskeletal system (23.9% of all readmitted patients), the integumentary system (8.6%), the nervous system (6.6%), and digestive system (2.5%).

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Level of Evidence

This is a Level III retrospective comparative study.

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Conclusions—Overall, the readmission rate for pediatric trauma patients was low. Measures of injury severity, specifically length of stay, were most useful in identifying those who would benefit from targeted care coordination resources.

Keywords

pediatric; trauma; injury; readmissions

1. Introduction

Readmissions are increasingly being scrutinized by public insurers, accountable care¹ organizations, and the American College of Surgeons [1–7]. Trauma readmissions have been promoted as a quality indicator [2, 5, 8], and they have been used as a metric to compare patient care approaches and hospital outcomes [9–12]. Published work has largely focused on adult trauma patient readmissions [5, 8, 10–24]. A number of those studies are limited to single institutions that do not track readmissions at different hospitals [13, 14, 16, 19, 21]. The readmission studies that have included pediatric trauma patients have described readmissions to the same institutions [25–28], and these may underestimate pediatric trauma readmissions [5, 29]. Among adult trauma patients in California, only 55% of the readmissions were in the same hospital as the index admission [12]. While the proportion is likely lower for pediatric patients, currently this is not known. Choi, et al. reported a very low pediatric trauma unplanned readmission rate of 0.38% over a 5-year study period in their institution [27]. Brown, et al. in a recent paper compared readmissions of pediatric trauma patients to those admitted to other surgical services; the rate of readmissions to trauma services was among the lowest at 2.3% [28]. However, this comparison did not account for trauma patients that may be admitted to other services, i.e. neurosurgical or orthopedic services.

Older age [20, 30], comorbidities [20, 30, 31], pre-injury medications [19], injury severity [20], body region injured [18, 20], length of stay [20], discharge disposition [18, 20, 30], and social deprivation [15] have all been associated with readmissions in adult trauma patients. Moore et al. reported a 30 day unplanned readmission rate of 5.9% for acutely injured trauma patients (16 years or older), and they estimated that 30% of the 30 day readmissions were due to potential complications of injury [20]. Reduced 30 day and 1 year readmissions for adult trauma patients were found to be associated with primary triage to trauma centers by Staudenmeyer and her colleagues, demonstrating a benefit of trauma center care beyond reduced mortality [12].

This study is the first to provide national estimates of pediatric trauma unplanned all-cause 30 day readmission rates by patient, injury, and hospital characteristics. Details about the readmission visits, including whether patients returned to the same hospital, readmission diagnoses and operative procedures are reported. We sought to identify higher readmission risk populations. We are using the National Readmission Database (NRD), a new Healthcare Cost and Utilization Project dataset which tracks readmissions across hospitals within

¹National Readmission Database (NRD), All Patient Refined Diagnosis Related Groupings (APR-DRG), Adjusted Odds Ratio (AOR)

participating states. A number of previous U.S. trauma readmission studies have used the state specific datasets that contribute to the NRD [10–12, 17, 18]. The NRD is useful for studying relatively rare events like readmission after pediatric trauma.

2. Methods

2.1 Data source and patient selection

The 2013 National Readmission Database has discharge records from 21 states. The NRD is a convenience sample of nearly 100% of the discharges in the participating states from those hospitals that are not rehabilitation or long-term acute care facilities. The 2013 dataset contains approximately 14 million hospital discharges; when weighted, it estimates 36 million discharges. The weighting is meant to compensate for under or over-representation of hospitals and patient populations in the target universe derived from American Hospital Association data. Post-stratification weighting accounted for the following hospital and patient characteristics: census region, hospital urban/rural location, hospital teaching status, number of beds, hospital control (public, private not-for-profit, and private for-profit), and patient age and sex [32]. NRD documentation provides details about excluded records and missing data imputation [32].

Our index event was pediatric trauma admission based on the principal diagnosis in children 1–17 years old. We did not include children under the age of 1, because the unique patient identifiers are not consistently reported across all states and their readmissions cannot be as readily tracked [32]. We defined hospitalized pediatric trauma patients using the National Trauma Data Standard Definition for trauma patients, International Classification of Diseases, Ninth Revision (ICD-9) injury diagnoses 800–959.9, excluding patients with codes only for late effects of injury, foreign bodies, or superficial injury [33]. We also excluded burn patients, as they are a distinct category of trauma patients with different transfer and readmission patterns [34, 35]. To capture acute injury events, patients with planned (elective) index admissions were excluded. Elective and non-elective readmissions were derived from the type of admission (emergency/urgent versus elective), and this variable is provided in the NRD for all admissions. Index events in which patients died were excluded. Patients admitted in December were also excluded, so that 30 days of follow-up were available for all patients. We also excluded patients with cancer and psychoses (1.2% of the sample). These conditions substantially increased the risk of readmission, and these types of exclusions are a recommended practice when evaluating readmissions in large sample populations [32]. Rather than exclude patients with other commonly occurring chronic conditions and comorbidities, we describe readmissions in these patients using the Chronic Condition Indicator (CCI) and the comorbidity measures provided in the NRD.

2.2 Transfers

Patients were tracked across hospitals within a state using patient linkage numbers and combined records for transferred patients. Combined transfer records were provided in the NRD and included the following: diagnoses from the latter discharge and combined lengths of stay (LOS) from the two discharges. We chose to combine the LOS for a small group of transferred patients (n=14) not considered same day events (LOS = 1 day for their first

admission and the second admission was within one day). The latter admission date was used as the date of the index event.

2.3 Readmission rates

We report 30 day all-cause unplanned readmission rates by patient, injury, and hospital characteristics. We have included readmission rates for the top five comorbid conditions, as well as readmission rates based on the number of chronic conditions listed among the secondary diagnoses. Descriptions of the readmission visit are provided, including the proportion returning to different hospitals, those requiring readmission for major operative procedures, and descriptions of the operative procedures. The readmission principal diagnoses were categorized using a list (Appendix A) developed and used by other researchers describing trauma readmissions [20, 36]. We have added updates to this trauma-related diagnosis list based on the readmission principal diagnoses seen in this sample of pediatric trauma patients.

2.4 Severity measures

Injury Severity Scores (ISS) and Abbreviated Injury Scores (AIS) were generated using a validated and publicly available Stata program, ICD Programs for Injury Categorization (ICDPIC) [37]. Hospital trauma level is not in the NRD, so we generated a trauma patient hospital volume variable using quartiles of the annual volume of trauma patients (all ages) with ISS >15. The All Patient Refined Diagnosis Related Groupings (APR-DRGs), developed by 3M™ Health Information Systems, were provided in the NRD, and we utilized its severity of illness measure because it takes into account age, comorbidities, and complications.

2.5 Statistical methods

Using SAS Enterprise Guide 7.1 (SAS Institute Inc., Cary, NC, USA), we produced 30 day all-cause unplanned readmission rates with 95% confidence intervals across patient, injury, and hospital factors. Multivariable logistic regression was used to evaluate risk factors for readmission.

3. Results

From January – November 2013, there were 21,594 index admissions and 381 readmissions in the sample (Table 1). When weighted, these represent an estimated 67,168 U.S. pediatric trauma patients and 1,166 readmissions, producing a national unplanned readmission rate of 1.7% (95% CI: 1.5–1.9). Readmission rates were similar across patient demographic categories. Across age categories, the highest rate was in 15–17 year olds, 2.1% (95% CI: 1.7 – 2.5). Readmissions were seen in patients with all types of principal injury diagnoses. Wide confidence intervals were seen in some categories because of small sample sizes. Only those with crushing injuries had a rate that was statistically higher (2.8% (95% CI: 2.1 – 3.4)) than the overall rate. Among pediatric patients with AIS scores 3, the highest readmission rate was seen in those with injuries to the abdominal and pelvic contents, 3.0% (95% CI: 2.2 – 3.8). Readmission rates increased with increasing injury severity scores. Patients with an ISS 25 had a readmission rate of 4.9% (95% CI: 2.8 – 6.9). Patients with

extreme loss of function, as measured by the APR-DRG, also had a higher readmission rate of 5.9%.

Across the top five most common comorbidities, only those with fluid and electrolyte disorders had higher readmission rates, 3.9% (95% CI: 2.6–5.2). Chronic conditions were seen in 31.7% of the children in the sample, and those with two or more chronic conditions had a higher readmission rate of 2.8% (95% CI: 2.1 – 3.5). Across the mechanisms of injury categories, there were small numbers of readmissions in some categories, limiting the estimate reliability. Pediatric patients with firearm injuries had a higher readmission rate of 4.5% (95% CI: 2.8 – 6.2). The readmission rates were similar for patients with and without a major operating room procedure in the index visit. Patients with an index LOS greater than a week also had higher readmission rates, and for patients with LOS ≥ 15 days, the readmission rate was 6.9% (4.5 – 9.2). Patients transferred to short-term hospitals, home health, and other facilities (i.e. skilled nursing facilities and intermediate care facilities) also had higher rates of readmission.

Table 2 shows readmission rates across the following hospital characteristics: trauma patient volume, children's hospitals versus non-children's hospitals, teaching status, control/ownership, bed size, and urban/rural location. There were only small differences in the readmission rates across hospital characteristics; rates ranged from 1.3 – 2.4%. In a multivariable logistic model controlling for trauma patient volume, patient age, sex, ISS, primary payer, patient urban/rural location, median household income by zip code, the presence of a chronic condition or an OR procedure, only LOS was associated with readmission (data not shown).

In Table 3, the sample readmission visits are described. Over 9% of patients were readmitted within one day, while another 38% were readmitted within one week. The majority returned to the same hospital, 86.2% (95% CI: 82.4 – 90.0). Readmission LOS beyond 3 days was seen in 41.7% of patients. For over a quarter of the readmitted patients, 26.5% (95% CI: 21.4 – 31.7), injury was the readmission principal diagnosis. The most commonly seen trauma-related principal diagnoses were in the musculoskeletal/integumentary category, 15.1% (95% CI: 10.6 – 19.7). Infection was the second most commonly listed principal diagnosis, 14.9% (95% CI: 10.8 – 19.0). Vascular, gastrointestinal, and pulmonary diagnoses were the next most commonly seen categories. Detailed diagnoses included in each of the trauma-related categories are reported in Appendix A. In the sample of readmitted patients, 16% had neither an injury nor trauma-related diagnosis as their principal diagnosis. When all 24 secondary diagnoses were evaluated, only 3.8% had none of the trauma-related readmission diagnoses (data not shown), though for this group the principal readmission diagnoses were not clearly trauma-related.

Of the readmitted patients, 38.7% (95% CI: 33.4 – 44.1) required an operating room procedure during the readmission. More specifically, operations on the musculoskeletal system (23.9% of all readmitted patients), the integumentary system (8.6%), the nervous system (6.6%), and digestive system (2.5%) were the top four categories of operations. Other operative categories had small sample sizes. Within the musculoskeletal system category, the majority were operative treatments of fracture or dislocation. The next most

frequently seen operative procedures were therapeutic procedures on muscles and tendons, spinal fusion, and partial excision of bone. Skin grafts and debridement of wound, infection, or burn were the top integumentary system procedures.

4. Discussion

The national pediatric trauma readmission rate is higher than a previously reported single institution rate [27]. It is lower, however, than that seen in an adult trauma population (4.6% in 16–54 year olds) [20]. It is also lower than the 30 day readmission rate reported for all pediatric surgical patients (4.4%) [28]. The NRD includes all hospitals within participating states and overcomes the limitation of many studies which describe only readmissions to the index hospital. This study shows that the majority of pediatric trauma patients returned to the same hospital, suggesting that single institution rates are meaningful quality improvement metrics.

While the readmission rates were similar for patients with and without a major operating room procedure in the index visit, over one-third required an operating room procedure during readmission. The majority of these were operative treatments of a fracture or dislocation. While our analysis was limited to unplanned readmissions, we cannot be certain that these were unplanned procedures.

Only index length of stay was significantly associated with readmission in a multivariable model controlling for patient demographics, injury severity, and hospital trauma patient volume. Patients with crushing or firearm injuries and those with comorbid fluid and electrolyte disorders were three higher risk populations. Patients with two or more chronic conditions were also at slightly higher risk of readmission. Previously, Berry et al. described a high 30 day readmission rate (17.1%) among pediatric patients with chronic conditions as a result of injuries [4]. Future readmission prevention efforts should focus on patients with more severe injuries requiring longer lengths of stay.

4.1 Limitations

Patients who traveled across state lines would not have been captured in this analysis. We do not know about deaths that occurred after discharge. The NRD is an administrative dataset which lacks some of the relevant clinical information. We have included only unplanned readmissions based upon a variable provided in the NRD. The use of administrative labels based on the timing of hospital registration for planned and unplanned admissions has been reported to have a high level of accuracy in one pediatric hospital [38], but we cannot verify the validity of these labels in our study. Our retrospective study could not evaluate important care delivery factors, such as access to specialized care, resources available at the primary institution, or caregiver and primary care resources which might affect readmission risk [39]. Day and time of discharge and caregivers' perceptions about readiness for discharge may also be important factors [26, 39]. While there were low rates of missing data, misclassification cannot be assessed.

5. Conclusions

Care continuums and long term outcomes are receiving greater emphasis in pediatric trauma; 30 day readmission is one such long term outcome. Like mortality in pediatric trauma patients, the overall 30 day unplanned readmission rate was low. Not surprisingly, measures of injury severity, including length of stay, were most useful in identifying those with a higher risk of readmission. Discharge planning and other readmission prevention efforts should target these patients.

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Appendix A. Categorization of readmission diagnoses

Trauma-related diagnoses	ICD 9 CM	
	Codes from Moore, 2014 [20] and Hoyt, 1992 [36]	Added codes
1. Musculoskeletal/Integumentary		
Compartment Syndrome	958.8	958.9
Decubitus	707.0;785.4	
Loss of Reduction/Fixation	996.4	
Nonunion	733.82	
Osteomyelitis	730.0–730.2	
Orthopedic Wound Infection	998.5;996.6	
Complication Orthopedic Internal Device		996.78
Late Amputation Complication		997.69
Nonhealing of a Surgical Wound		998.83
Old Foreign Body in Soft Tissue		729.6
Acquired Limb Deformity		736.89
2. Infection		
Clostridium difficile		008.45
Cellulitis/Traumatic Injury	681–682	

Trauma-related diagnoses	ICD 9 CM	
	Codes from Moore, 2014 [20] and Hoyt, 1992 [36]	Added codes
Fungal Sepsis	038.9;117.9	
Tracheostomy Infection		519.01
Sialoadentitis		527.2
Infection of Cystostomy		596.81
Intra-abdominal Abscess	567.2;998.5	
Local Skin Infection		686.9
Pyogenic Arthritis		711.0
Fever		780.60, 780.61
Line Infection	996.62;999.3	
Necrotizing Fascitis	729.4	
Sepsis-like Syndrome/Septicemia	038	
Sinusitis	461;473	
Wound Infection	998.5	958.3
Yeast Infection	112	
3. Vascular		
Anastomosis Hemorrhage	996.1–996.74	
DVT	444.21–444.22;451.0;451.11; 451.19;453.8;997.2;999.2	
Embolus (non-pulmonary)	444	
Gangrene	785.4	
Graft Infection	996.62	
Thrombosis	996.74	
4. Gastrointestinal		
Anastomotic Leak	997.4	
Bowel Injury (iatrogenic)	998.2	
Dehiscence/Evisceration	998.3	
Enterotomy	998.2	
Fistula (other than pancreatic fistula)	998.6	

Trauma-related diagnoses	ICD 9 CM	
	Codes from Moore, 2014 [20] and Hoyt, 1992 [36]	Added codes
Rectal and Anal Hemorrhage		569.3
GI Hemorrhage	578	
Ileus	560.1;997.4	
Peritonitis	567.2;567.9;998.5	
SBO (Small Bowel Obstruction)	560.9;997.4	
Intestinal Obstruction		560.89
Perforation of Intestine		569.83
Ulcer- Duodenal/Gastric	531–533	
5. Pulmonary		
Acute Tracheitis No Obstruction		464.10
Stenosis of Larynx		478.74
Abscess (excludes empyema)	513.0	
ARDS	518.5	
Aspiration/Pneumonia	507.0;997.3	
Atelectasis	518.0	
Empyema	510.9	
Fat Embolus	958.1	
Hemothorax/Pneumothorax	511.8;512.0;512.8;998.2	
Pneumonia	480–486	
Pulmonary Edema	428.1;518.4	
Pulmonary Embolus	415.1	
Respiratory Failure/Distress	518.81–518.82	518.84
Pleural Effusion	511.1–511.9	
Other Pulmonary	519.8	
Traumatic Subcutaneous Emphysema		958.7
6. Pain/Fluids/Other		
Acute Postop Pain		338.18:

Trauma-related diagnoses	ICD 9 CM	
	Codes from Moore, 2014 [20] and Hoyt, 1992 [36]	Added codes
Post-trauma Headache		339.20, 339.21
Chest Pain		786.50
Abdominal Pain		789.0
Joint Pain Pelvis		719.45
Pain in Limb		729.5
Anesthetic Complication	995.2	
Fluids	276.0–276.1;276.3;276.5–276.8	
Hypothermia	780.9;991.6	
Unexpected Postoperative Hemorrhage	998.1	
Other Complications of Procedures		998.89
7. Neurologic		
Alcohol Withdrawal	291.0;291.3;291.8	
Anoxic Encephalopathy	348.1;997.0	
Diabetes Insipidus	253.5	
Postconcussion Syndrome		310.2
Meningitis	322;958.8	
Intracranial Abscess		324.0
Obstructive Hydrocephalus		331.4
Cerebrospinal Rhinorrhea		349.81
Subdural Hemorrhage		432.1
Neuropraxia (iatrogenic)	997.0	
Nonoperative SDH/EDH	253.6	
Lumbosacral Neuritis		724.4
Seizure in Hospital	780.3	
SIADH	253.6	
Stroke/CVA	434;436	
Ventriculitis-Postsurgical	322.9;996.63	

Trauma-related diagnoses	ICD 9 CM	
	Codes from Moore, 2014 [20] and Hoyt, 1992 [36]	Added codes
8. Renal/GU		
Renal Failure	584.5;584.9;958.5	
Pyelonephritis		590.10, 590.80
Cystitis		595.9
Gross Hematuria		599.71
Ureteral Injury	998.2	
UTI	599.0	
9. Hepatic, Pancreatic, Biliary, Splenic		
Abscess of Liver		5720
Cholangitis		5761
Obstruction of Bile Duct		5762
Pancreatic Cyst/Pseudocyst		577.2
Acalculous Cholecystitis	575.0–575.1	
Hepatitis	070	
Liver Failure	570;573.4;997.4	
Pancreatic Fistula	577.8	
Pancreatitis	577.0	
Splenic Injury (iatrogenic)	998.2	
Other Hepatic/Biliary	573.9;574;576.8–576.9	
10. Psychiatric		
Transient Mental Disorder	293.9	
Acute Stress Reaction		308.9
11. Cardiovascular		
Arrhythmia	427;997.1	
Cardiac Arrest (unexpected)	427.5	
Cardiogenic Shock	785.51	
CHF (iatrogenic)	428	

Trauma-related diagnoses	ICD 9 CM	
	Codes from Moore, 2014 [20] and Hoyt, 1992 [36]	Added codes
MI	410	
Pericarditis	410.90–410.99;420.0;423.1, 423.2;423.9	
Pericardial Effusion or Tamponade	420.90;423.0;423.9	
Syncope and Collapse		780.2
Shock	785.50;785.59	
Other Cardiovascular	997.1	

ICD: International Classification of Diseases

Table 1

Pediatric trauma patient 30 day readmission rates by patient and injury characteristics

	Sample		National estimates	
	Index	Readm	%	95% CI
Total	21,594	381	1.7	(1.5 – 1.9)
Age (age in years at the index admission)				
1–4	3,743	64	1.8	(1.3 – 2.3)
5–9	5,102	71	1.4	(0.9 – 1.8)
10–14	6,165	102	1.6	(1.2 – 1.9)
15–17	6,584	144	2.1	(1.7 – 2.5)
Sex				
Male	14,700	261	1.8	(1.5 – 2.1)
Female	6,894	120	1.6	(1.2 – 2.0)
Median household income (by zip code)				
\$1–\$37,999	6,478	130	2.1	(1.6 – 2.5)
\$38,000–\$47,999	5,610	94	1.7	(1.3 – 2.2)
\$48,000–\$63,999	5,070	76	1.4	(1.0 – 1.9)
\$64,000 or more	4,141	72	1.6	(1.1 – 2.1)
Primary expected payer				
Public	10,480	200	1.9	(1.6 – 2.2)
Private insurance	10,067	161	1.6	(1.4 – 1.9)
Self-pay/no charge	1,011	20	1.5	(0.5 – 2.5)
Patient location (urban/rural)				
Metro areas of 1 million population	11,148	197	1.7	(1.4 – 2.0)
Counties in metro areas of 250,000–999,999	4,611	90	2.0	(1.5 – 2.4)
Counties in metro areas of 50,000–249,999	2,304	33	1.3	(0.8 – 1.8)
Not metropolitan or micropolitan counties	3,485	59	1.8	(1.2 – 2.3)
Principal diagnosis ^a				
Fracture of neck of femur (hip)	441	12	4.0	(1.4 – 6.7)
Crushing injury	2,191	75	2.8	(2.1 – 3.4)
Other injuries and conditions due to external causes ^b	514	14	2.7	(1.0 – 4.3)
Other fractures	980	25	2.7	(1.6 – 3.8)
Open wounds of extremities	1,023	21	1.9	(1.0 – 2.8)
Fracture of lower limb	4,542	81	1.9	(1.4 – 2.4)
Intracranial injury	3,854	65	1.7	(1.3 – 2.2)
Skull and face fractures	1,453	21	1.2	(0.7 – 1.7)
Fracture of upper limb	4,997	48	0.9	(0.6 – 1.3)
Open wounds of head, neck, and trunk	1,107	10		

	Sample		National estimates	
	Index	Readm	%	95% CI
Total	21,594	381	1.7	(1.5 – 1.9)
Joint disorders and dislocations/Sprains and strains	343	10		
Spinal cord injury	149	10		
Severe injury (AIS 3) by body region				
Head/neck/face	6,559	105	1.6	(1.2 – 1.9)
Chest	1,499	33	2.4	(1.5 – 3.4)
Abdominal and pelvic contents	1,869	68	3.0	(2.2 – 3.8)
Extremities or pelvic girdle	10,890	164	1.5	(1.3 – 1.8)
External	777	11	1.7	(0.5 – 2.8)
Injury Severity Score (ISS)				
1–15	19,168	294	1.5	(1.3 – 1.7)
16–24	1,793	59	3.4	(2.5 – 4.2)
25–75	558	28	4.9	(2.8 – 6.9)
All Patient Refined DRG: Severity of illness subclass				
Minor loss of function	10,830	134	1.2	(1.0 – 1.5)
Moderate loss of function	7,703	124	1.6	(1.2 – 1.9)
Major loss of function	2,292	79	3.2	(2.4 – 4.0)
Extreme loss of function	767	44	5.9	(3.9 – 7.9)
Top five comorbidities ^c				
Chronic pulmonary disease	1,860	38	1.6	(1.0 – 2.3)
Fluid and electrolyte disorders	823	35	3.9	(2.6 – 5.2)
Substance abuse	523	16	2.5	(1.3 – 3.7)
Deficiency anemia	439	12	2.3	(0.9 – 3.7)
Other neurological disorders	379	14	3.1	(1.4 – 4.9)
# Chronic conditions ^d				
0	14,749	202	1.4	(1.2 – 1.6)
1	4,152	92	2.2	(1.7 – 2.7)
2	2,693	87	2.8	(2.1 – 3.5)
Mechanism ^a				
Firearm	570	25	4.5	(2.8 – 6.2)
Pedestrian, other; Transport, other	1,632	36	2.4	(1.4 – 3.4)
Motor vehicle accident	4,264	89	2.0	(1.5 – 2.4)
Struck by, against	2,424	44	1.9	(1.2 – 2.5)
Other/unspecified	1,129	22	1.5	(0.8 – 2.3)
Fall	8,025	116	1.4	(1.1 – 1.7)
Cut/pierce	723	12	1.3	(0.4 – 2.1)
Pedal cyclist, other	955	10		

	Sample		National estimates	
	Index	Readm	%	95% CI
Total	21,594	381	1.7	(1.5 – 1.9)
Natural/environmental	515	10		
Machinery	98	10		
Drowning/submersion/suffocation	14	10		
Major operating room procedure				
No	10,338	174	1.7	(1.4 – 1.9)
Yes	11,256	207	1.8	(1.5 – 2.1)
Length of stay (days)				
0–3	17,028	217	1.3	(1.1 – 1.5)
4–7	2,909	72	2.2	(1.6 – 2.8)
8–14	949	44	3.9	(2.7 – 5.0)
15	708	48	6.9	(4.5 – 9.2)
Disposition of patient				
Routine	20,297	328	1.6	(1.4 – 1.8)
Transfer	532	26	4.7	(2.5 – 6.9)
Home health care, skilled nursing, intermediate, and other facilities	724	27	3.4	(2.0 – 4.8)
Against medical advice/destination unknown	41	-		

Readm = Readmissions; DRG = Diagnosis related grouping; AIS = Abbreviated Injury Score

^aInjury and mechanism were based on categories generated by the Clinical Classifications Software.

^bThe “Other injuries and conditions due to external causes” category includes nerve injuries (950–951,953–957) other than the spinal cord, non-specific injuries (959) and traumatic complications (958). Readmissions were seen in each of these subcategories.

^cThe NRD has 29 comorbidity measures.

^dThe Chronic Condition Indicator (CCI) in NRD provides labels for all diagnoses (chronic or not). This count does not include principal diagnoses, such as spinal cord injury, that are chronic conditions.

Table 2

Pediatric trauma patient 30 day readmission rates by hospital characteristics

	Sample		National estimates	
	Index	Readm	%	95% CI
Annual number of trauma patients with ISS>15 ^a				
Q1: 1–59	5,334	91	1.7	(1.3 – 2.1)
Q2: 60–190	5,622	80	1.4	(1.1 – 1.8)
Q3: 191–457	5,647	107	1.7	(1.4 – 2.1)
Q4: 458–1419	4,991	103	2.1	(1.7 – 2.5)
Children's hospital				
No	18,460	323	1.7	(1.5 – 1.9)
Yes	3,134	58	1.9	(1.3 – 2.5)
Teaching status				
Metropolitan non-teaching	3,593	61	1.6	(1.1 – 2.0)
Metropolitan teaching	17,175	309	1.8	(1.6 – 2.0)
Non-metropolitan	826	11	1.3	(0.4 – 2.2)
Control/ownership of hospital				
Government, nonfederal [public]	4,784	91	1.9	(1.5 – 2.3)
Private, not-for-profit [voluntary]	15,546	264	1.7	(1.4 – 1.9)
Private, investor-owned [proprietary]	1,264	26	2.0	(1.2 – 2.8)
Bed size of hospital ^b				
Small	1,135	26	2.4	(1.3 – 3.5)
Medium	4,245	77	1.8	(1.4 – 2.2)
Large	16,214	278	1.7	(1.4 – 1.9)
Hospital urban-rural designation				
Large metropolitan areas with at least 1 million residents	12,409	231	1.8	(1.6 – 2.1)
Small metropolitan areas with less than 1 million residents	8,359	139	1.7	(1.4 – 1.9)
Not metropolitan or micropolitan	826	11	1.3	(0.4 – 2.2)

Readm = Readmissions; Q= Quartile based on annual patient volume

^aTrauma patient volume (ISS>15) included children and adults.^bBed size categories were dependent upon each hospital's region in the US, urban-rural designation, and teaching status.

Table 3

Characteristics of the readmission stay for pediatric trauma patients

	Sample	National estimates		
	n	N	%	95% CI
Total	381	1,166	100.0	
Readmitted within (days)				
1	35	113	9.7	(6.5 – 13.0)
2–7	146	440	37.7	(32.5 – 42.9)
8–14	95	305	26.1	(21.7 – 30.6)
15+	105	308	26.4	(21.8 – 31.1)
Same/different hospital				
Different hospital readmission	54	161	13.8	(10.0 – 17.6)
Same hospital readmission	327	1,005	86.2	(82.4 – 90.0)
Readmission LOS (days)				
0–3	222	680	58.3	(53.2 – 63.5)
4–7	96	292	25.1	(20.8 – 29.3)
8–14	37	105	9.0	(5.8 – 12.1)
15	26	89	7.6	(4.3 – 10.9)
Principal readmission trauma-related diagnosis categories ^a				
Injury diagnosis	109	310	26.5	(21.4 – 31.7)
Musculoskeletal integumentary	55	177	15.1	(10.6 – 19.7)
Infection	54	173	14.9	(10.8 – 19.0)
Vascular	31	105	9.0	(4.7 – 13.3)
Gastrointestinal	39	103	8.8	(5.9 – 11.7)
Pulmonary	17	83	7.1	(3.2 – 11.0)
Pain/fluid/other complication	27	69	5.9	(3.7 – 8.1)
Neurologic	19	66	5.6	(2.8 – 8.5)
Renal/genitourinary	10			
Hepatic, pancreatic, biliary, splenic	10			
Psychiatric	10			
Cardiovascular/hematologic	10			
Late effect of injury ^b	10			
Aftercare ^c	14	32	2.7	(0.7 – 4.7)
Principal diagnoses is not an injury or trauma related diagnosis	60	186	16.0	(11.9 – 20.1)
Readmission OR procedure				
No	237	714	61.3	(55.9 – 66.6)
Yes	144	451	38.7	(33.4 – 44.1)
Operative procedures ^d				

	Sample	National estimates		
	n	N	%	95% CI
Total	381	1,166	100.0	
Musculoskeletal system	91	278	23.9	(18.8 – 29.0)
Integumentary system	29	100	8.6	(4.9 – 12.2)
Nervous system	22	77	6.6	(3.2 – 10.0)
Digestive system	11	30	2.5	(1.0 – 4.0)
Respiratory system	10			
Cardiovascular system	10			
Respiratory system	10			
Urinary system	10			

Readm= Readmissions

^a The trauma-related diagnoses grouped in each category are shown in Appendix A.

^b Late effects of injuries, poisonings, toxic effects and other external causes (905–909) excluding 909(.3, .5).

^c Aftercare codes included supplementary V codes, V54, V57, and V58.

^d Categorization was based on the CCS (Clinical Classification Software).