A Clinical Decision Rule: Predicting Complicated Mild TBI in Adolescent Trauma to Aide in the Clinical-Decision Making of CT Imaging

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Background: The Pediatric Emergency Care Applied Research Network (PECARN) traumatic brain injury algorithm is used in the clinical setting to identify children at low risk of clinically significant traumatic brain injuries. This study aimed to determine the validity of the PECARN criteria utilizing data from a local Trauma Registry for clinical decision-making CT imaging. **Methods**: This is a single center study of Trauma Registry data, inclusive years July 1, 2016, to July 1, 2020. The inclusion criteria were all adolescent (age 10-15 years), GCS of 13-15, with a confirmed mechanical blow to the head admitted to this pediatric level II trauma center in South Carolina. The exclusion criteria were all those who did not receive a CT image of the brain. Complicated mTBI (cmTBI; hemorrhage, hematoma) was the dependent variable. A logistic regression was performed in SPSS to ascertain the effects of predictor variables on the likelihood that an adolescent mTBI trauma patient would experience a cmTBI. **Results**: 136 patients were included in the analysis based upon the requirements specified in the methods section; 21 (15%) had a confirmed cmTBI by CT imaging. The logistic regression model was statistically significant (N=131, p<0.01). The model explained 61% (Nagelkerke R2) of the variance in cmTBI and correctly classified 57% of cases (alpha=0.05), a small but significant finding. Several significant risk factors for cmTBI were identified, which included fall trauma (OR=25.93, p=0.05), MCC/ATV trauma (OR=211.75, p<0.01), unspecified mechanism (OR=42, p=0.03), and consult activation (OR=17.44, p=0.01). The most notable findings found in

PECARN that were not significant in this research included loss of consciousness and MVC trauma. **Conclusions**. This research identified several risk factors for cmTBI in our local adolescent mTBI trauma population, most surprisingly in the associated risk with MCC/ATV, unspecified mechanism, and consult activation, which speaks to potential lack of helmet use and NAT. It is recommended that future research provide a more in-depth understanding of clinical decision making in diagnosing cmTBI and add to the decision tree for ordering of CT imaging. Clinical trials that disseminate evidence-based patient guidelines via eHealth technologies is warranted.

Disclosures

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Disclaimer:

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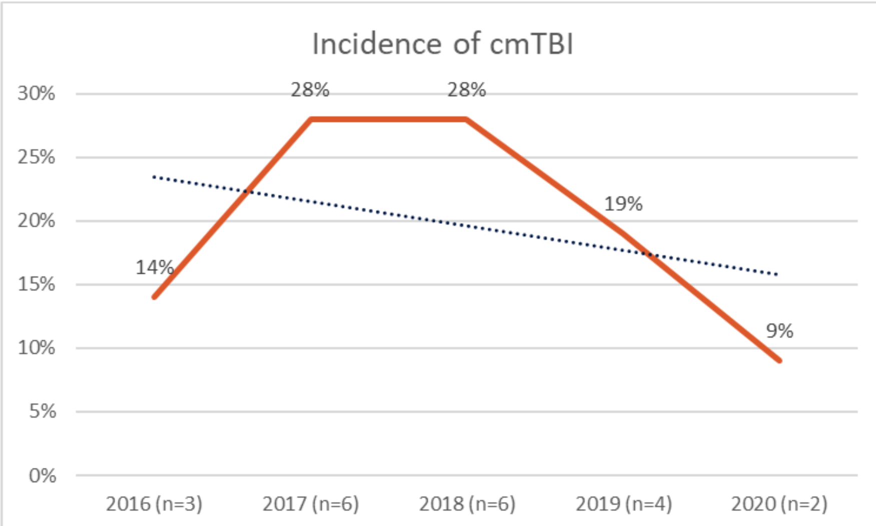
Table 1. Logistic Regression Analysis of Adolescent (10-15 years) Trauma Patients Diagnosed with an mTBI, Inclusive Years July 1, 2016 to July 1, 2020 (N=136)

Outcome/Dependent Variable: Complicated mTBI						
	B	**S.E**	**Wald**	**df**	**Sig.**	**Exp(B)**
Fall Trauma	3.25	1.67	3.8	1	0.05	25.93
MCC/ATV Trauma	5.35	1.96	7.44	1	<0.01	211.75
Unspecified Trauma	3.73	1.77	4.45	1	0.03	42.00
Consult Activation	2.85	1.17	5.95	1	0.01	17.44


Incidence of cmTBI
30%
25%
20%
15%
10%
5%
0%
28%
28%
19%
14%
9%
2016 (n=3)
2017 (n=6)
2018 (n=6)
2019 (n=4)
2020 (n=2)

Pediatric Penetrating Thoracic Trauma: Examining the Impact of Trauma Center Designation and Penetrating Trauma Volume on Outcomes

Gretchen M Floan, James M Prieto, Richard Y Calvo, Kyle D Checchi, Michael J Sise, Romeo C Ignacio, C Beth Sise, Vishal Bansal, Matthew J Martin

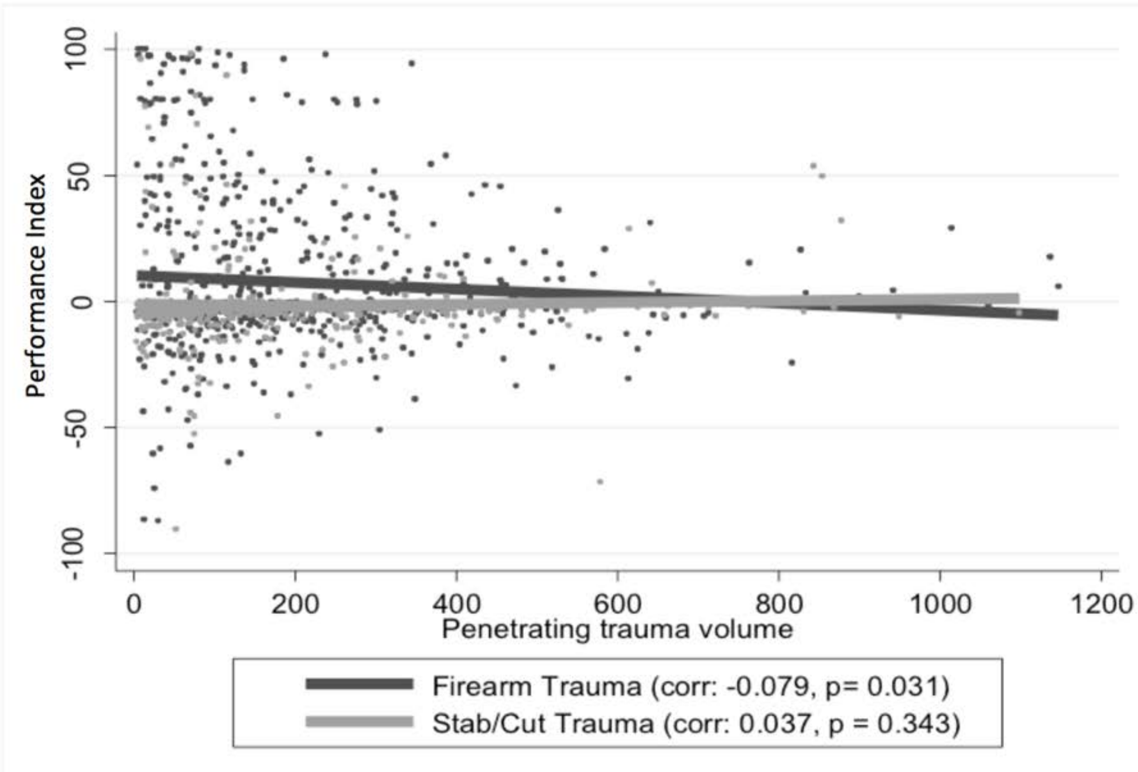
Introduction: Penetrating thoracic injuries (PTI) in the pediatric population are rare but carry a high risk of morbidity and mortality. It is not known whether there is a volume-outcome relationship in this population. We analyzed the impact of treating center designation and case volume of penetrating trauma on outcomes after pediatric PTI.

Methods: Using the National Trauma Data Bank (2013-2016), we identified patients <18 years old with PTI. Treating trauma centers were categorized by type (Pediatric or Adult) and designation status (Level I, Level II, and other). Center performance was calculated as the difference between observed and expected mortality and standardized using the total penetrating trauma volume per center. Expected mortality was calculated using the Trauma Mortality Prediction Model. Pearson correlation and linear mixed-effects models were used to evaluate the association between variables and performance.

Results: We identified 4,134 PTI patients treated at 596 trauma centers, including 879 (21%) at Adult Level I centers, 608 (15%) at Adult Level II centers, 531 (13%) at Pediatric Level I centers, 320 (8%) at Pediatric Level II centers, and 1,796 (43%) at other centers. Patients had a mean age of 14.7 ±3.5 and a median Injury Severity Score of 10 (IQR: 4-20). Firearm-related injury was the primary mechanism (58%) followed by cut/piercing (42%). Overall mortality was 16% and median predicted mortality was 3.6% (IQR: 1.5% - 11.2%). Among patients with thoracic firearm-related injuries, centers with lower penetrating case volume and total trauma care demonstrated significantly worse outcomes (Fig.1). Multivariable analysis revealed Adult Level I centers had superior outcomes compared with all other non-Level I centers. There was no significant difference in mortality between Pediatric and Adult Level I centers.

Discussion: Adult Level 1 trauma center designation and annual case volume of penetrating thoracic trauma are associated with improved mortality after pediatric firearm-related thoracic injuries. Further study is needed to identify factors in higher volume centers that improve outcomes, and interventions to improve outcomes at lower volume centers.

Figure 1. Relationship between Penetrating Trauma Case Volume and Trauma Center Performance Index



Abstract

Background: Although published clinical decision rules have identified indications for the use of head computed tomography (CT) in children with mild traumatic brain injury (mTBI), substantial practice variation exists.

Objective: This study seeks to evaluate whether the utilization of head CT in pediatric trauma patients presenting with mTBI varies between American College of Surgeons verified pediatric trauma centers (ACS-PTC) and adult-only trauma centers (ACS-AOTC).

Material and methods: A retrospective cohort study of 24,104 trauma patients, aged 17 and younger, who presented to the emergency department at 337 ACS verified level I or II trauma centers with isolated mTBI was conducted using National Trauma Data Bank records from 2011-2015. Multivariable logistic regression was used to compare the odds of a patient receiving a head CT when treated at an ACS-PTC vs. an ACS-AOTC, controlling for demographic, injury, and hospital-level confounders. Effect modification by loss of consciousness was assessed and adjusted head CT odds were recalculated in patients stratified by loss of consciousness status.

Results: There was no significant difference in the adjusted odds of receiving a head CT at an ACS-PTC vs. an ACS-AOTC (odds ratio: 0.98, 95% confidence interval: 0.92-1.04). However, in patients who had a loss of consciousness, the adjusted odds ratio of receiving a head CT at an ACS-PTC was 0.71 (95% confidence interval: 0.65-0.78), compared to ACS-AOTC.

Conclusion: Children presenting to the emergency department of an ACS-verified level I or II trauma center with mTBI who had a loss of consciousness are less likely to receive a head CT at an ACS verified pediatric trauma center than at an ACS verified adult-only trauma center.

Kids Gone Wild – Alcohol Use and Patient Characteristics in Pediatric Trauma during the Covid-19 Pandemic

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Introduction

Reported Covid-19 pandemic effects on pediatric trauma volumes and patient characteristics have been variable. Our goal was to investigate the characteristics of pediatric trauma, including alcohol use, during the pandemic at our urban trauma center.

Methods

The trauma database of our ACS level 1 trauma center was queried for all pediatric (age$\leq$18) patients presenting between March 1 and October 30, 2020. Data from March to October of 2017 through 2019 served as a control. Patient variables analyzed included demographics, mechanisms, injury severity, hospitalization characteristics, and positive blood alcohol.

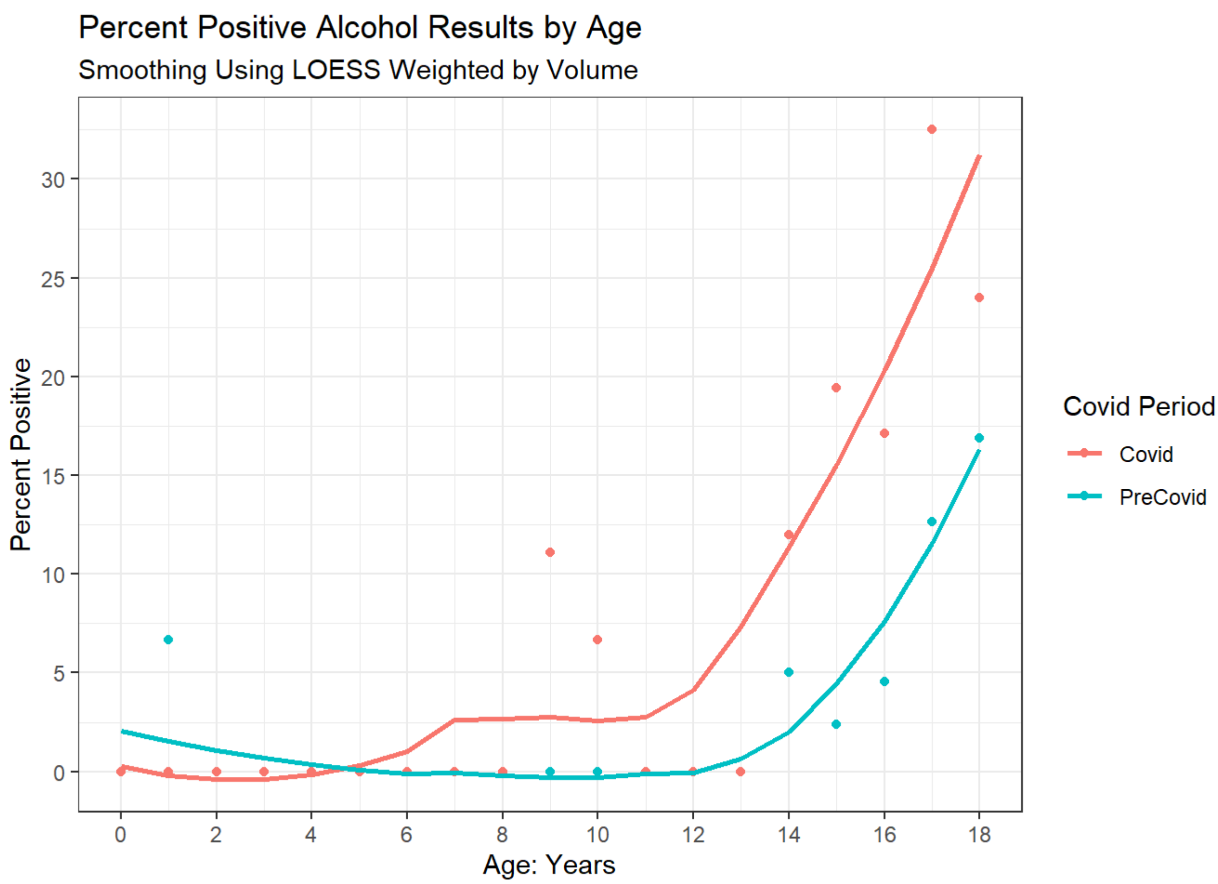
Results

Overall pediatric trauma volumes increased by 67.5% during the study period (330 vs 197/year). During the pandemic, patients were younger (mean age 10.9 vs 11.9, $p=0.011$), but similar in gender, ethnicity, ISS, TRISS, Hospital Length of Stay (LOS), In-Hospital Mortality and ratio of blunt to penetrating injury. Pandemic pediatric positive blood alcohol was significantly higher (5.1% vs 11.2%, $p<0.001$), especially in the 14-18 year olds (9.5% vs 21.7%, $p<0.001$). An increased number of patients presented with falls (24.0% vs 17.1%, $p=0.012$) with fall patterns shifting away from falls >6m (0% vs 7.9%) and towards 1-6m (58.2% vs 51.5%), $p=0.028$. Reported numbers of transportation related injuries (41.3% vs 44.4%) were similar; however, mechanisms shifted away from motor vehicle crashes (62.5% vs 76.0%) towards recreational vehicles, such as motorcycles (5.1% vs 3.0%), ATVs (16.2% vs 7.6%) and bicycles (16.2% vs 13.3%), $p=0.018$. Proportions of patients admitted to the ICU were similar but pandemic mean pandemic ICU LOS was longer (5.2 vs 3.3 days, $p=0.046$). Percentage of patients requiring mechanical ventilation also were similar. However, mean pandemic length of ventilation was longer (7.8 vs 4.4 days, $p=0.046$).

Conclusion

Pediatric trauma volumes during the Covid-19 pandemic study period increased, with more transportation injuries secondary to recreational vehicles. Overall, patients were younger, had longer ICU stays and ventilation duration, and had higher rates of positive blood alcohol, especially in ages 14-18. This suggests an increased need for alcohol assessment and targeted interventions in the pediatric population during the pandemic. Additional preventative measures during pandemics or school closures, for both parents/caregivers and youth, may be warranted.

Pediatric Trauma Patient Characteristics			
	Pre-Pandemic 592 (197/year)	**Pandemic 330**	**p**
Age (Mean)	11.9	10.9	**0.014***
Gender (Male)	361 (61.0%)	206 (62.4%	0.673
In-Hospital Mortality	24 (4.1%)	6 (1.8%)	0.081
ISS (Mean)	10.1	9.8	0.321
TRISS (Mean)	0.962	0.974	0.278
Mechanism of Injury			0.642
Blunt	487 (84.0%)	285 (86.4%)	
Penetrating	69 (11.7%)	33 (10.0%)	
Other	26 (4.4%)	12 (3.6%)	
Injury by Firearm	34 (5.7%)	18 (5.5%)	1.000
Injury by Fall	101 (17.1%)	79 (24.0%)	**0.012***
Fall Type			**0.028***
Fall Under 1m	41/101 (40.6%)	33/79 (41.8%)	
Fall 1m - 6m	52/101 (51.5%)	46/79 (58.2%)	
Fall Over 6m	8/101 (7.9%)	0/79 (0.0%)	
Transportation Injury	263 (44.4%)	136 (41.3%)	0.368
Transportation Type			**0.018***
MVC	200/263 (76.0%)	85/136 (62.5%)	
Motorcycle	8/263 (3.0%)	7/136 (5.1%)	
ATV	20/263 (7.6%)	22/136 (16.2%)	
Bicycle	35/263 (13.3%)	22/136 (16.2%)	
Hospital LOS (Mean)	3.0	3.6	0.189
ICU Admission	187 (31.6%)	110 (33.3%)	0.610
ICU LOS (Mean)	3.3	5.2	**0.046***
Ventilated	68 (11.5%)	37 (11.2%)	1.000
Vent Days (Mean)	4.4	7.8	**0.046***
Overall Alcohol Use	30 (5.1%)	37 (11.2%)	**0.0008***
Alcohol Use (14-18)	29 (9.5%)	35 (21.7%)	**<0.0001***


Percent Positive Alcohol Results by Age
Smoothing Using LOESS Weighted by Volume
Percent Positive
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
Age: Years
Covid Period
Covid
PreCovid

Title: Complications associated with subsequent vascular access in pediatric ECMO patients

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Introduction: Achieving central venous access in children can be challenging. Following ECMO decannulation, the need for central venous access often persists in this critically ill population. Intensivists and surgeons must consider whether to reuse the cannulation site for subsequent central venous catheters (CVC), or seek access at a remote location. This study investigates the risk of infectious complication associated with the reuse of peripheral ECMO cannulation sites for subsequent central access.

Methods: A retrospective review was conducted for patients aged 0-18 years, who underwent peripheral ECMO cannulation between 2009 and 2021 at a single children's hospital. We hypothesized there would be increased rate of central line-associated bloodstream infections (CLABSIs) among patients who underwent contemporaneous CVC placement at the time of ECMO decannulation using the same access site.

Results: Of the 285 charts reviewed, after ECMO decannulation, 53 patients received a CVC at the same location, 25 received a CVC at a different location, 63 received a peripherally inserted central catheter (PICC), and 145 had no subsequent vascular access placed within 30 days of decannulation. Among the patients with secondary access placed at the same site, there were 2 CLABSIs or 1.87 CLABSIs per 1000 line days. Patients with PICC lines after ECMO decannulation had 0.43 CLABSIs per 1000 line days. In comparison, the institution's hospital-wide CLABSI rate was 1.46 per 1000 line days during this same period. The rate of CLABSI among patients with secondary access at the site of decannulation was higher than the rate among patients with PICC lines and the institutional rate. However, this did not rise to the level of statistical significance ($p=0.91$ and $p=0.79$ respectively). There were no CLABSIs reported among those with secondary access at a different site or those with no subsequent vascular access.

Conclusion: CVC placement at the time of ECMO decannulation had no significant difference in CLABSI development compared with institutional CLABSI rates. Compared with ECMO patients with subsequent CVCs placed at an alternative access site or via PICC after decannulation, patients with contemporaneous CVC placement at the site of decannulation trended towards slightly higher rates of CLABSIs, but this did not reach statistical significance.

Title: Development of a Pediatric Brain Injury Guideline: Investigating the BIG Algorithm

Introduction: Traumatic brain injury is a leading cause of death and disability for the pediatric trauma patient. Hospitalization and neurosurgical consults are costly. The Brain Injury Guideline (BIG) was developed in adult populations to assist in determining which patients can safely go home. The algorithm has been reviewed in one pediatric population.
Methods: We conducted a retrospective chart review of patients arriving at a level 1 trauma center between 7/2013 and 12/2018 who were <18 years of age, had positive head CT findings, and who did not need emergency surgery. We collected demographic, injury and hospital-course data. We determined the utility of the BIG algorithm in this pediatric population as well as investigated predictors of the need for neurosurgical intervention.
Results: 822 patients met inclusion criteria. 38.6%, 54.5%, and 6.9% were retrospectively identified as meeting criteria for the BIG 3, 2, and 1 categories, respectively. All 57 patients in the BIG 1 category were deemed appropriate for non-admission based on review. A number of factors were associated with a need for neurosurgical intervention including GCS, reported loss of consciousness, abnormal pupillary exam, and specific brain bleed locations. Having a non-depressed skull fracture was significantly related to NOT requiring neurosurgical intervention (OR = 0.19, 95% CI 0.08-0.48).
Conclusion: The BIG algorithm worked well to identify which patients can avoid hospital admission but data shows that there may be more children who can avoid admission if BIG categories were modified for pediatric use. Further study is warranted to determine if removal of skull fracture alone from the pediatric BIG would allow for more children to safely be discharged after mild-moderate head injury.
Figures:

Table 1. Outcomes by retrospective BIG category

	BIG 1(n=57)	BIG 2 (n=448)	BIG 3 (n=317)
Age, median (IQR), y	3.64 (0.37-10.80)	1.57 (0.57-6.06)	2.3 (0.51-7.26)
Male, %	52.6	58.7	58.7
CAMP, %	0	0	1.3
Intoxication, %	0	0.7	1.6
GCS Score < 15, %	7.1	8.9	33.7
Abnormal focal neuro exam (794 examinable), %	0	0	6.9
Abnormal pupillary exam, %	0	0	5.6
Loss of Consciousness %	19.3	10.5	25.6
Seizure, %	5.3	1.3	9.5
Elevated PT/PTT (n=345 tested)	37	40.5	51
Intubated, %	0	0.2	21.1
Time to presentation, median (IQR), hr	2.45 (1.05-3.95)	3.4 (1.3-5.3)	2.0 (1.0-4.1)
ISS, median (IQR)	10 (8-16)	8 (5-10)	13 (9-17)
Head AIS score, mean (SD)	2.91 +/- 0.71	2.54 +/- 0.69	3.31 +/- 0.78
LOS, median (IQR), days	1.0 (0.7-1.7)	0.8 (0.3-1.2)	1.7 (0.9-4.0)

Table 2. Odds of needing neurosurgical intervention by patient characteristics

Age	1.10 (1.04-1.15)	p=0.001
Male	1.04 (0.59-1.82)	p=0.894
Transferred	0.489 (0.27-0.85)	p=0.018
Examinable	0.11 (0.05-0.24)	p<0.001
LOC	4.85 (2.79-8.75)	p<0.001
Intoxication	2.05 (0.25-16.98)	p=0.505
Seizure (pre hospital or ED)	6.76 (3.15-14.49)	p<0.001
Elevated PT or PTT in the ED	2.33 (1.19-4.56)	p=0.013
Intubation	21.68 (11.61-40.49)	p<0.001
GCS < 15	11.91 (6.22 -22.79)	p<0.001
Abnormal pupil exam	58.87 (17.31-161.48)	p<0.001
Abnormal neuero exam	6.28 (2.17-18.17)	p=0.001
Concussion	0.32 (0.14-0.72)	p=0.006
Non-depressed skull fracture	0.19 (0.08-0.48)	p< 0.001
EDH	3.85 (2.11-7.00)	p<0.001
SDH	1.83 (1.01-3.30)	p=0.046
IPH	5.59 (2.57-12.17)	p<0.001
SAH	2.57 (1.43-4.63)	p=0.002
IVH	30.64 (5.48-171.34)	p<0.001
Contusion	5.14 (2.62-10.08)	p<0.001
Pneumocephalus	5.36 (2.94-9.78)	p<0.000
Multi-system injury	8.25 (4.44-15.31)	p<0.001

Disparities in Childhood Opportunity and Appropriate Use of Child Safety Restraints in Motor Vehicle Collisions

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Introduction: Motor vehicle child safety restraints are frequently improperly used or unused. Previous studies have demonstrated disparities in safety restraint use. We aimed to use the Childhood Opportunity Index (COI), a metric for neighborhood social determinants of health, to investigate differences in safety restraint use in motor vehicle collisions (MVCs). The COI has not yet been used to describe disparities in pediatric trauma. We hypothesized that MVC patients from low-COI neighborhoods are more likely to be not appropriately restrained than patients from high-COI neighborhoods.

Methods: A single-center retrospective cross-sectional study was performed for children/adolescents ≤18-years-old in MVCs between 1/1/2011-12/1/2021. The outcome was safety restraint use categorized as appropriately restrained and not appropriately restrained. Not appropriately restrained included non-restrained and improperly restrained children/adolescents. COI based on patient home zip code was categorized as very low, low, moderate, high, and very high. Multivariable logistic regression analysis was performed to identify factors associated with safety restraint use, controlling for patient age.

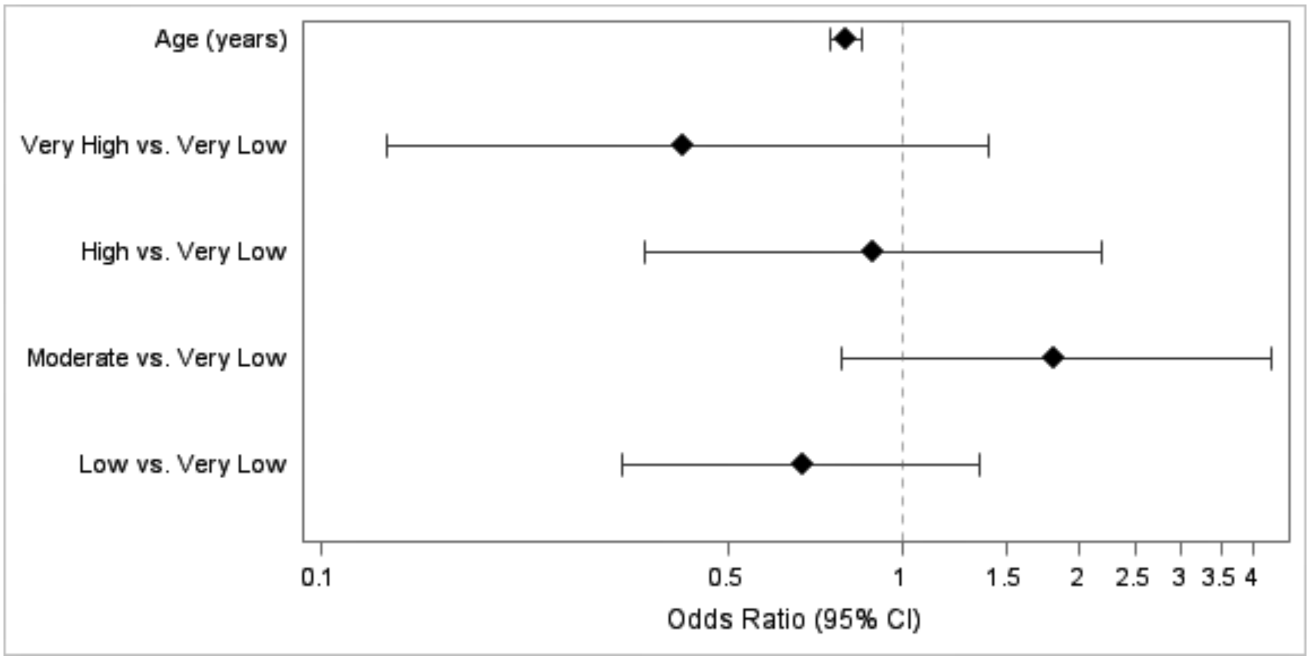
Results: Of 337 children/adolescents (median age 4 years, IQR:1.7-7.0 years), 73.9% were appropriately restrained and 26.1% were not appropriately restrained (21.4% non-restrained, 4.7% improperly restrained). Patients were from neighborhoods with very low (42.4%), low (22.3%), moderate (18.1%), high (11.9%), and very high (5.3%) COI. Compared to not appropriately restrained patients, more appropriately restrained patients were from very low- and moderate-COI neighborhoods. Meanwhile, more not appropriately restrained children/adolescents than appropriately restrained children/adolescents were from low-, high-, and very high-COI neighborhoods (p=0.031) (Table). After controlling for age, there were no significant associations in appropriate restraint use based on COI (Figure). However, there was a non-significant trend that children/adolescents from moderate-COI neighborhoods were more likely than those from very low-COI neighborhoods to be appropriately restrained (OR 1.82, 95% CI:0.78-4.28), while children/adolescents from low-, high-, and very high-COI neighborhoods were less likely to be restrained than children/adolescents from very low-COI neighborhoods.

Conclusion: Child safety restraint use varies by COI, and inappropriate use is not limited to families from low-COI neighborhoods. Education should target patient populations from different COI level neighborhoods. This study highlights that interventions across varied neighborhood types could positively impact injury prevention in children.

Table 1: Childhood opportunity index (COI) levels of appropriately restrained and not appropriately restrained children in motor vehicle collisions

	Appropriately Restrained (n=249, 73.9%)	Not Appropriately Restrained (n=88, 26.1%)	p-value
COI, n (column %)			0.031
Very Low	110 (44.2)	33 (37.5)	
Low	52 (20.9)	23 (26.1)	
Moderate	51 (20.5)	10 (11.4)	
High	27 (10.8)	13 (14.8)	
Very High	9 (3.6)	9 (10.2)	

Figure. Multivariable logistic regression analysis for appropriate safety restraint use based on childhood opportunity index (COI) levels (very low vs. low, moderate, high, and very low), controlling for age



Pediatric All-Terrain Vehicle Trauma in the Rocky Mountain Region

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Introduction:

Pediatric injuries from ATV accidents are common, despite recommendations from the American Academy of Pediatrics discouraging use of ATVs by children less than 16 years old. ATV laws are state specific; in Colorado, state legislature requires children under 18 years old to wear a helmet and children under 16 years old to be supervised by someone with a valid driver's license while operating an ATV (Bill HB18-110). This study sought to summarize the experience of ATV injuries at a Level 1 Pediatric Trauma Center, which is a referral center for eight states in the Rocky Mountain Region, and secondarily assess the impact of Colorado state regulation on ATV helmet use and adult supervision.

Methods:

A retrospective review of children with traumatic injuries related to ATV accidents treated at Children's Hospital Colorado from 2010-2020 was performed. Demographics, accident circumstances, injury characteristics, and hospital course data were collected and analyzed. Accidents within the state of Colorado were separately analyzed in a sub-analysis.

Results:

There were 407 ATV accidents throughout the study period; in 2020, ATV accidents accounted for over 5.0% of all traumas (Figure 1). The median (min, max) age was 12 (0, 20) years and 62.2% (n=253) of patients were male. The median Glasgow Coma Scale and Injury Severity Score were 15.0 (3.0, 15.0) and 8.0 (1.0, 43.0), respectively (Table 1). The percentage of patients who required an operation was 43.8% (n=178). A sub-analysis of ATV accidents in Colorado revealed that 87.2% (n=306 of 351) of ATV injuries occurred in children under 16 years. Among these, only 30.1% (n=92) were wearing a helmet at the time of their injury, and only 19.3% (n=59) had parental supervision.

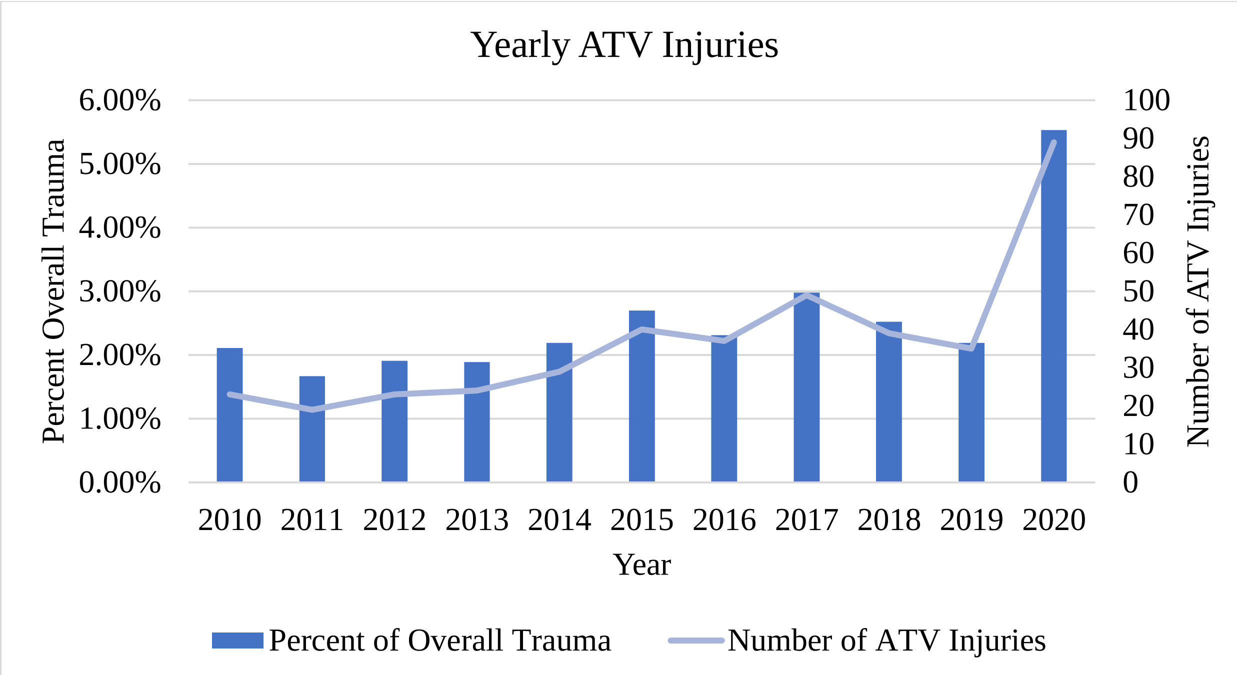
Conclusion:

ATV accidents are a common cause of trauma within our patient population, resulting in substantial injuries. Despite state legislation implemented in 2018, our results demonstrate children in Colorado still engage in risky behavior when riding an ATV. These data underscore the need for increased ATV education, outreach, and regulation directed towards the pediatric population.

Table 1. Demographic and Injury Characteristics of the Overall Population

	Total Population (n=407)
Age (years)	12 (0, 20)
Gender	
Male	253 (62.2%)
Female	154 (37.8%)
Injury Mechanism	
Rollover	190 (46.7%)
Ejection	131 (32.2%)
Collision	82 (20.1%)
Other	25 (6.1%)
Operator	250 (61.6%)
Barbed Wire Involvement	34 (8.4%)
Restrained	14 (3.4%)
Parental Supervision	72 (17.7%)
Helmet Use	118 (29.0%)
Anatomic Injury Location	
Head	127 (31.2%)
Face	55 (13.5%)
Neck	7 (1.7%)
Thorax	68 (16.7%)
Abdomen	57 (14.0%)
Spine	43 (10.6%)
Upper Extremity	117 (28.7%)
Lower Extremity	103 (25.3%)
External	238 (58.5%)
Level of Hospital Care	
Observation	77 (18.9%)
Floor	175 (43.0%)
ICU	84 (20.6%)
Discharged	73 (17.9%)
Intubated	27 (6.7%)
Operation Needed	178 (43.8%)
Median Hospital LOS	1.0 (0.0, 33.0)
Median ICU LOS	1.0 (1.0, 18.0)
Discharged to Rehab	15 (3.7%)

Figure 1. ATV Injury Trends from 2010 through 2020



Use of Reverse Shock Index Times Glasgow Coma Scale (rSIG) to Identify Pediatric Trauma Patients Who Require Higher Levels of Care

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Introduction: Nearly half of the pediatric population in the United States lives greater than 30 miles from a pediatric trauma center (PTC), and a majority live more than one hour from a Level 1 PTC. The Need For Trauma Intervention (NFTI) score was developed to assess trauma triage criteria and is dependent on whether someone requires one of six urgent interventions (NFTI+). We sought to determine if a novel scoring tool, rSIG, could predict NFTI and facilitate the transfer decision making process.

Methods: Children 1-18 years old transferred to our level 1 PTC from 2010 - 2020 with complete vital signs and Glasgow Coma Scale (GCS) score at the transferring facility were included. rSIG was calculated as previously described [(SBP/HR) x GCS], and the following cutoffs were used for each age group: ≤13.1, ≤16.5, and ≤20.1 for 1-6, 7-12, and 13-18 years, respectively. Clinical outcomes upon arrival to the PTC were collected to determine if patients met any NTFI criteria (NFTI+). Logistic regression adjusting for injury severity score (ISS) and blood product transfusion prior to transfer were fit to predict NFTI+ and each criterion based on abnormal rSIG.

Results: A total of 456 patients met inclusion criteria. The average age was 10.1 years, and the median ISS was 14.0. The proportion of patients with an abnormal rSIG was 60.1% (274) and 37.0% (169) were NFTI+. A greater proportion of patients with an abnormal rSIG were NFTI+ compared to those with a normal rSIG (51.8% vs 14.8%, p<0.001). Patients with abnormal rSIG had increased odds of being NFTI+ and meeting 3 of 6 NFTI criteria: blood transfusion within 4 hours of arrival, Intensive Care Unit Admission ≥ 3 days, and requiring non-procedure ventilation on both logistic regressions (Table 1).

Conclusion: Children with an abnormal rSIG are more likely to be NFTI+ and require higher levels of care, indicating this scoring tool can identify pediatric trauma patients who may benefit from expedited transfer. Incorporating rSIG into the initial evaluation and triage of traumatically injured children may expedite the transfer decision making process and limit delays in transport to a PTC.

Table 1. Summary of Logistic Regressions Predicting NFTI+ and Criteria, Based on Abnormal rSIG

Predicted Outcome:	**Univariate Model**		**Multivariate Model***	
	OR (95% CI)	**p-value**	**OR (95% CI)**	**p-value**
NFTI+	6.18 (3.90, 10.07)	< 0.001	4.57 (2.83, 7.59)	<0.001
NFTI Criterion Met†				
Blood transfusion within 4 hours of arrival	7.83 (3.09, 26.42)	<0.001	3.72 (1.37, 13.0)	0.019
Operation within 90 min of ED arrival	1.56 (0.77, 3.38)	0.235	1.14 (0.53, 2.56)	0.751
Intensive care unit admission ≥ 3 days	7.01 (3.34, 17.19)	<0.001	4.10 (1.86, 10.35)	0.001
Nonprocedural mechanical ventilation within 72 hours	12.11 (6.56, 24.60)	<0.001	8.96 (4.76, 18.44)	<0.001

**Adjusted for injury severity score and blood transfusion prior to transfer; †No patients required interventional radiology and no patients with a normal rSIG died within 60 hours and were excluded from the model*

Low-Level Trauma Activation Decreases Emergency Department Length of Stay in a Level 1 Pediatric Trauma Center

Introduction

Length of Stay (LOS) in the Emergency Department (ED) is an ongoing issue for trauma patients. We believed that this could be decreased with the implementation of a low-level trauma activation in a pediatric trauma center.

Methods

We conducted a retrospective analysis of all pediatric patients admitted to the trauma service during a 7-year period at Primary Children's Hospital. Using patients pre- and post-implementation of Trauma Three activations, we analyzed ED LOS for patients who were previously Trauma Consults or non-activations and compared it to Trauma Three activation patients. Pre-implementation refers to patients admitted 2015-2018 (n=1294) and post-implementation refers to patients admitted 2019-2021 (n=1044). Patients who were excluded were those who were Level 1 or Level 2 trauma activations and patients who were directly admitted.

Results

A total of 2338 patients met criteria for data review (1294 pre- and 1044 post-implementation). The average ED LOS for patients in the pre-implementation group was 03:35 with a median LOS of 03:19. The average ED LOS for patients in the post-implementation group was 02:45 with a median LOS of 02:18. This is displayed in Figure 1. We also reviewed only the patients who were transferred from outside facilities within the same pre- and post- implementation groups (856 pre- and 797 post-implementation). This is displayed in Figure 2. The average ED LOS for transfer patients in the pre-implementation group was 03:09 with a median LOS of 2:54. The average ED LOS for patients in the post-implementation group was 02:15 with a median LOS of 1:57.

Conclusion/Discussion

With these results we learned that implementing a low-level trauma activation does in fact significantly decrease ED LOS in a Level 1 Pediatric Trauma Center, especially for patients transferred from another facility.

*Figure 1

ALL INCLUDED PTS	NUMBER OF PATIENTS	AVERAGE ED LOS	MEDIAN ED LOS
2015-2018 (PRE-TR3)	1294	3:35	3:19
2019-2021 (POST-TR3)	1044	2:45	2:18
2019	284	2:52	2:29
2020	355	2:45	2:18
2021	405	2:39	2:11

*Figure 2

TRANSFERRED PTS	NUMBER OF PATIENTS	AVERAGE ED LOS	MEDIAN ED LOS
2015-2018 (PRE-TR3)	856	3:09	2:54
2019-2021 (POST-TR3)	797	2:15	1:57
2019	210	2:25	2:06
2020	273	2:16	1:57
2021	314	2:08	1:48

Hemodilution in pediatric trauma: Defining the expected changes in hemoglobin in the non-bleeding trauma patient with liver or spleen injury: An ATOMAC secondary analysis

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Background: Solid organ grading is based on either laceration or contusion. Many patients with blunt liver and/or spleen injury (BLSI) do not ever bleed intraperitoneally. Despite this, decreases in measured hemoglobin level is common after pediatric trauma. This study reports the expected hemoglobin drop for patients with BLSI injury who show no radiographic or hemodynamic signs of intra-abdominal or other bleeding.

Methods: Children aged 0 to 18 years with evidence of blunt liver and/or spleen injury (BLSI) without active bleeding were identified from the prospective ATOMAC study of blunt liver and spleen injury. Initial and repeat hemoglobin (Hb) levels were analyzed by time. Patients who had free fluid on initial CT, +FAST ultrasound, hypotension at any time, or were transfused during hospitalization were excluded. Patients who did not have repeat Hb measurements within 10 hours were also excluded.

Results: Of the initial 1007 patients enrolled, 839 patients were excluded for one or more criteria, and 168 (16.7%) were included in the study. The mean drop in Hb was 1.5 g/dl (+/-2.75) at a mean time of recheck of 3.5 hours [+/-3.7] .

Conclusion: Measured hemoglobin decreases of 1.5g/dL in pediatric trauma patients are expected shortly after arrival, even if they are not bleeding. This further supports the lack of utility for routine rechecking of hemoglobin.

	ΔHb	**Δtime (h)**
Median	**-0.9**	**4.075**
IQR 25	-1.50	2.00
IQR 75	-0.30	6.00
Mean	-1.45	3.51
SD	2.75	3.71

Title: What are the Predictors of Early Blood Product Transfusion in Pediatric Trauma? A Review of the Pediatric Trauma Quality Improvement Database

Sophia S. Sugar BS, Jenny Stevens MD MPH, Kaci Pickett MS, Shannon Acker MD, Denis Bensard MD

Introduction: Blood product transfusion practices in pediatric trauma patients remain generally uncharacterized. To date, there are no comprehensive studies identifying patient demographics, clinical characteristics, and/or injury mechanisms that predict the need for transfusions. Thus, we sought to characterize predictors of early blood product transfusion in pediatric trauma patients.

Methods: Patients (≤18 years) in the pediatric Trauma Quality Improvement Program (TQIP) database (2007-2018) were included and stratified based on transfusion status: non-transfusion, early transfusion (within 4 hours from presentation), and late transfusion (between 4-24 hours from presentation) groups. Univariate logistic regression was used to determine associated strength of predictors and transfusions. Receiver operating characteristic curves were generated and area under the curve (AUC) was calculated for each predictor.

Results: Overall, 210,860 pediatric trauma patients were included. Of these, 5,293 received an early blood product transfusion. Only 35 patients received their first transfusion between 4-24 hours from presentation. As such, the late transfusion group was excluded from further analysis, and we proceeded to assess non-transfusion vs. early transfusion recipient groups. Patients who received early transfusions were older (11.3 vs. 9.3 years, $p<0.001$), had higher Injury Severity Scores (ISS) (33.8 vs. 9.8, $p<0.001$) and lower Glasgow Coma Scale (GCS) scores (8.3 vs. 14.4, $p<0.001$) compared to those who were not transfused. Significant predictors of early transfusion included the presence of traumatic brain injury (TBI) (OR 29.48, CI 27.77-31.29) and elevated shock index-pediatric age-adjusted (SIPA) (OR 6.18, CI 5.84-6.54. ISS had the strongest association with early transfusions (AUC 0.92).

Conclusion: The need for early blood transfusion is uncommon amongst traumatically injured pediatric patients, but TBI, elevated SIPA, and ISS significantly increase the likelihood of receiving blood products. Recognition of predictors will allow for expedient identification of patients who may require such transfusions and better direct resource allocation. Future directions will assess different mechanisms of injury as predictors of transfusion and explore why children with severe TBI receive blood transfusion.

Table 1. Predictors of early blood transfusion (<4 hours from presentation) in pediatric trauma

	No Early Blood Transfusion (n=205,567)	**Early Blood Transfusion (n=5,293)**	**Total (n=210,860)**	**p-value**
Age (years)	9.3 (5.2)	11.3 (5.8)	9.3 (5.2)	<0.001
ISS	9.8 (9.2)	33.8 (17.8)	10.4 (10.3)	<0.001
GCS Total	14.4 (2.2)	8.3 (5.4)	14.3 (2.6)	<0.001
Univariable Logistic Regression				
	OR	**95% CI**	**p-value**	
TBI	29.48	27.77-31.29	<0.0001	
Elevated SIPA	6.18	5.84-6.54	<0.0001	

Data are presented as means with standard deviation

Abbreviations: ISS, Injury Severity Score; GCS, Glasgow Coma Scale; TBI, traumatic brain injury; SIPA, shock index pediatric age-adjusted; OR, odds ratio

Title: Injuries Sustained and Predictors of Mortality in Pediatric Drowning Victims Presenting to United States Emergency Departments

Authors: Christina M. Theodorou MD, Ganesh Rajasekar MPH, Nikia R. McFadden MD, Samya Faiq BS, Miriam Nuño PhD, Erin G. Brown MD

Introduction: Drowning is a leading cause of death among children. The incidence of traumatic injuries sustained by these patients is unknown. We aimed to describe the incidence and type of injuries seen in pediatric drowning victims, and to analyze predictors of mortality.

Methods: The Nationwide Emergency Department Sample (NEDS) was queried from 2016 to 2018 for patients <20 years old who presented after drowning. Patients were categorized as injured or uninjured. Demographics, injuries sustained, length of stay (LOS), and mortality were analyzed.

Results: Of 51,700 patients presenting after a drowning event, 3,290 sustained injuries (6.4%). The overall mortality was 2.6% and was higher among non-injured patients (2.7% vs. 1.6%, p<0.0001). Injured patients were older (median 11.1 years vs. 5.9 years, p<0.0001) and were more commonly male (63.6% of injured vs. 53.9% of non-injured patients, p<0.0001). Diving was the mechanism most commonly associated with injuries (82.6% of injured patients vs. 62.0% of non-injured), while incidents at swimming pools were more common among non-injured patients (18.6% of non-injured patients vs. 3.2% of injured patients, p<0.0001 for both). The most common injuries sustained were head or brain injuries (45.9%) and extremity injuries (49.2%, Table 1). Most patients were discharged from the emergency department (82.4%); 7.5% required hospital admission. Injured patients had longer LOS (median 2.7 vs. 0.9 days, p=0.03), and higher total hospital charges (median $53,346 vs. $18,038, p=0.006).

After excluding patients who died in the ED (n=969, 1.9% of all patients), in-hospital mortality was higher among injured patients (13.5% vs. 9.8% of uninjured patients, p<0.0001). There were no differences in injury patterns among admitted patients who died or survived. On multivariable analysis, presence of an injury was not independently associated with mortality (OR 1.1, 95% CI 0.5-2.5).

Conclusions: Injuries are uncommon in pediatric drowning victims and do not independently predict mortality. Injuries are associated with increased healthcare utilization. Traumatic brain injuries and extremity injuries are the most common injuries documented in this population. Knowledge of these injury patterns may guide pediatric trauma providers in the care of these patients.

Table 1: Characteristics of traumatic injuries among 3,290 injured patients

Injury Type: n (%)	Total n=3290
All Head Injuries	1509 (45.9)
Traumatic brain Injury (TBI)	325 (9.9)
Skull Fracture	70 (2.1)
Cerebral Hemorrhage	19 (0.6)
Other Head Injury	1170 (35.6)
Long Bone Injuries	1617 (49.2)
Finger/toe fracture	714 (21.7)
Radius or ulna fracture	331 (10.1)
Humerus fracture	131 (4.0)
Femur fracture	102 (3.1)
Tibia or fibula fracture	<10
Thoracic Injuries	109 (3.3)
Lung Injury	70 (2.1)
Hemo/Pneumothorax	31 (1.0)
Cardiovascular Injuries	<10
Thoracic Esophagus Injury	<10
Trachea, bronchus, or diaphragm injury	0
Intra-Abdominal Injury	39 (1.2)
Liver, biliary system, or gallbladder injury	22 (0.7)
Spleen injury	<10
Rectal injury	<10
Stomach, small intestine, colon, or pancreas injury	0
Pelvic Fracture	21 (0.7)
Any Spine Injury or Fracture	86 (2.6)
Cervical spine fracture	63 (1.9)
Thoracic spine Fracture	21 (0.6)
Lumbar spine Fracture	0
Spinal Cord Injury	25 (0.8)
Injury Across More than One System	87 (2.6)
More than One Injury of Any Type	142 (4.3)

Title: High Volume Blood Product Resuscitation is Associated with Deleterious Outcomes in Blunt Injured Pediatric Trauma Patients with Traumatic Brain Injury

Authors: Jenny Stevens MD MPH[1], Kaci Pickett MS[2], Marina L. Reppucci MD[1], Shannon Acker MD[1], Steven Moulton MD[1], Denis Bensard MD[1]

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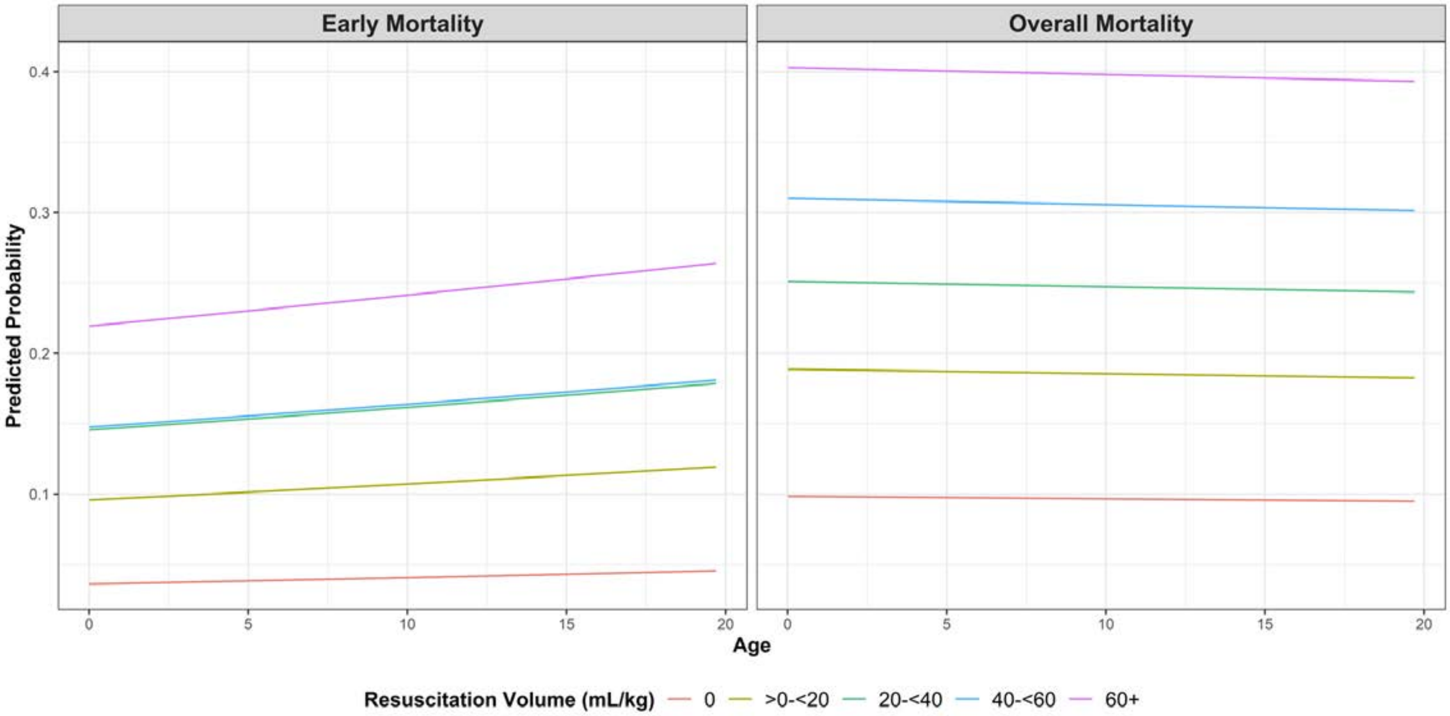
Introduction: Traumatic brain injury (TBI) remains a leading cause of morbidity and mortality in pediatric trauma patients; however, resuscitation strategies vary among trauma centers with little consensus regarding target resuscitation volumes to improve outcomes. Thus, we sought to determine the impact of blood product resuscitation volume on mortality in blunt injured pediatric trauma patients with TBI.

Methods: Pediatric patients (≤18-years-old) with isolated TBI [defined as documentation of Glascow Coma Scale ≤8 and injuries located only in Injury Severity Score (ISS) region 1 (head/neck)] in the 2017-2018 TQIP database with complete blood product transfusion data were included. Patients were divided into five groups based on the total amount of resuscitation (mL/kg) received within 24 hours of presentation. Group differences were tested via Kruskal-Wallis and Chi Squared tests. Logistic regression, adjusting for ISS and age, was used to test for associations between resuscitation volume and mortality, and to obtain Odds Ratios (OR) for comparisons.

Results: Overall, 2,380 patients were included for analysis. The median age of the cohort was 11.0 years [5.0,15.0], and the median ISS was 33 [19.0,43.0]. There were significant differences in the rates of both early mortality (0mL/kg: 4.3%, <20mL/kg: 14.0%, 20-40mL/kg: 19.4%, 40-60mL/kg: 22.0%, >60mL/kg: 28.7%, p<0.001) and overall mortality (0mL/kg: 13.7%, <20mL/kg: 28.7%, 20-40mL/kg: 34.9%, 40-60mL/kg: 49.1%, >60mL/kg: 61.8%, p<0.001) based on blood product resuscitation volume. On logistic regression, patients receiving >60mL/kg volume had increased odds of both early [OR 2.65 (95% CI: 1.3, 5.4), p=0.0072] and overall mortality [2.9 (95% CI: 1.55, 5.44), p=0.0009] compared to patients who received <20mL/kg (Figure 1).

Conclusion: Increased blood product resuscitation volume is associated with higher rates of both early and overall mortality in blunt injured pediatric trauma patients with isolated TBI. Resuscitation strategies including judicious fluid administration in conjunction with the use of hypertonic saline and/or vasopressors in this unique pediatric trauma cohort may lead to improved survival outcomes.

Figure 1: Predicted probabilities of early and overall mortality from logistic regression based on blood product resuscitation volume in patients with isolated TBI



Abstract

Title: Seizure risk following mild traumatic brain injury in children

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Introduction: While moderate to severe traumatic brain injury is a known risk factor for seizures, the impact of repeated mild head trauma on long-term seizure risk is less clear. We developed a modeling tool to determine what clinical characteristics predict long-term seizure risk following mild TBI (mTBI).

Methods: Utilizing a national longitudinal healthcare claims database, a total of 156,118 children (age < 18) diagnosed with mTBI without a prior history of seizures or antiepileptic drug (AED) use were identified from 2003 to 2021. Comorbidities linked to childhood epilepsy were collected during the six months preceding the initial mTBI event. Each mTBI event was defined as a qualifying diagnosis code indicating head injury with ≤1 hour loss-of-consciousness. Repeated mTBI was defined as a subsequent mTBI diagnosis code at least one month following the prior mTBI event. Follow-up was censored at either AED initiation, moderate or severe TBI, or loss-to-follow-up. Time-varying multivariable Cox regression was used to assess impact of repeat mTBI. Three distinct machine learning approaches were evaluated for predictive modeling of seizure risk.

Results: Median duration of follow-up was 22.6 months (IQR 9.2-45.4) and, among all patients with post-mTBI seizures, median time-to-seizure was 306 days. Seizures among those with radiographic findings and/or loss-of-consciousness occurred earlier (median time-to-seizure 112.5 days [imaging findings only, IQR 5 to 526.25], 80 days [loss-of-consciousness only, IQR 7 to 652], 22 days [both, IQR 5 to 192]).

Both mTBI without and with short loss-of-consciousness resulted in increasing seizure risk with repeated events (HR=1.196, 95%CI 1.082-1.322; HR=2.025, 95%CI 1.828-2.244; respectively). The survival random forest approach performed best, achieving fixed-time AUROCs of 0.780 and 0.777 at 30- and 90-days post-mTBI. Long-term stratification was robust (high-risk vs low risk, HR=8.852, 95%CI 7.269-10.78).

Conclusion: Utilizing a machine learning approach, children with elevated seizure risk following mTBI can be identified. Repeated mTBI accompanied by loss-of-consciousness doubles the risk for future seizures and taking into account multiple variables, a small subset of children with nearly a 9-fold elevated seizure risk can be identified. These results suggest a subset of children who have multiple mTBI events may benefit from prophylactic antiepileptic drugs.

Title: Factors associated with Abusive Head Trauma in Young Children Presenting to Emergency Medical Services using Machine Learning, and Natural Language Processing

Authors: Kathleen Adelgais, MD MPH[1], Allison Broad BS[1], Jan Leonard MSPH[1], Seth Wheeler[2], Zhan Zhang, PhD[3], Xiao Luo, PhD[2]

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Background: Abusive head trauma (AHT) is a leading cause of death and disability in young children. The standard analysis of clinical characteristics among patients presenting to Emergency Medical Services (EMS) is limited to structured data fields. Machine learning (ML) and natural language processing (NLP) may enhance detection of diagnoses through identification of factors not found in structured data. The purpose of this study was to apply ML and NLP to free-text narrative documentation in EMS encounters of young children with AHT.

Methods: This is a secondary analysis of the ESO Research Data Collaborative which includes EMS structured data, free-text narratives, and hospital diagnoses. Eligible encounters were 911 ground transports aged <36 months, excluding scene deaths. An NLP pipeline extracted demographics, mechanism of injury, and phrases identifying eligible encounters. A vector space model built text representation. We selected the top 10th percentile of ranked features using Chi-square feature selection to fit into the ML algorithms. We compared 5 ML algorithms with 5-fold cross-validation to predict the AHT cases using the Area Under the Receiver Operator Curve (AUROC) as our outcome. SHapley Additive exPlanations (SHAP) provided information on the impact of individual words on predicting AHT.

Results: There were 697 encounters with a hospital diagnosis of AHT. After chart review, 623 cases met inclusion criteria excluding 74 encounters: motor vehicle collision (n=43), interfacility transfer (n=15), or age >36 months (n=16). Among ML algorithms, Random Forest performed the best (AUROC 0.901, specificity 97.4%, and sensitivity 94.4%). (Figure 1) Words positively correlated with AHT included "blood" (s=0.033), "objects" (s=0.026), "hands" (s=0.022), "fell" (s=0.020), "abrasions" (s=0.018), "avulsion" (s=0.010) and "cut" (s=-0.009). Words negatively correlated with AHT included "mva" (s=-0.055), "mvc" (s=-0.045), "transported" (s=-0.029), "fracture" (s=-0.021), "pole" (s=-0.017), "vehicle" (s=-0.015), and "facility" (s=-0.007). (Figure 2)

Conclusion: Machine Learning algorithms have high sensitivity and specificity to detect AHT in EMS free-text narratives. Words associated with physical signs of trauma or a fall mechanism are strongly associated with AHT. ML using NLP may help EMS identify sentinel injuries to aid detection of AHT in young children.

Figures:

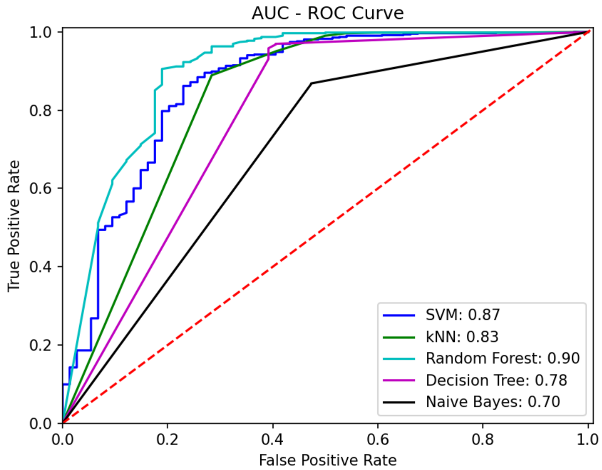

Figure 1 Comparison of the AUROC of different machine learning algorithms based on 5-folds (Naïve Bayes, Support Vector Machine, Decision Tree, k Nearest Neighbor, and Random Forest)

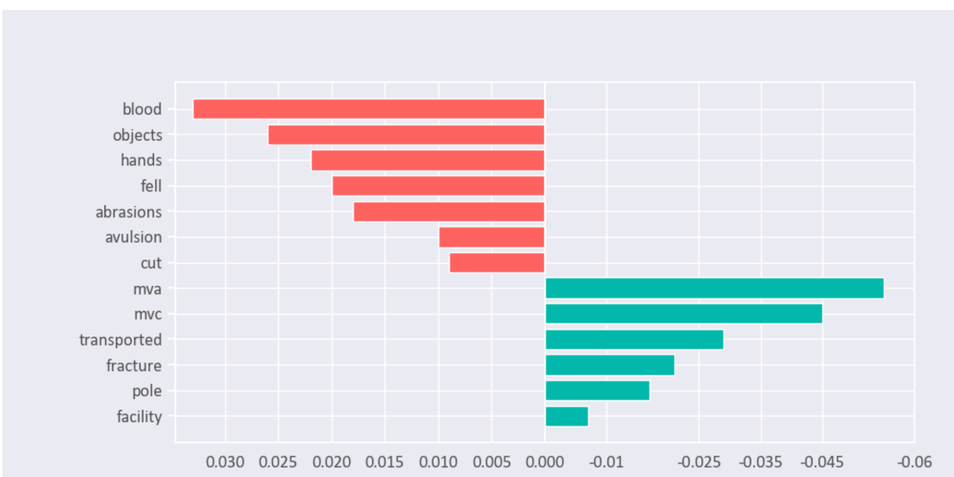

Figure 2: SHapley Additive exPlanations (SHAP) showing magnitude of words using in ML algorithms

Title: Characteristics of Abusive Head Trauma in Young Children Transported by Emergency Medical Services

Authors: Kathleen Adelgais, MD MPH[1], Allison Broad BS[1], Jan Leonard MSPH[1]

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Introduction: Abusive head trauma (AHT) is a leading cause of death and disability in young children. Characteristics of children presenting with AHT to Emergency Medical Services (EMS) are not well described. The purpose of this study is to describe patient demographic and clinical factors and EMS primary impression and interventions associated with a diagnosis of AHT in preverbal children.

Methods: This is a secondary analysis of the ESO Research Data Collaborative. Eligible patient encounters were those aged <36 months transported from the scene by EMS to a receiving facility over a 2-year period. We excluded scene deaths and aeromedical transports. Our primary outcome was the prevalence of AHT and secondary outcomes include patient demographics (median age, gender), EMS primary impression and interventions, and patient disposition.

Results: Over the study period, there were 179,546 encounters of children <36 months of which 624 had a hospital diagnosis of AHT (0.35%). Median age was 1 year (0-2), 53% were male, median EMS GCS was 15, and 47% were transported by ALS. In our cohort, 79.3% (n=495) were coded as being a "traumatic" encounter with the following top 4 EMS primary impressions: Injury of Head/Face (35.7%), Traumatic Injury (21.3%), Injury (31.2%), No Complaints or Injury/Illness Noted (7.3%). Overall, 7.5% had IV access (n=47), 2.4% (n=15) received a medication, and 7.5% received airway management most receiving supplemental oxygen (63%). Top medications included epinephrine (n=7), benzodiazepines (n=6), and analgesics (n=6). Non-febrile seizures accounted for 13 encounters of which half received midazolam. Overall, 12% (n=74) of patients were admitted and among those with a documented hospital length of stay, the median was 3 days; 6 patients (1%) died.

Conclusions: In our dataset, most EMS transports of children with AHT have an EMS impression of trauma however, 1 in 5 were classified as a medical condition. EMS performed very few interventions and treatments despite a significant number requiring hospital admission. AHT remains an occult diagnosis in preverbal children and further research characterizing EMS clinical impressions and rationale for treatment decisions in this high-risk patient population are needed.

Title: Pediatric Whole Body CT prior to Transfer to a Pediatric Trauma Center after Blunt Trauma: A Retrospective Cohort Study of Imaging Appropriateness in Northern California

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Background: Injured children initially presenting to non-pediatric trauma centers often undergo Whole Body CT (WBCT) prior to transfer to a pediatric trauma center (PTC) for higher level of care. This imaging is rarely indicated in pediatric patients and can lead to increased radiation exposure and transfer delays. The goal of this study is to quantify the proportion of unindicated WBCT in injured children.

Method: This study is a retrospective cohort study of patients who underwent a WBCT prior to transfer to Children's Hospital Oakland (2020-2022). Each patient was evaluated for presence of clinical indication for WBCT and each single body region CT (SBRCT) using the American College of Surgeons Trauma Quality Improvement Program Best Practices in Imaging guidelines. Descriptive statistics were used to describe characteristics of the pediatric trauma patient who underwent unindicated WBCT, evaluate for missed injuries and describe cumulative radiation dosage of unindicated CT.

Results: 45 transferred patients were included in the analysis. The most common mechanism of injury was motor vehicle collision. The mean age of patients was 9.2 (Range:0.2-17) years old. Only 20% (N=9) had indications for WBCT, while 13% (N=6) had no clinical indication for any CT imaging. Among children undergoing WBCT, 80% (N=36) had at least one SBRCT that was not indicated based on presentation. The most common SBRCT that was unindicated was a chest CT 75.6% (34), followed by C-Spine CT 46.7% (N=21). There were no injuries noted on an unindicated scan that required clinical intervention. 83 CT scans could have been prevented using selective single body region imaging guidelines.

Conclusions: The majority of injured children who undergo WBCT presenting to non-PTCs undergo at least one unnecessary body region CT. Following single body region guidelines for imaging will likely not lead to any missed injuries and will reduce radiation exposure amongst children. Future work includes expanding this study to a multicenter analysis of all children transferred within a regional trauma system and designing system-based interventions to decrease overutilization of WBCT.

WC: 327

Title: Neurologic Deterioration and Routine Repeat Neuroimaging in Children with Traumatic Intracranial Hemorrhage

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Introduction
Our objective was to describe rates of clinically important neurologic deterioration after injury and associated clinical characteristics and outcomes in children with traumatic intracranial hemorrhage, and among the subgroup of children with hemorrhage who did not undergo immediate interventions (within 4 hours) upon emergency department (ED) arrival.

Methods
We conducted a single center retrospective cross-sectional study of non-transferred children <18 years old evaluated in the ED from 05/01/2014-02/28/2020 with neuroradiographic evidence of intracranial hemorrhage secondary to blunt trauma. We determined rates of the primary outcome, clinically important neurologic deterioration after injury and within 96 hours of ED arrival, which was defined as any intubation for TBI, hyperosmotic agent, neurosurgery, mortality, and/or clinician documentation of new or worsening neurologic signs/symptoms resulting in an acute (within 4 hours) change in clinical management. Rates of deterioration were then calculated among children who did not undergo immediate (within 4 hours of ED arrival) critical interventions, in addition to rates of secondary outcomes, including ICU admission, hospital length-of-stay, and repeat neuroimaging.

Results
We identified 156 children, with a median (IQR) age of 1.0 (0.5-4.6) years (Table). Half (n=78) were admitted to the ICU and 4.5% (n=7) died. Repeat neuroimaging was obtained in 57.1% (n=89). 25.0% (n=39) developed clinically important deterioration after injury and within 96 hours of ED arrival. Among children who did undergo immediate intervention, 7.9% (n=10) deteriorated. 81.4% (n=127) presented with an initial Glasgow Coma Scale (GCS)≥14, including all 10 children who later developed clinically important deterioration. Initial GCS ($p<0.001$) and non-accidental trauma ($p=0.006$) were associated with deterioration. Initial neuroradiographic findings are displayed in the Figure. No children with initial GCS ≥14, isolated, non-epidural hemorrhage after accidental injury deteriorated after injury, however 35% (25/71) received repeat neuroimaging.

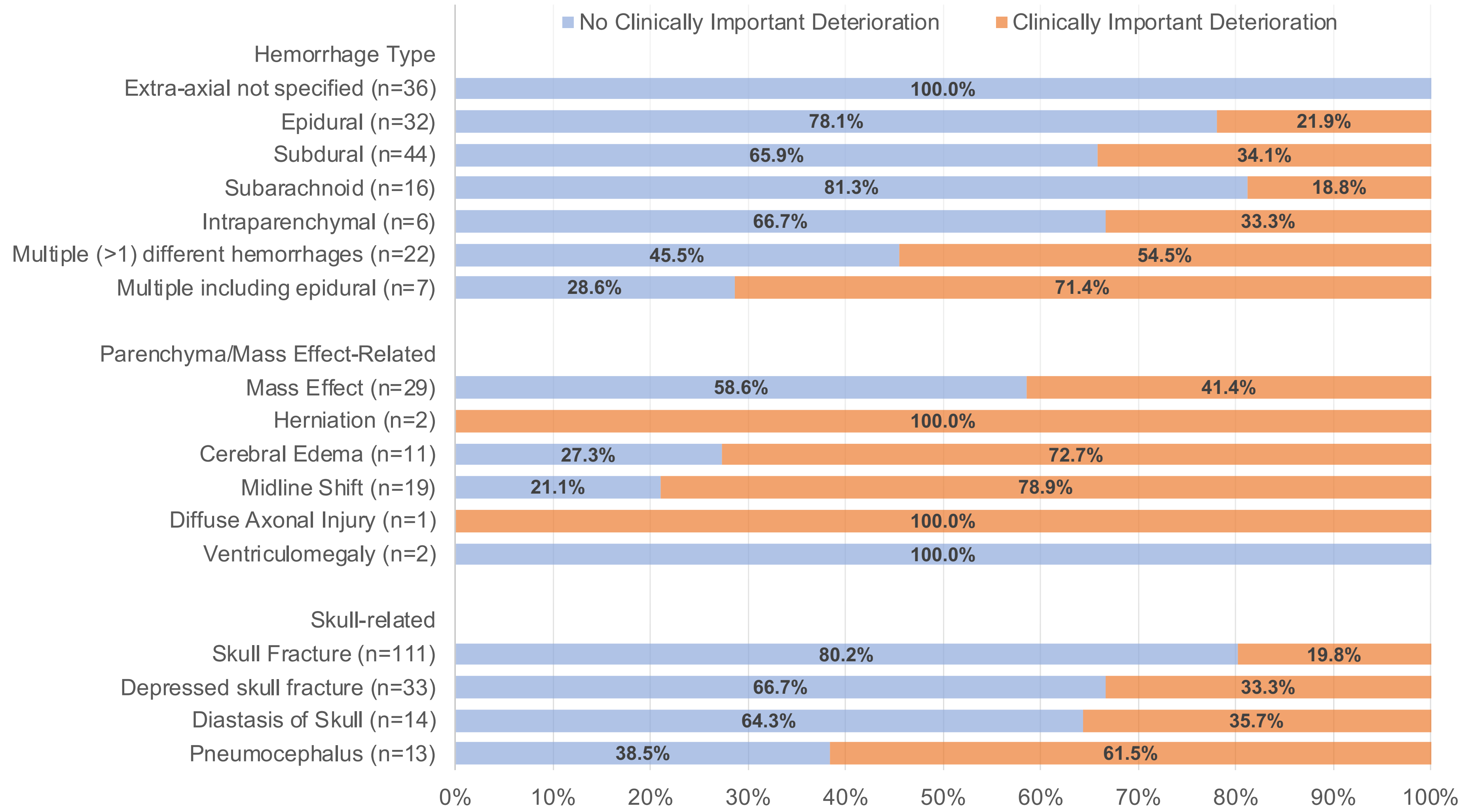
Conclusion
Clinically important neurologic deterioration occurred after injury and within 96 hours of ED arrival in 25% of children with traumatic intracranial hemorrhage. 8% of children who did not undergo immediate ED interventions later deteriorated, all 10 of whom had an initial GCS≥14. We will next explore clinical course and risk factors for deterioration in a multicenter sample to better understand deterioration in this population.

Table. Characteristics of children with intracranial hemorrhage after blunt head trauma, stratified by presence of clinically important neurologic deterioration, and among subgroup of children who did not undergo immediate interventions within 4 hours of ED arrival

Characteristics	**All**				**Patients without immediate interventions**			
	No Deterioration (n=117, 75%)	**Deterioration (n=39, 25%)**	**All (n=156)**	**p-value***	**No Deterioration (n=117, 92.1%)**	**Deterioration (n=10, 7.9%)**	**All (n=127)**	**p-value***
Age [IQR] in years	0.8 [0.4, 2.9]	4.5 [0.7, 10.0]	1 [0.5, 4.6]	0.002	0.8 [0.4, 2.9]	0.8 [0.6, 7.7]	0.8 [0.4, 2.9]	0.747
Sex (female)	49 (41.9)	14 (35.9)	63 (40.4)	0.51	49 (41.9)	5 (50.0)	54 (42.5)	0.618
Race/Ethnicity				0.073				0.17
Asian	9 (7.7)	3 (7.7)	12 (7.7)		9 (7.7)	1 (10.0)	10 (7.8)	
Black	5 (4.3)	7 (18.0)	12 (7.7)		5 (4.3)	2 (20.0)	7 (5.5)	
Hispanic/Latino	73 (62.4)	18 (46.2)	91 (58.3)		73 (62.4)	4 (40.0)	77 (60.6)	
White	12 (10.3)	3 (7.7)	15 (9.6)		12 (10.3)	1 (10.0)	13 (10.2)	
Other	18 (15.4)	8 (20.5)	26 (16.7)		18 (15.4)	2 (20.0)	20 (15.8)	
Hospital LOS [IQR] in days	1.7 [1.1, 2.6]	9.1 [4.0, 20.0]	2 [1.2, 6.0]	<0.001	1.7 [1.1, 2.6]	10.2 [5.9, 20.0]	1.8 [1.1, 3.1]	<0.001
ICU Admission	42 (35.9)	36 (92.3)	78 (50.0)	<0.001	42 (35.9)	7 (70.0)	49 (38.6)	0.045
Repeat Neuroimaging	57 (48.7)	32 (82.1)	89 (57.1)	<0.001	57 (48.7)	10 (100.0)	67 (52.8)	0.002
Initial GCS				<0.001				1
Mild, GCS ≥14	113 (96.6)	14 (35.9)	127 (81.4)		113 (96.6)	10 (100.0)	123 (96.9)	
Moderate, GCS 9-13	4 (3.4)	5 (12.8)	9 (5.8)		4 (3.4)	0 (0)	4 (3.2)	
Severe, GCS ≤8	0 (0)	20 (51.3)	20 (12.8)		0 (0)	0 (0)	0 (0)	
Head injury due to non-accidental trauma	14 (12.0)	13 (33.3)	27 (17.3)	0.006	14 (12.0)	6 (60.0)	20 (15.8)	0.001

Footnotes:
Values in the table represent median [interquartile range] or frequency (percent)
Proportions might not sum to 100% because of rounding
**p-values are χ^2, Mann-Whitney U, or Fisher's Exact test between no clinically important neurologic deterioration and clinically important neurologic deterioration*
Abbreviations: ED, emergency department; GCS, Glasgow Coma Scale; IQR, interquartile range

Figure: Initial neuroradiographic findings of children with intracranial hemorrhage after blunt head trauma, stratified by development of clinically important deterioration



Primary Caregiver Employment Status is Associated with Traumatic Brain Injury in Children

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Introduction: Traumatic brain injury (TBI) is a common injury in pediatric patients. Previous literature has demonstrated that primary caregiver employment may be associated with a child's risk for TBI. We aimed to investigate the association between current child TBI and primary caregiver employment status.
Methods: A retrospective cross-sectional study was performed for children ages 0-17 years using the public-access National Survey of Children's Health (NSCH) 2018-2019 database. The NSCH contains data on children's health collected from surveys completed by adult caregivers from randomly selected households in the United States. Prevalence of current TBI was compared between children from households of different employment statuses. Current TBI was defined by a primary caregiver survey response indicating that a health care provider diagnosed a TBI or concussion for the child and that the child had the condition at time of survey completion. Household employment status was categorized as two caregivers employed, two caregivers unemployed, one of two caregivers unemployed, single caregiver employed, and single caregiver unemployed. Multivariable logistic regression was performed to identify factors associated with current TBI, controlling for child sex, child age, child race/ethnicity, household income level in relation to the federal poverty level (FPL), primary caregiver age, whether the primary caregiver was a grandparent, and whether additional adults resided in the household.
Results: Of 56,438 children (mean age ± standard deviation, 9.5 ± 5.2 years), 0.59% (n=334) had a current TBI (Table 1). Children with TBI were older than children without TBI (mean 11.3 years vs. 9.5 years, $p<0.001$). In multivariable regression analysis, compared to households with both caregivers employed, households with one of two caregivers unemployed (OR 1.56, 95% CI: 1.16-2.11), or households with both caregivers unemployed (OR 2.27, 95% CI: 1.22-4.23) were associated with increased odds of having a TBI (Table 2).
Conclusion: Children in households with one of two caregivers unemployed or both caregivers unemployed had increased odds of TBI compared to children from households with both caregivers employed. These findings highlight a population of families that may benefit from targeted injury prevention education and intervention.

Table 1. Cohort characteristics overall and stratified by presence of current TBI

	Overall n=56,438	TBI n=334 (0.59%)	No TBI n=56,104 (99.4%)	p-value
Female Sex, n (%)	27,019 (47.9)	149 (44.6)	26,870 (47.9)	0.288
Age, years (Mean ± SD)	9.48 ± 5.2	11.32 ± 4.8	9.47 ± 5.2	<0.001
Race/Ethnicity				0.059
Black, Non-Hispanic	3,397 (6.0)	26 (7.8)	3,371 (6.0)	
Hispanic	6,529 (11.6)	48 (14.4)	6,481 (11.6)	
Other/Multi-Racial, Non-Hispanic	6,960 (12.3)	33 (9.9)	6,927 (12.3)	
White, Non-Hispanic	39,552 (70.1)	227 (68.0)	39,325 (70.1)	
Income Level				<0.001
0-199% FPL	15,265 (27.0)	123 (36.8)	15,142 (27.0)	
200-299% FPL	9,151 (16.2)	68 (20.4)	9,083 (16.2)	
300-399% FPL	8,552 (15.2)	40 (12.0)	8,512 (15.2)	
400% FPL or Greater	23,470 (41.6)	103 (30.8)	23,367 (41.6)	
Household Employment Status				<0.001
Both Caregivers Employed	27,304 (48.4)	112 (33.5)	27,192 (48.5)	
One Caregiver Employed and One Caregiver Unemployed	19,944 (35.3)	138 (41.3)	19,806 (35.3)	
Single Caregiver Employed	5,709 (10.1)	39 (11.7)	5,670 (10.1)	
Single Caregiver Unemployed	1,767 (3.1)	27 (8.1)	1,740 (3.1)	
Both Caregivers Unemployed	1,714 (3.0)	18 (5.4)	1,696 (3.0)	
Parent Household Type				0.001
Single Caregiver Household	7,701 (13.6)	67 (20.1)	7,634 (13.6)	
Two Caregiver Household	48,737 (86.4)	267 (79.9)	48,470 (86.4)	
Primary Caregiver Age, years (Mean ± SD)	42.45 ± 9.3	45.25 ± 9.6	42.43 ± 9.3	<0.001
Primary Caregiver is a Grandparent				<0.001
Yes	1,698 (4.3)	22 (10.6)	1,676 (4.3)	
No	37,860 (95.7)	185 (89.4)	37,675 (95.6)	
Extra Adult in Household				<0.001
Yes	51,424 (91.1)	286 (85.6)	51,138 (91.1)	
No	5,014 (8.9)	48 (14.4)	4,966 (8.9)	

Table 2. Univariate and multivariable model of household factors associated with current TBI

	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)
Household Employment Status		
Both Caregivers Employed	Ref	Ref
One Caregiver Employed and One Caregiver Unemployed	1.69 (1.32-2.17)	1.56 (1.16-2.11)
Single Caregiver Employed	1.67 (1.16-2.41)	0.74 (0.09-6.36)
Single Caregiver Unemployed	3.77 (2.47-5.75)	0.53 (0.06-4.73)
Both Caregivers Unemployed	2.58 (1.56-4.25)	2.27 (1.22-4.23)
Child Age, (centered at 9.5 years)		1.07 (1.03-1.11)
Household Income Level		
0-199% FPL		1.17 (0.79-1.71)
200-299% FPL		1.61 (1.11-2.32)
300-399% FPL		0.89 (0.57-1.39)
400% FPL or Greater		Ref

*Controlling for child sex, child race/ethnicity, primary caregiver age, grandparent as primary caregiver, and presence of additional adults in the household

Title: Disparities in Detection of Suspected Child Abuse

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Background: Child abuse is a significant cause of injury and death among children, but accurate identification is often challenging. This study aims to assess whether racial disparities exist in the identification of possible child abuse.

Methods: The 2010-2014 and 2016-2017 National Trauma Data Bank was queried for trauma patients ages 1-17. Using ICD-9CM and ICD-10CM codes, children with injuries consistent with child abuse were identified and analyzed by race.

Results: Between 2010-2014 and 2016-2017, 798,353 patients were included in NTDB. Suspected child abuse victims (SCA) accounted for 7903 (1%) patients. Of these, 51.3% were White, 32.8% Black, 1.1% Asian, 0.3% Native Hawaiian/Other Pacific Islander, 2.1% American Indian, and 12.4% other race. Black patients were disproportionately overrepresented, composing 12.6% of the US population, but 32.8% of SCA patients ($p<0.001$ Figure 1). Although White SCA patients were more severely injured (ISS 16-24: 20.44% vs 16%, $p<0.01$) and had higher in-hospital mortality (9% vs. 6%, $p=0.01$), Black SCA patients were hospitalized longer (7.2±31.4 vs. 6.2±9.9 days, $p<0.01$) despite controlling for ISS (1-15: 4. 5.7±35.7 vs. 4.2±6.2 days, $p<0.01$). In multivariate regression, Black children continued to have longer lengths of stay despite controlling for ISS and insurance type.

Conclusions: Utilizing a nationally representative dataset, Black children were disproportionately identified as potential victims of abuse. When compared with abused White

children, Black children were subject to longer hospital stays, despite milder injuries. Further studies are needed to better understand the etiology of the observed trends and whether such trends reflect potential underlying unconscious or conscious biases of mandated reporters.

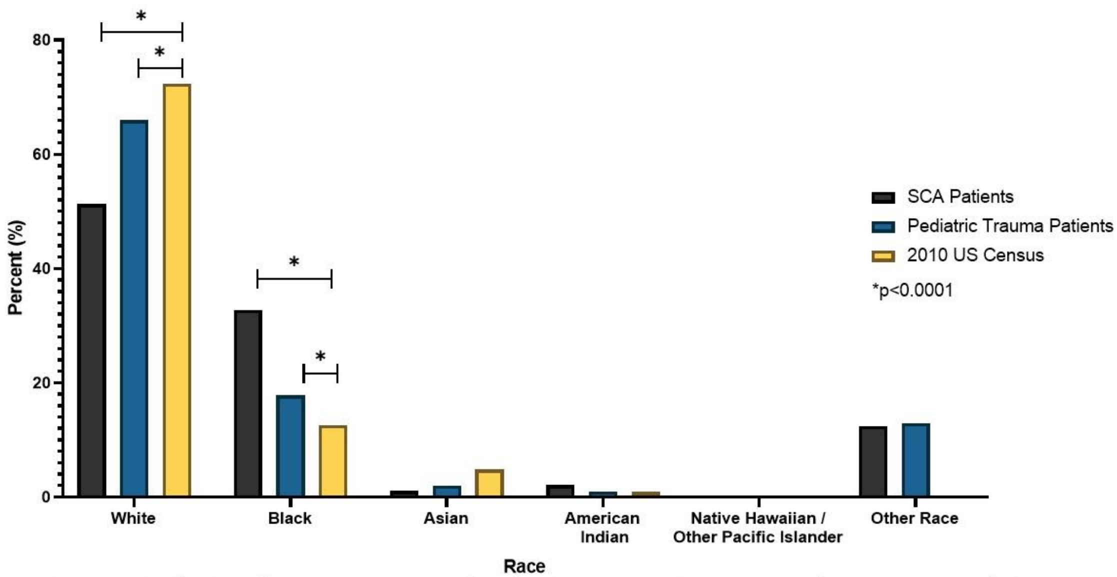

Figure 1. Distribution of races among SCA and pediatric trauma patients compared to 2010 US population. Black children constitute 12.6% of the United States population and 17.79% of the pediatric trauma population, however, represent 32.8% of SCAN patients (p<0.001).

Title: The Impact of the COVID-19 Pandemic on Pediatric Firearm Injuries in Colorado

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Introduction: Similar to national trends, in 2019 firearm injuries surpassed automobile-related injuries as the leading cause of child and adolescent death in the state of Colorado. In the spring of 2020, the COVID-19 pandemic led to widespread community-level social, economic, and health impacts as well as changes to injury epidemiology. Thus, we sought to determine the impact of the COVID-19 pandemic on pediatric firearm injuries in the state of Colorado.

Methods: A retrospective chart review of pediatric firearm injured patients ($\leq$ 18 years old) evaluated at four pediatric trauma centers in Colorado from January 2019- May 2021 was conducted. Patients were stratified into two groups based on the time of their firearm injury relative to the onset of the COVID-19 pandemic (pre- COVID-19 injuries: January 2019 – February 2020; and post- COVID-19 injuries: April 2020 – May 2021). Demographics and clinical information, including injury intent, were abstracted. Group differences were examined using t tests for continuous variables and Cochran-Mantel-Haenszel test for categorical variables.

Results: A total of 194 firearm injuries occurred during the study period. There was a 43% increase in pediatric firearm injuries following the onset of the COVID-19 pandemic (pre-COVID-19= 80, post- COVID-19=114). Assaults were the most common injury intent seen both pre-and post-onset of COVID-19 (63.8% vs. 56.1%, respectively); however, unintentional injuries significantly increased from 8.8% to 20.2% ($p=0.02$) following the onset of the pandemic (Table 1). The most common firearm injury intent for children younger than 10 years was unintentional injuries with a 500.0% increase in such injuries pre-post-onset of COVID-19. Additionally, the onset of the COVID-19 pandemic was associated with a 128.6% increase in unintentional injuries in adolescents (Table 2).

Conclusion: Pediatric firearm injuries, specifically unintentional injuries, increased significantly in Colorado following the onset of the COVID-19 pandemic. The substantial increase in unintentional injuries among adolescents since the onset of COVID-19 is unique to data from previous years and highlights the necessity of a multi-disciplinary, public health approach to mitigate future pediatric firearm injury and death.

Table 1: Pediatric Firearm Injuries Pre-and Post- COVID-19 Stratified by Injury Intent

	Pre COVID-19	**Post COVID-19**	**p-value**
Assault	51	64	0.32
Self-inflicted	4	3	0.39
Unintentional	7	23	**0.02**
Undetermined	18	24	0.66

Table 2: Unintentional Firearm Injuries Pre- and Post- COVID-19 Stratified by Age

Age Groups	**Pre COVID-19**	**Post COVID-19**	**p-value**
<10 years	1	6	0.54
10-12 years	3	1	0.11
13-18 years	3	16	**0.01**

Title: High Volume Blood Product Resuscitation is Associated with Deleterious Outcomes in Blunt Injured Pediatric Trauma Patients with Traumatic Brain Injury

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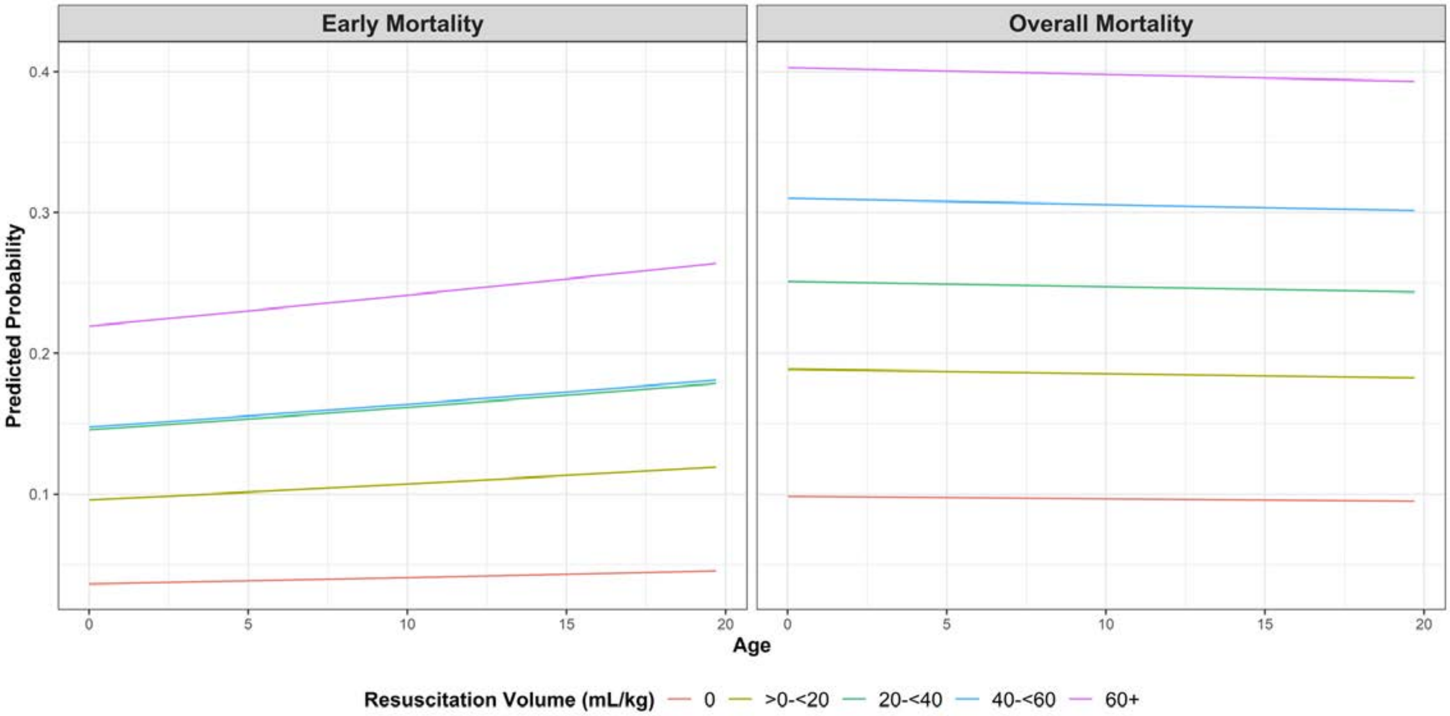
Introduction: Traumatic brain injury (TBI) remains a leading cause of morbidity and mortality in pediatric trauma patients; however, resuscitation strategies vary among trauma centers with little consensus regarding target resuscitation volumes to improve outcomes. Thus, we sought to determine the impact of blood product resuscitation volume on mortality in blunt injured pediatric trauma patients with TBI.

Methods: Pediatric patients (≤18-years-old) with isolated TBI [defined as documentation of Glascow Coma Scale ≤8 and injuries located only in Injury Severity Score (ISS) region 1 (head/neck)] in the 2017-2018 TQIP database with complete blood product transfusion data were included. Patients were divided into five groups based on the total amount of resuscitation (mL/kg) received within 24 hours of presentation. Group differences were tested via Kruskal-Wallis and Chi Squared tests. Logistic regression, adjusting for ISS and age, was used to test for associations between resuscitation volume and mortality, and to obtain Odds Ratios (OR) for comparisons.

Results: Overall, 2,380 patients were included for analysis. The median age of the cohort was 11.0 years [5.0,15.0], and the median ISS was 33 [19.0,43.0]. There were significant differences in the rates of both early mortality (0mL/kg: 4.3%, <20mL/kg: 14.0%, 20-40mL/kg: 19.4%, 40-60mL/kg: 22.0%, >60mL/kg: 28.7%, p<0.001) and overall mortality (0mL/kg: 13.7%, <20mL/kg: 28.7%, 20-40mL/kg: 34.9%, 40-60mL/kg: 49.1%, >60mL/kg: 61.8%, p<0.001) based on blood product resuscitation volume. On logistic regression, patients receiving >60mL/kg volume had increased odds of both early [OR 2.65 (95% CI: 1.3, 5.4), p=0.0072] and overall mortality [2.9 (95% CI: 1.55, 5.44), p=0.0009] compared to patients who received <20mL/kg (Figure 1).

Conclusion: Increased blood product resuscitation volume is associated with higher rates of both early and overall mortality in blunt injured pediatric trauma patients with isolated TBI. Resuscitation strategies including judicious fluid administration in conjunction with the use of hypertonic saline and/or vasopressors in this unique pediatric trauma cohort may lead to improved survival outcomes.

Figure 1: Predicted probabilities of early and overall mortality from logistic regression based on blood product resuscitation volume in patients with isolated TBI



Lethal Means Availability Among a Nationally Representative Sample of High-School Age Youth with Recent Depression or Suicidality: Examining Firearm Possession and Access

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Introduction: Limiting access to firearms, the most lethal means of suicide, is essential to decreasing youth suicide rates. Efforts to date have focused on counseling parents about safe firearm storage and temporary removal of firearms from the home, yet little is known about overall rates of firearm access and personal firearm possession among youth at increased risk for suicide. Our objective was to estimate prevalence of firearm possession and access among teens with and without recent depression (past two weeks) and/or lifetime history of suicidality (DLHS).

Methods: We conducted a probability-based cross-sectional web survey of 1914 parent-teen dyads between 06/24/2020 and 07/22/2020. Data was weighted to generate a nationally representative sample of U.S. teenagers (age 14-18). Our dependent variables were teen firearm possession and perceived firearm access, and method of attainment of firearms.

Results: Among U.S. youth, 22.6% (95% CI: 19.4, 25.8) reported DLHS, 11.5% (95% CI: 8.7, 14.3) endorsed personal firearm possession, and 44.2% (95% CI: 40.2-48.2) endorsed firearm access. U.S. youth experiencing DLHS had increased perceived firearm access overall (AOR: 1.56; 95%CI: 1.07, 2.28) when compared to youth without DLHS. There was no significant association found between experiencing DLHS and personal firearm possession (AOR: 0.97; 95% CI: 0.47, 2.00)]. Among youth who possessed a personal firearm, those with DLHS were more likely to have bought it or traded something for it (OR: 5.66; 95%CI: 1.17, 27.37) and less likely to have obtained it as a gift (OR: 0.06; 95%CI: 0.01, 0.36) than those without DLHS.

Conclusion: U.S. youth experiencing DLHS have higher perceived access to firearms compared to youth not experiencing DLHS. Providers should speak directly to youth at higher risk for suicide about their firearm access in addition to counseling parents about reducing access to lethal means.

Table 1: Socio-demographic characteristics among adolescent youth (age 14-18) with or without firearm possession and with and without on or off property firearm access

	Teen Firearm Possession		Perceived Teen Firearm Access		Total Sample
	Yes	No	Yes	No	
	11.5% (8.7, 14.3%)	88.5% (85.7, 91.3%)	44.2% (40.2, 48.2%)	55.8% (51.8, 59.8%)	
	% (95% CI)		% (95% CI)		% (95% CI)
Teen's Age *Mean (SD)* [2]	16.3 (15.9, 16.7)	16.0 (15.8, 16.1)	16.2 (16.0, 16.4)	15.8 (15.7, 16.0)	16.0 (15.9, 16.1)
Gender [1]					
Male	70.7 (59.5, 82)	46.1 (41.9, 50.3)	51.5 (45.3, 57.8)	46.9 (41.7, 52.1)	49.0 (44.9, 53.0)
Female	25.2 (14.8, 35.6)	52.1 (47.9, 56.3)	46.3 (40.0, 52.5)	51.2 (46.0, 56.4)	49.0 (45.0, 53.0)
Another gender[a]	4.1 (0.0, 9.9)	1.7 (0.8, 2.7)	2.2 (0.5, 3.9)	1.9 (0.5, 3.2)	2.0 (1.0, 3.1)
Race [1]					
White	87.5 (79.5, 95.4)	72.5 (68.5, 76.5)	74.4 (68.8, 79.9)	74.1 (69.2, 79.0)	74.2 (70.5, 77.9)
Black	1.3 (0.0, 3.4)	12.1 (8.9, 15.2)	9.1 (5.3, 12.9)	12.2 (8.1, 16.2)	10.8 (8, 13.7)
Multi-Racial	2.8 (0.4, 5.2)	10.2 (7.7, 12.8)	9.9 (6.1, 13.6)	9.0 (6.2, 11.8)	9.4 (7.1, 11.6)
Other [b]	8.5 (1.1, 15.9)	5.2 (3.2, 7.2)	6.7 (3.4, 9.9)	4.7 (2.3, 7.1)	5.6 (3.6, 7.5)
Ethnicity					
Hispanic	10.2 (1.8, 18.5)	17.6 (14.1, 21)	15.0 (10.2, 19.7)	18.1 (13.8, 22.5)	16.7 (13.5, 19.9)
Region					
Northeast	15.3 (4.7, 26.0)	17.0 (13.9, 20.2)	16.8 (11.9, 21.7)	16.9 (13, 20.7)	16.8 (13.8, 19.9)
Midwest	25.3 (14.0, 36.7)	20.1 (16.9, 23.3)	21.8 (14.8, 23.8)	21.8 (17.5, 26.1)	20.7 (17.6, 23.8)
South	37.6 (25.2, 50.0)	36.5 (32.4, 40.7)	41.6 (35.4, 47.9)	32.7 (27.9, 37.6)	36.7 (32.8, 40.6)
West	21.8 (11.8, 31.7)	26.4 (22.6, 30.1)	22.3 (17.1, 27.5)	28.6 (23.8, 33.4)	25.8 (22.3, 29.3)
Public Assistance	9.8 (3.1, 16.5)	17.3 (13.8, 20.7)	14.0 (9.6, 18.4)	18.3 (13.8, 22.8)	16.4 (13.2, 19.6)
Depression/ Lifetime Suicidality [2]	19.6 (8.9, 30.2)	23 (19.7, 26.4)	26.5 (21.2, 31.9)	19.6 (15.8, 23.3)	22.6 (19.4, 25.8)

All results calculated using the weighted sample.
Unweighted n: 1914, weighted n=2003
a: Another gender includes trans, genderqueer/gender non-conforming and other identity genders.
b: Other race includes Native Hawaiian/Pacific Islander, American Indian/Alaskan Native, Asian, Middle Eastern/North African, and Unknown/Other
1: Chi-Square/comparison of means test p-value <0.05 for Teen Firearm Possession
2: Chi-Square/comparison of means test p-value <0.05 for Teen Firearm Access

Table 2. Firearm ownership characteristics among a nationally representative sample of youth (age 14-18) endorsing personal firearm ownership (unweighted n=192), with and without a history of recent depression (i.e. past 2 weeks) or a lifetime history of suicidality (DLHS).

	DLHS	**Non-DLHS**	**Total Sample**	**OR (95% CI)**
	19.6% (8.9, 30.2%)	80.4% (69.8, 91.1%)		
	% (95% CI)	% (95% CI)	% (95% CI)	
Method Firearm obtained: [a]				
As a gift	66.9 (34.7, 99.0)	97.0 (94.1, 99.9)	91.1 (83.0, 99.3)	0.06 (0.0, 0.4)
Bought/traded for it	34.3 (2.3, 66.3)	8.5 (3.3, 13.7)	13.5 (4.8, 22.2)	5.66 (1.2, 27.4)
Other	0.8 (0.0, 2)	1.5 (0.0, 3.0)	1.3 (0.1, 2.6)	0.54 (0.1, 3.5)
From whom firearm was obtained [a]				
Family member	67.3 (35.1, 99.5)	91.8 (84.1, 99.5)	87.0 (77.3, 96.6)	0.18 (0.0, 1.1)
Friend or peer	1.6 (0.0, 3.9)	0.0 (0.0, 0.0)	0.3 (0.0, 0.7)	NA
Online seller	15.2 (0.0, 41.9)	1.0 (0.0, 3.0)	3.8 (0.0, 9.7)	17.78 (1.0, 319.8)
Store	18.2 (0.0, 44.8)	10.6 (4.9, 16.3)	12.1 (4.9, 19.2)	1.89 (0.3, 12.5)
Trade or gun show	0.0 (0.0, 0.0)	4.3 (0.0, 11.5)	3.5 (0.0, 9.3)	NA
Other	0.4 (0.0, 1.2)	0.6 (0.0, 1.6)	0.6 (0.0, 1.4)	0.61 (0.1, 8.1)

*All results calculated using the weighted sample and are among the sample who personally own a firearm
Unweighted n: 158, weighted n=192
[a] Indicates a “Check all that apply” response

Title: ACS Verification and Pediatric Readiness

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Introduction

The American College of Surgeons (ACS) recently added the National Pediatric Readiness Project (NPRP) assessment to Trauma Verification Criteria, requiring hospitals to have a corrective plan for areas noted for improvement. The NPRP assessment tallies metrics around pediatric care, including the presence of a Pediatric Emergency Care Coordinator (PECC), creating a weighted pediatric readiness score (wPRS). The recent pilot of the NPRP assessment in Colorado provides an opportunity to evaluate the degree of pediatric readiness among ACS verified facilities. Our objective was to quantify the wPRS and presence of pediatric-specific factors among Colorado's ACS verified centers.

Methods

In 2020, Colorado piloted the NPRP assessment among 79 hospitals which resulted in changes to three questions. In follow up, investigators surveyed all facilities to obtain updated information. We quantified the wPRS (maximum score = 100) and the following factors among non-pediatric ACS verified centers: presence of a PECC; weight in kilograms; pediatric medication dosing; disaster plans with pediatric considerations; and policies for child maltreatment, pediatric radiation dose for imaging, pediatric death, and pediatric pain assessment. We compared mean wPRS between ACS verified and non-ACS verified facilities. We used one-way ANOVA and performed linear regression examining the effect of pediatric volume on wPRS among ACS verified facilities.

Results

Overall, 59 hospitals completed the assessment (79% response rate). Average daily pediatric volume was between 0-27 children. Mean wPRS among ACS verified facilities was 75.2 (SD 15.0). Among ACS verified centers, 53.8% had a PECC compared to 34.8% of non-ACS verified centers. A higher proportion of ACS verified centers had pediatric specific factors of interest but only wPRS met statistical significance compared to non-ACS verified centers (Table 1). Adjusting for pediatric volume, ACS verification did not impact wPRS ($\beta = 7.37$ (95% CI -2.74 – 17.47)). Hospitals with a PECC did have higher wPRS compared to those with no PECC (77.8 vs 58.8, $p<0.001$) (Table 2).

Conclusion

High volume ACS verified centers have the highest wPRS scores. Presence of PECCs is positively associated with wPRS and meeting all pediatric readiness factors provides opportunities for ACS verified centers looking to improve their pediatric readiness.

Tables

Table 1: Comparison of ACS verified centers to centers that do not have ACS verification. Significant difference seen only in mean wPRS.

	ACS Verified (n=13)	Non-ACS Verified (n=46)	p-value
wPRS, mean (SD)	75.2 (14.7)	63.6 (14.2)	**0.01**
Presence of a PECC, n (%)	7 (53.8%)	16 (34.8%)	0.21
Weight in Kg, n (%)	12 (92.3%)	33 (71.7%)	0.16
Pediatric medication dosing, n (%)	11 (84.6%)	31 (67.4%)	0.31
Child maltreatment policy, n (%)	12 (92.3%)	36 (78.3%)	0.43
Radiation dosing protocols, n (%)	9 (69.2%)	28 (60.9%)	0.75
Policy regarding pediatric death, n (%)	8 (61.5%)	24 (52.2%)	0.55
Pediatric Pain management, n (%)	13 (100%)	42 (91.3%)	0.57
Disaster planning, n (%)	6/6 (100%)	15/18 (83.3%)	0.55
IFT Guidelines, n (%)	10 (76.9%)	31 (67.4%)	0.74
QI Peds, n (%)	7 (53.8%)	16 (34.8%)	0.21

Table 2: Comparison of centers with PECCs to those without PECCs. Significant difference seen in mean wPRS.

	PECC	No PECC	p-value
	(n=23)	(n=36)	
wPRS, mean (SD)	77.8 (12.8)	58.8 (11.2)	**<0.001**
Weight in Kg, n (%)	18 (78.3%)	27 (75.0%)	0.77
Pediatric medication dosing, n (%)	16 (69.6%)	26 (72.2%)	0.83
Child maltreatment policy, n (%)	19 (82.6%)	29 (80.6%)	>0.99
Radiation dosing protocols, n (%)	15 (65.2%)	22 (61.1%)	0.75
Policy regarding pediatric death, n (%)	17 (73.9%)	15 (41.7%)	**0.02**
Pediatric pain management, n (%)	23 (100%)	32 (88.9%)	0.15
Disaster planning, n (%)	7/10 (70.0%)	14/14 (100%)	0.06
IFT Guidelines, n (%)	17 (73.9%)	24 (66.7%)	0.56
QI Peds, n (%)	12 (52.2%)	11 (30.6%)	0.10

Neighborhood Deprivation Index and Childhood Opportunity Index are Associated with Violent Injury Among Children in Los Angeles County

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Introduction

Previous research has demonstrated associations between neighborhood socioeconomic factors, such as poverty level and income inequality, and incidence of violence in children. The Childhood Opportunity Index (COI) is comprised from 29 factors across three domains (Education, Health & Environment, and Social & Economic), divided into quintiles from very low to very high opportunity. The Neighborhood Deprivation Index (NDI) includes four socioeconomic measures, with high scores associated with higher neighborhood disadvantage. We evaluated the association of both COI and NDI with incidence of violent injuries in children across the zip codes of Los Angeles (LA) County.

Methods

We performed a retrospective cross-sectional study of children aged <18 years from 2017-2019 who were evaluated in 1 of 15 trauma centers and entered in the LA County trauma registry after violent mechanisms of injury (MOI), which were defined as gunshot, stabbing, or assault. Self-inflicted injuries were excluded. The number of incidences of violent MOI per 100,000 children <18 years-old for each zip code were calculated using population data from the 2019 US Census American Community Survey 5-Year estimates. COI scores were categorized and NDI scores were measured continuously. The incidence of violence per capita <18 years-old for each zip code was compared independently to the zip code COI and NDI via simple linear regression models. Geographic heat maps of incidence of violent injury per 100,000 children, metro-normed COI, and NDI for LA County zip codes were generated.

Results

Of 6,971 injuries reported from 2017-2019, 866 (12.4%) were violent MOIs. Of 298 zip codes included, 80 (26.8%) had >5 cases of violent injury per 100,000 children. Of these 80 zip codes, 64 (80%) had “low” or “very low” metro-normed COI scores. There

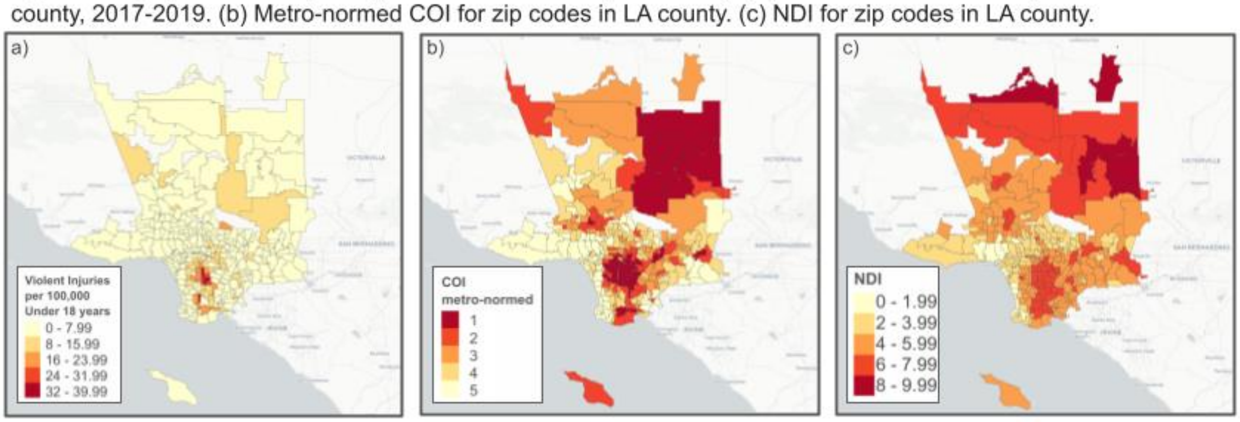
was a significant negative association between metro-normed COI score and violent injuries ($p<0.01$), and a significant positive association between NDI scores and violent injuries ($p<0.01$). Geographic heat maps are displayed in the Figure.

Conclusions

Children living in low opportunity zip codes had greater rates of violent injury. Further study of neighborhood factors is needed to design effective interventions to reduce violent injuries among children living in low opportunity areas.

Figure: Geographic heat maps of (a) Instances of violent pediatric injury per 100,000 children in zip codes in LA county, 2017-2019. (b) Metro-normed COI for zip codes in LA county. (c) NDI for zip codes in LA county

Figure: Geographic heat maps of (a) Instances of violent pediatric injury per 100,000 children in zip codes in LA county, 2017-2019. (b) Metro-normed COI for zip codes in LA county. (c) NDI for zip codes in LA county.



An Analysis of Motor Vehicle Collision Caused Pediatric Trauma Outcomes

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BACKGROUND: Differential access to high-level trauma centers may contribute to disparities in pediatric trauma outcomes. We sought to evaluate the association between sociodemographic characteristics and Trauma Center access for children injured in motor vehicle collisions (MVC).

METHODS: We performed a retrospective cohort study utilizing the 2019 Nationwide Emergency Department Sample. Patients aged <18 years were included if their mechanism of injury was MVC as determined by International Classification of Disease 10^{th} Edition Codes. Patients were excluded if they died or were discharged from the Emergency Department. Our primary outcome was inpatient admission to a Level 3 or Non-Trauma Center (NTC). We analyzed patient characteristics including age, race, sex, insurance, location, zip-code-based median household income, and injury severity scores. We utilized generalized linear models with inverse-probability survey weighting to determine the association between these characteristics and the primary outcome.

RESULTS: A total of 16,569 weighted patients were included of whom 897 (5.4%) were admitted to a Level 3/NTC. Compared to patients admitted or transferred to a Level 1 or 2 Trauma Center on univariate analysis, admission to a Level 3/NTC was statistically associated with public insurance (11% vs. 89%, p=.03) and age (p=<.0001). After multivariable adjustment, the odds of admission to a Level 3/NTC were significantly higher for publicly insured patients when compared to privately insured patients (adjusted odds ratio (aOR) [95% Confidence Interval]: 1.91 [1.08-3.35], p=0.025), Asians and Pacific Islanders when compared to Whites (aOR [95%CI]: 2.67, [1.06-6.75], p=0.04), and patients aged 6-10 years (aOR [95%CI]: 3.54, [2.02-6.18], p<0.001, p<0.001) and 11-14 years (aOR [95%CI]: 2.52, [1.22-5.20], p=0.013) when compared to patients aged 15-17. There was no significant association between Level 3/NTC admission and zip-code-based median household income, location, or injury severity. (Table)

CONCLUSION: After being injured in a MVC, a significant percentage of children are admitted to lower level or non-trauma centers. The child's age, race, and insurance status are significantly associated with an increased likelihood of lower-level trauma center admission. Improving trauma center access for injured minority and disadvantaged children presents an opportunity for regional trauma systems to ensure equitable quality of trauma care.

	Admission to Level 3 or Non-Trauma Center		
Characteristic	Weighted Rate (%)	Multivariable Odds Ratio (95% CI)	p-value
Female			
Male	565 (5.9%)	—	
Female	332 (4.8%)	0.81 (0.57-1.16)	0.2
Age group			
15-17 years	55 (2.4%)	—	
11-14 years	198 (5.4%)	2.52 (1.22-5.20)	0.013
6-10 years	524 (7.3%)	3.54 (2.02-6.18)	<0.001
1-5 years	101 (3.3%)	1.45 (0.67-3.15)	0.3
Less than 1 year	19 (6.1%)	2.51 (0.53-11.8)	0.2
Race			
White	501 (5.6%)	—	
Black	74 (2.6%)	0.39 (0.12-1.28)	0.12
Hispanic	195 (5.9%)	0.96 (0.34-2.66)	>0.9
Asian or Pacific Islander	48 (11%)	2.67 (1.06-6.75)	0.038
Native American	4 (2.1%)	0.31 (0.04-2.58)	0.3
Other	75 (8.6%)	1.78 (0.81-3.96)	0.2
Patient Location			
Urban	658 (5.2%)	—	
Rural	239 (6.0%)	0.93 (0.38-2.28)	0.9
Median household income			
$1-$45,999	380 (6.1%)	—	
$46,000-$58,999	273 (6.0%)	0.88 (0.39-1.95)	0.7
$59,000-$78,999	190 (5.6%)	0.80 (0.28-2.28)	0.7
$79,000 or more	55 (2.3%)	0.30 (0.09-1.02)	0.054
Expected primary payer			
Private	432 (4.3%)	—	
Public	419 (7.5%)	1.91 (1.08-3.35)	0.025
No Charge/Other	46 (4.8%)	1.19 (0.57-2.48)	0.6
Injury Severity Score			
Minor	342 (5.6%)	—	
Moderate	208 (5.4%)	0.94 (0.67-1.31)	0.7
Severe	187 (6.8%)	1.18 (0.80-1.73)	0.4
Very Severe	160 (4.2%)	0.66 (0.40-1.08)	0.10

Variation in CT Scan Rates of Pediatric Trauma Patients Among Emergency Medicine-Trained and Pediatric Emergency Medicine-Trained Physicians

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Background: Pediatric trauma care has been shown to vary between general and pediatric emergency departments (EDs). Specifically, pediatric EDs do fewer CT scans with no change in clinical outcome. Why pediatric EDs scan less is unclear. No pediatric trauma studies have evaluated general and pediatric EDs within the same institution. By eliminating institutional variability, we sought to identify whether the training background of ED providers affects the CT rate.

Objective: To compare CT rates of pediatric trauma patients treated within one institution by physicians trained in either emergency medicine or pediatric emergency medicine.

Study design: This was a single-center retrospective study of children <18 years entered into our Trauma Registry between Nov 2018 and Nov 2021. Patients were reviewed for CT utilization at our level 1 adult/pediatric trauma center. Attending physicians were categorized into two groups: emergency medicine residency training only (EM), or pediatric emergency medicine fellowship training (PEM). Primary outcomes were proportion of patients with a CT and percent positive CTs. Groups were compared using χ-square analysis and t-tests, and association quantified with odds ratios, designating p-values <0.05 as significant.

Results: Of 463 study patients, 275/463 (59.4%) received at least one CT scan. CTs obtained in 145/228 (63.6%) patients treated by the EM group, and 130/235 (55.3%) in the PEM group [χ^2 (1, N = 463)= 3.29, p=.07]. CT positivity rate was equal between groups, 21.3% (EM) vs 18.9% (PEM) [χ^2 (1, N = 675)= 0.55, p=.46]. The mean number of CTs per patient in the EM group (M= 2.8, SD=3.3) was statistically higher than the PEM group (M=2.1, SD=1.8); t(273)=3.3, p=.001. Patients in the EM group were more likely to get a CT C-spine (OR 1.73, 1.07 to 2.82) or chest (OR 2.07, 1.13 to 3.82).

Conclusions: There was no difference in the number of pediatric trauma patients who underwent a CT scan between EM-trained and PEM-trained providers. However, the mean number of scans per patient in the EM-trained group was significantly higher. The differences in C-spine and chest scans highlight future opportunities for investigation given lack of pediatric trauma imaging guidelines for these regions.

Pediatric Firearm Injuries Before and During the COVID-19 Pandemic Across United States Children's Hospitals

Introduction

Firearm injuries are a leading cause of injury-related death in children in the United States (US), and early reports suggested this public health crisis was exacerbated by the COVID-19 pandemic. We aimed to determine the impact of COVID-19 on pediatric firearm injuries across the US and assess for sustained changes over 11 months.

Methods:

Using the Pediatric Health Information System, we conducted a retrospective cohort study of children aged <18 years presenting with firearm injuries to 48 US children's hospitals based on ICD-10 codes. Patients treated during the first 11 months of the pandemic (April 1, 2020 - Feb 28, 2021) were compared to patients treated during corresponding months of the previous year (April 1, 2019 - Feb 29, 2020). Patient characteristics (age, sex, race/ethnicity, insurance, zip-code-based median household income, rurality, and region), intent categories (assault, accidental, self-harm, and undetermined), and monthly injury rates were compared using Chi-squared tests and Wilcoxon rank-sum tests. Secondary outcomes included mortality and length of stay (LOS).

Results:

In total, 2,463 pediatric firearm injuries were observed: 1,006 (40.8%) pre-pandemic and 1,457 (59.2%) during the pandemic. The monthly rate of firearm injuries was significantly higher during the pandemic (median: 128, interquartile range (IQR): 15.5) when compared to pre-pandemic months (median: 89, IQR: 10.5) ($p<0.001$). There were no significant differences in pre-pandemic vs. pandemic months when comparing proportions of injuries by intent ($p=0.5$), sex ($p=0.2$), age ($p=0.2$), neighborhood SES ($p=0.3$), rurality ($p>0.9$), or region ($p=0.7$). However, during the pandemic, a greater proportion of injured children were Non-Hispanic Black (62% vs. 67%, $p=0.03$) and had public insurance (74% vs. 79%, $p=0.005$). There were no differences in mortality (6.1% vs. 6.0%, $p>0.9$) or LOS (median (IQR): 1 day (2.0) vs. 1 d (2.0), $p=0.06$).

Conclusion:

Rates of pediatric firearm injuries increased during the first 11 months of the COVID-19 pandemic across the US. Non-Hispanic Black children and those with public insurance represented greater proportions of injured children during the pandemic. This unequal burden of pediatric firearm injuries mirrors the disproportionate impact of COVID-19 on social determinants of health for racial/ethnic minority families and warrants enhanced public health attention and targeted interventions.

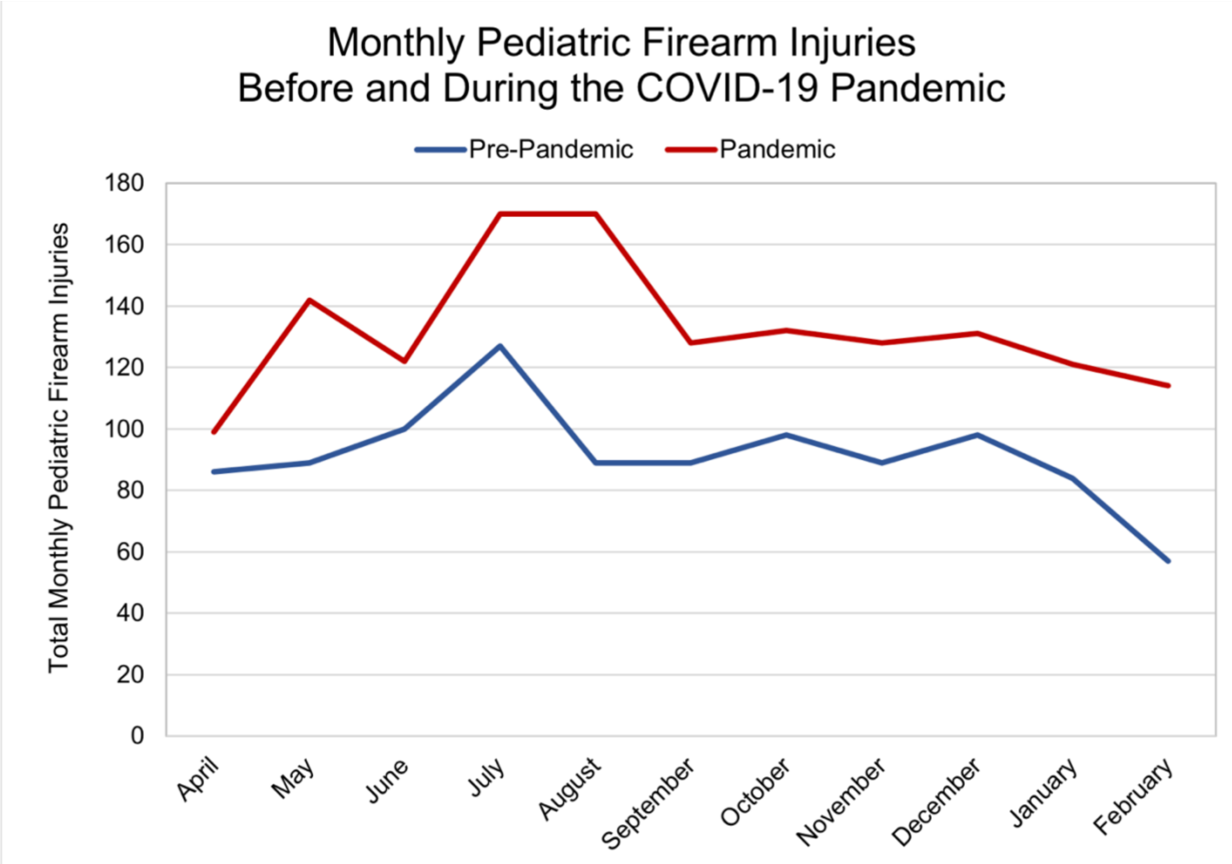
Monthly Pediatric Firearm Injuries
Before and During the COVID-19 Pandemic
Pre-Pandemic
Pandemic
Total Monthly Pediatric Firearm Injuries
0
20
40
60
80
100
120
140
160
180
April
May
June
July
August
September
October
November
December
January
February

Table 1. Patient Demographics, Firearm Injury Rates and Mechanisms

	Pre-Pandemic N = 1,006[1]	**Pandemic** N = 1,457[1]	p-value[2]
Monthly Firearm Injuries	89 (10.5)	128 (15.5)	<0.001
Intent			0.5
Accidental	612 (61%)	882 (61%)	
Assault	334 (33%)	475 (33%)	
Self-Harm	26 (2.6%)	53 (3.6%)	
Undetermined	34 (3.4%)	47 (3.2%)	
Sex			0.2
Female	196 (19%)	315 (22%)	
Male	810 (81%)	1,142 (78%)	
Age Group			0.2
0 – 5	124 (12%)	212 (15%)	
6 – 11	162 (16%)	195 (13%)	
12 – 17	720 (72%)	1,050 (72%)	
Race/Ethnicity			0.029
Non-Hispanic White	184 (18%)	219 (15%)	
Non-Hispanic Black	619 (62%)	981 (67%)	
Hispanic/Latinx	148 (15%)	187 (13%)	
Other	55 (5.5%)	70 (4.8%)	
Median Household Income Quartile			0.3
4 (>$41, 896)	264 (26%)	343 (24%)	
3 ($33,311 – 41, 657)	250 (25%)	399 (27%)	
2 ($26,974 – 33,311)	240 (24%)	334 (23%)	
1 (<$26,974)	252 (25%)	381 (26%)	
Payor			0.005
Private	184 (18%)	196 (13%)	
Public	749 (74%)	1,149 (79%)	
Other/Self-Pay	73 (7.3%)	112 (7.7%)	
Rurality			>0.9
Rural	102 (10%)	149 (10%)	
Urban	904 (90%)	1,308 (90%)	
Region			0.7
Northeast	56 (5.6%)	66 (4.5%)	
Midwest	271 (27%)	398 (27%)	
South	606 (60%)	892 (61%)	
West	73 (7.3%)	101 (6.9%)	
Mortality	61 (6.1%)	87 (6.0%)	>0.9
Length of Stay (days)	1.0 (2.0)	1.0 (2.0)	0.06

[1]n (%); Median (IQR)

[2]Pearson's Chi-squared test; Wilcoxon rank sum test

Intentional Self-Harm Injuries Presenting to United States Children's Hospitals Before and During the COVID-19 Pandemic

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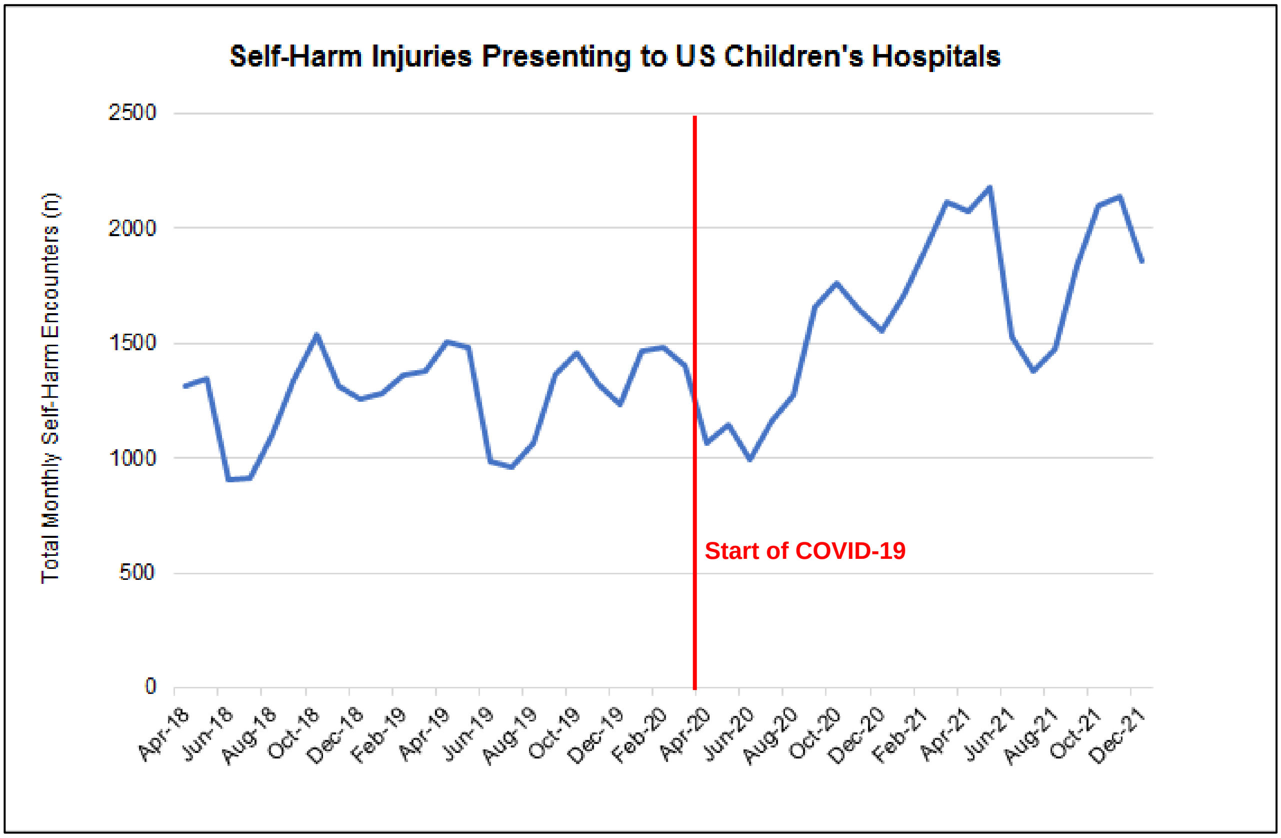
University of Utah, Department of Surgery, Division of Pediatric Surgery

Background
In October 2021, a national emergency in pediatric mental health was declared by the American Academy of Pediatrics, the American Academy of Child and Adolescent Psychiatry, and the Children's Hospital Association. We aimed to evaluate the impact of the COVID-19 pandemic on intentional self-harm injury rates, severity, and mechanisms for patients presenting to children's hospitals across the United States.

Methods
Using the Pediatric Health Information System, we conducted a retrospective cohort study of children aged 5-17 years presenting to 47 US children's hospitals with intentional self-harm injuries based on previously validated ICD-10 codes. Patients treated during the first 21 months of the pandemic (April 1, 2020 - December 31, 2021) were compared to historical controls using corresponding months to provide equivalent duration and account for seasonal variability (April 1, 2018 – December 31, 2019). The primary outcome was the rate of monthly self-harm injuries. Secondary outcomes included mortality, intensive care unit (ICU) admissions, and self-harm mechanisms. Patient demographics included age, sex, race/ethnicity, insurance payor, zip-code-based median household income, rurality, and geographic region. Outcomes were assessed using Chi-squared tests and Wilcoxon rank-sum tests.

Results
A total of 60,534 self-harm injuries were included: 26,396 (43.6%) pre-pandemic and 34,138 (56.4%) during the pandemic, representing a 29.3% percent increase in total self-harm encounters. The monthly rate of self-harm injuries was significantly higher during the pandemic (mean: 1625.6, standard deviation (SD): 357.6) when compared to pre-pandemic (mean: 1257.0, SD: 194.2) ($p<0.001$). Rates of mortality (0.4% vs 0.3%, $p=0.07$) and ICU admissions (11% vs 11%, $p=0.1$) were not significantly different between cohorts. Notably, the majority of patients were female in both cohorts, and during the pandemic, the proportion of females increased significantly (76% vs. 80%, $p<0.001$).

Conclusions
The number of pediatric patients presenting to US children's hospitals after intentional self-harm significantly increased during the COVID-19 pandemic, and females were at heightened risk. While enhanced mental healthcare resources and outreach are critically needed, pediatric emergency medicine and trauma providers should be aware of this increased burden of disease and prepare for the complex physical and psychological needs of these patients.



Self-Harm Injuries Presenting to US Children's Hospitals
Total Monthly Self-Harm Encounters (n)
2500
2000
1500
1000
500
0
Start of COVID-19
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Apr-19
Jun-19
Aug-19
Oct-19
Dec-19
Feb-20
Apr-20
Jun-20
Aug-20
Oct-20
Dec-20
Feb-21
Apr-21
Jun-21
Aug-21
Oct-21
Dec-21

Table 1. Patient Demographics, Self-Harm Mechanisms, and Outcomes

	Pre-COVID-19 N = 26,396	COVID-19 N = 34,138	p-value[1]
Monthly Injuries, mean (SD)	1257.0 (194.2)	1625.6 (357.6)	<0.001
Age Group, n (%)			<0.001
5-11	1,824 (6.9%)	1,797 (5.3%)	
12-17	24,572 (93%)	32,341 (95%)	
Sex, n (%)			<0.001
Female	19,999 (76%)	27,295 (80%)	
Male	6,397 (24%)	6,843 (20%)	
Race/Ethnicity, n (%)			<0.001
Non-Hispanic White	14,750 (56%)	19,141 (56%)	
Non-Hispanic Black	5,059 (19%)	5,734 (17%)	
Hispanic/Latino	4,140 (16%)	6,093 (18%)	
Other	2,447 (9.3%)	3,170 (9.3%)	
Insurance Payor, n (%)			<0.001
Private	11,451 (43%)	15,484 (45%)	
Public	13,704 (52%)	16,857 (49%)	
Self-Pay	1,017 (3.9%)	1,102 (3.2%)	
Other	224 (0.8%)	695 (2.0%)	
Median Household Income Quartile, n (%)			<0.001
Fourth	6,325 (24%)	9,019 (26%)	
Third	6,471 (25%)	8,697 (25%)	
Second	6,637 (25%)	8,484 (25%)	
First	6,963 (26%)	7,938 (23%)	
Residential Location, n (%)			0.6
Rural	2,306 (8.7%)	3,021 (8.8%)	
Urban	24,090 (91%)	31,117 (91%)	
Census Region, n (%)			<0.001
Midwest	9,506 (36%)	11,274 (33%)	
Northeast	1,967 (7.5%)	2,621 (7.7%)	
South	10,480 (40%)	14,001 (41%)	
West	4,443 (17%)	6,242 (18%)	
Injury Mechanism, n (%)			<0.001
Asphyxiation	353 (1.3%)	458 (1.3%)	
Blunt object	118 (0.4%)	106 (0.3%)	
Drowning	13 (<0.1%)	28 (<0.1%)	
Drug poison	14,838 (56%)	20,348 (60%)	
Explosive/burn	33 (0.1%)	44 (0.1%)	
Firearm	55 (0.2%)	93 (0.3%)	
Jumping from height	103 (0.4%)	118 (0.3%)	
Jumping in front of moving object	45 (0.2%)	77 (0.2%)	
Non-drug poison	2,150 (8.1%)	2,454 (7.2%)	
Other mechanism	2,462 (9.3%)	2,649 (7.8%)	
Sharp Object	6,226 (24%)	7,763 (23%)	
ICU Admission, n (%)	2,964 (11%)	3,695 (11%)	0.11
Mortality, n (%)	115 (0.4%)	117 (0.3%)	0.066

[1] Wilcoxon rank sum test, Pearson's Chi-squared test

PEDIATRIC THORACOLUMBAR SPINE TRAUMA IN THE VERY YOUNG PATIENT

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INTRO: Pediatric thoracolumbar spine trauma is relatively rare. When it occurs, it is more common in the adolescent population. However, most pediatric thoracolumbar (T/L) clearance protocols are standardized across all ages. The purpose of this study was to determine the incidence of T/L spine injuries in patients < 5 y.o. and further classify; mechanisms, presenting symptoms and treatments algorithms.

METHODS: After IRB approval, a retrospective review of all patients < 5 years old with any T/L spine imaging was performed at a Level 1 Pediatric Trauma Center, utilizing the trauma registry data from January 2011 through December 2021. Our statistics are descriptive.

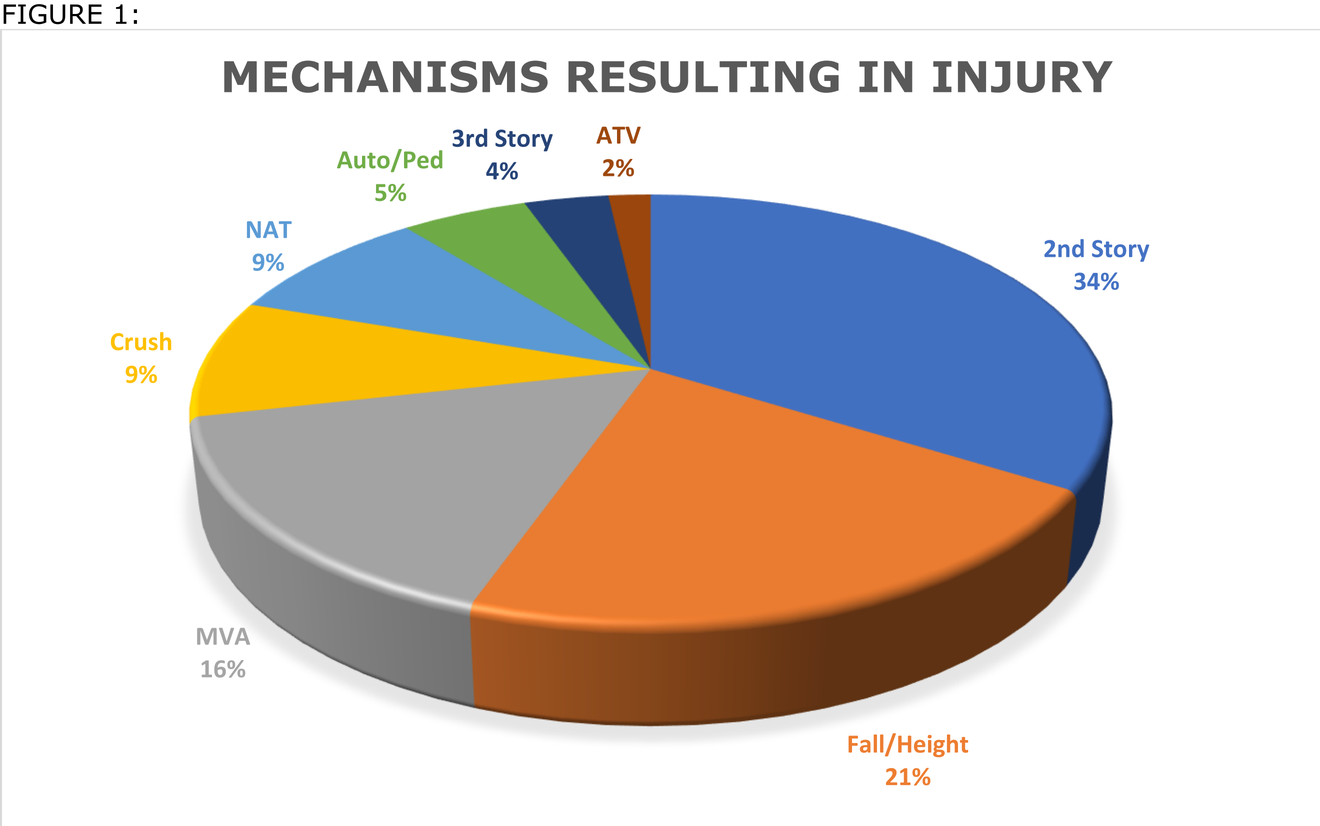
RESULTS: We identified 1429 patients that met our inclusion criteria. Of those patients, 926 had skeletal survey imaging that identified 2 injuries. Fifty-six total patients (3%) were found to have a thoracolumbar injury. The mean age of those injured was 3.27 and only 2 patients (.01%) under the age of 1 were found in injured group. The most common mechanism to result in injury was falling out of a window (2^{nd} + 3^{rd} story 38%) followed by a fall from a height (21%) and MVA (16%). The most common symptom was bruising (2.8%) followed by back pain (2.6%) and abrasions/lacerations (1.6%). Fourteen percent of the injured patients had no symptoms at all. Seventy-seven percent of the injuries were anterior wedge compression fractures with only 1 that required treatment. Six patients (0.4% of all patients) had a T/L injury that required a treatment (4 spinal fusion, 1 TLSO, 1 Collar, 1 Spica cast) and all of those patients had a positive presenting symptom.

CONCLUSION: This study confirms that clinically significant T/L injuries that require intervention are very rare in young children. Patients with clinically significant injuries were all symptomatic, however this can be difficult to reliably assess in young children. It is possible that we can limit spinal imaging in this age group, but additional work needs to be done before strong conclusions can be drawn.

TABLE 1:

INJURIES REQUIRING TREATMENT				
Age	Mechanism	Symptoms	Injury	Treatment
1.58	Fall w/ Dad: hyperextension	Back Pain MAEW	L1, L2 subluxation L2 endplate fx Ligament Injury	L1-L2 ORIF and fusion TLSO postop
4.23	MVA restrained: hyperflexion	low BP Back pain MAEW	T3 vertebral body fx T4 chance fx Ligament injury	T3-T4 Fusion
4.5	2nd story	back pain, hip pain MAEW	T6 burst fx T4-T9 comp fx T3 body fx	TLSO
3.7	2nd story	back pain MAEW	T4-T6 comp T4-T5 perched facets 2 spinous px fx Thoracic EDH	Risser Cast (spica)
4.59	MVA: booster ejection	Back pain Bruising MAEW	T5 Chance FX	T3-T7 fusion
1.9	Fall slide 5 ft	Back pain, neck pain MAEW	C7-T1 comp fx	C-collar d/t pain

FIGURE 1:



Optimizing Patient Selection for ECMO after Pediatric Hypothermia Cardiac Arrest

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Abstract

Introduction
In 2004 we created a protocol to activate ECMO for children with suspected hypothermic cardiac arrest. Currently, we use serum potassium <9, submersion <90 minutes and core body temperature <30 degrees C as criteria for activation. (Figure 1) In 2017 Pasquier *et al.* *d*eveloped a comprehensive model to help predict survival after hypothermic cardiac arrest, the HOPE score. This score was not designed for children and has not been validated in children. We sought to apply this score to our pediatric patient population to determine if it may help us optimize our patient selection.

Methods
After approval by the IRB, we conducted a retrospective review of all patients cannulated onto VA ECMO for hypothermic cardiac arrest at our institution. We reviewed all criteria in the HOPE score: age, sex, CPR duration, asphyxia vs. no asphyxia during hypothermia, serum potassium and core body temperature. We then applied the score to our patient population using a calculator that can be easily found and utilized at www.hypothermiascore.org. We calculated each patient's score for both mechanisms because it is often difficult to determine if asphyxia preceded hypothermia.

Results
Since 2004 we have cannulated 18 patients for a suspected hypothermic arrest. There were 3 survivors (17%). The HOPE score survival prediction ranged from 1% to 86% with asphyxia and 6% to 98% without asphyxia. (Table 1) The survivors had HOPE scores of 9%, 12%, and 86% with asphyxia, and 42%, 49%, and 98% without asphyxia. The non-survivors ranged from 1% to 29% with asphyxia and 6% to 57% without asphyxia. If we picked a cutoff of >5% predicted survival with asphyxia to be considered for ECMO, we could have cut our cannulations in half and not missed any survivors.

Conclusion
ECMO can be a lifesaving measure for specific children after hypothermic arrest. However, identifying the patients that will benefit from this resource intensive intervention remains difficult. HOPE score utilization may decrease the rate of futile cannulation in children, but the limited size of our series prevents conclusions and recommendations. More research must be done to help define pediatric hypothermic arrest patients who will respond to ECMO.

Figure 1: Primary Children's Hospital protocol for hypothermic cardiac arrest.

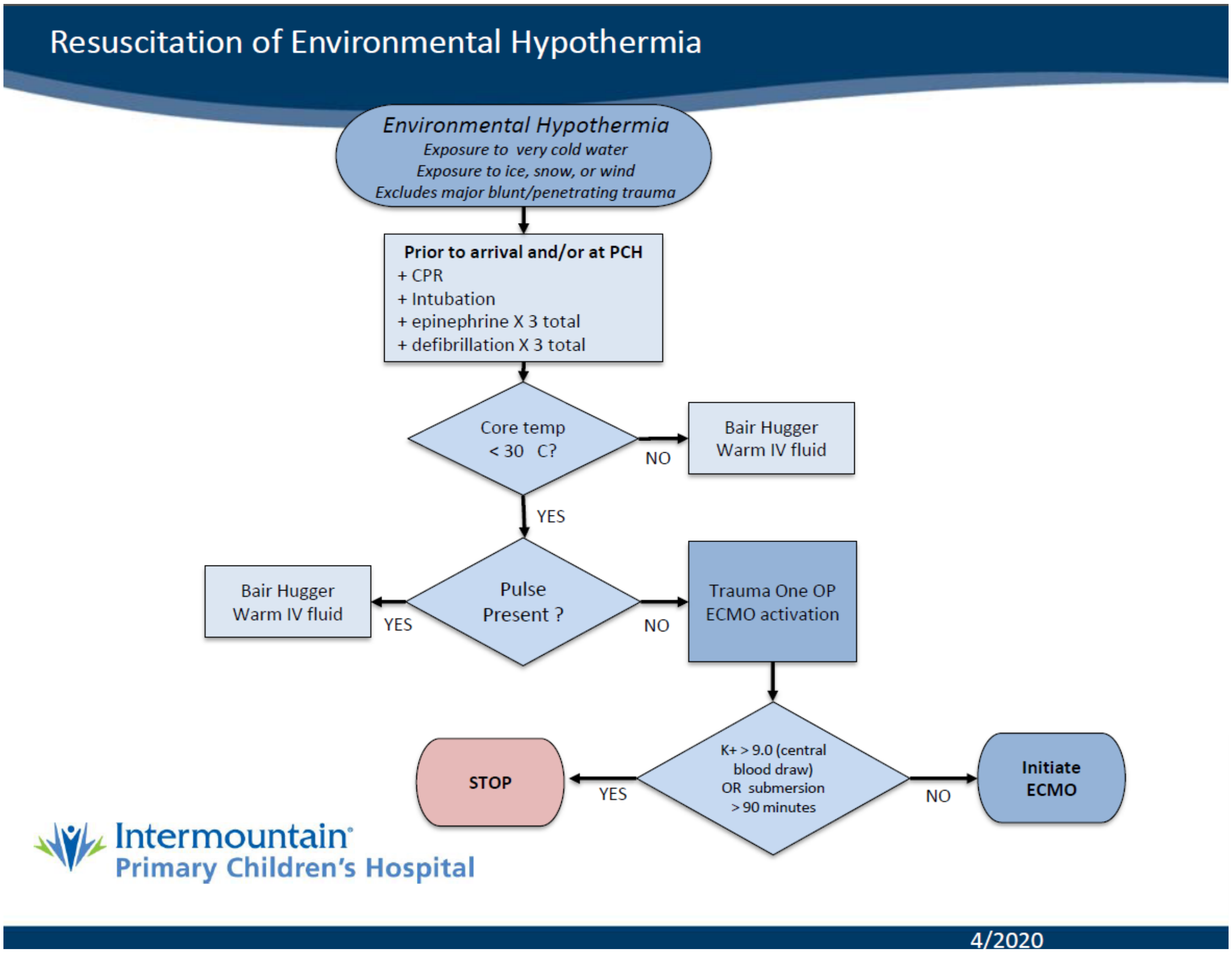

Table 1: Cases of hypothermic cardiac arrest that were cannulated onto VA ECMO.

Case	Age	Sex	pH	K+	CPR Duration (mins)	Temp (°C)	Asphyxia HOPE Score	No Asphyxia HOPE Score	Survival
1	3	F	6.69	3.4	90	20.8	86%	98%	Yes
2	2	M	6.7	4.7	60	27.4	12%	49%	Yes
3	2	M	6.5	6.5	80	29.5	2%	10%	No
4	5	M	6.5	9	180	25.1	2%	11%	No
5	1	M	6.44	9	160	18	5%	26%	No
6	8	F	6.9	5.2	76	27	29%	75%	No
7	4	M	6.5	3.9	93	27.8	12%	49%	No
8	2	M	6.7	4.5	96	27.6	9%	41%	No
9	2	M	6.6	7.2	85	25.7	5%	28%	No
10	10	M	7	4.9	260	29.9	1%	6%	No
11	1	M	6.54	7	90	26.8	4%	22%	No
12	7	M	6.8	5.1	180	27	4%	25%	No
13	14	M	6.5	9	120	26.8	1%	7%	No
14	2	F	6.5	3.5	175	28.9	25%	70%	No
15	2	M	6.59	4.5	100	27.4	9%	42%	Yes
16	4	M	6.5	3.9	60	30.5	5%	26%	No
17	2	M	6.69	4.5	120	25.3	16%	57%	No
18	2	M	6.57	7.2	60	24	11%	46%	No

Pediatric Trauma at a Regional Level 1 Adult Center: Is Chest Computed Tomography being overused?

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Introduction: Chest x-ray (CXR) is the initial diagnostic study in the evaluation of pediatric patients with thoracic trauma. CXR has a high level of sensitivity and specificity in the identification of mediastinal injury and delivers 1/400th of the radiation dose compared to chest computed tomography (CCT). Current recommendations for CCT in blunt pediatric trauma are limited to CXR with signs of potential mediastinal injury. Adult guidelines for CCT are different given anatomic and developmental differences and risk from radiation exposure. The primary aim of this study is to examine use of CCT at an Adult Level 1 Regional Trauma Center for pediatric trauma patients.

Methods: The trauma registry was used to identify pediatric patients (≤17 years old) who were admitted between 1/2020-12/2022 having underwent CCT. We excluded any patient with a penetrating mechanism of injury (MOI). We collected information on demographics, MOI, CXR and interventions performed.

Results: There were 174 pediatric trauma patients identified over the 2 year period who underwent CCT. MOI was blunt in 164 patients. Majority (57.3%, 94/164) of the patients were ≤13 years old. Almost all patients underwent CXR (87.8%, 144/164) in addition to CCT. Over half (61.1%, 88/144) had no abnormalities on their CXR. There were 6 patients with mediastinal abnormalities on CXR, 3 were confirmed on CCT (Table 1). Compared to CXR, CCT identified significantly more pneumothoraces, but differences in identification of atelectasis/contusion, hemothorax/effusion and rib fractures were not significant (Table 2).

Conclusion: CXR demonstrates excellent sensitivity and specificity for blunt pediatric trauma. CCT increased radiation exposure without identifying additional clinically significant injuries in our study population. Indiscriminate use of CCT in pediatric patients increases radiation exposure without improving injury identification. There should be strict guidelines governing the use of CCT in pediatric trauma patients with suspected blunt thoracic injury. More regional studies are needed to assess adherence to established pediatric guidelines at both pediatric and adult centers.

Patient Number	CXR Findings	CCT Findings
1	Small Amount Pneumomediastinum	Large Volume Pneumomediastinum
2	Extensive Pneumomediastinum	Extensive Pneumomediastinum
3	Small Pneumomediastinum	Small Pneumomediastinum
4	Widening of the Mediastinum	No Mediastinal hematoma or Pneumomediastinum. Normal Thymic Tissue
5	Cardiac Silhouette Prominent	No Mediastinal hematoma or Pneumomediastinum.
6	Perihilar prominence. Cardiac Silhouette Obscured.	No Mediastinal hematoma or Pneumomediastinum.

Table 1. Patients with mediastinal abnormalities on CXR

Injury	CT chest	CXR	*p*-value
No Gross Abnormalities	86 (52.4%)	88 (61.1%)	0.123
Atelectasis	58 (35.4%)	39 (27.1%)	0.119
Hemothorax/Effusion	7 (4.27%)	3 (2.08%)	0.280
Pneumothorax	31 (18.9%)	12 (8.33%)	0.008*
Rib fractures	17 (10.4%)	9 (6.25%)	0.194
Other fractures	23 (14.0%)	17 (11.8%)	0.562
Mediastinal abnormality	6 (3.66%)	6 (4.17%)	0.810

Table 2. Statistical analysis using Z-test of proportions to compare the rate of injuries on CCT to CXR

Goodman, Laura F., Schomberg, John, Wallace, Elizabeth, Awan, Saeed, Gibbs, David, Nahmias, Jeff, Guner, Yigit

Electric Bicycles (E-Bikes) are an Increasingly Common Pediatric Public Health Problem

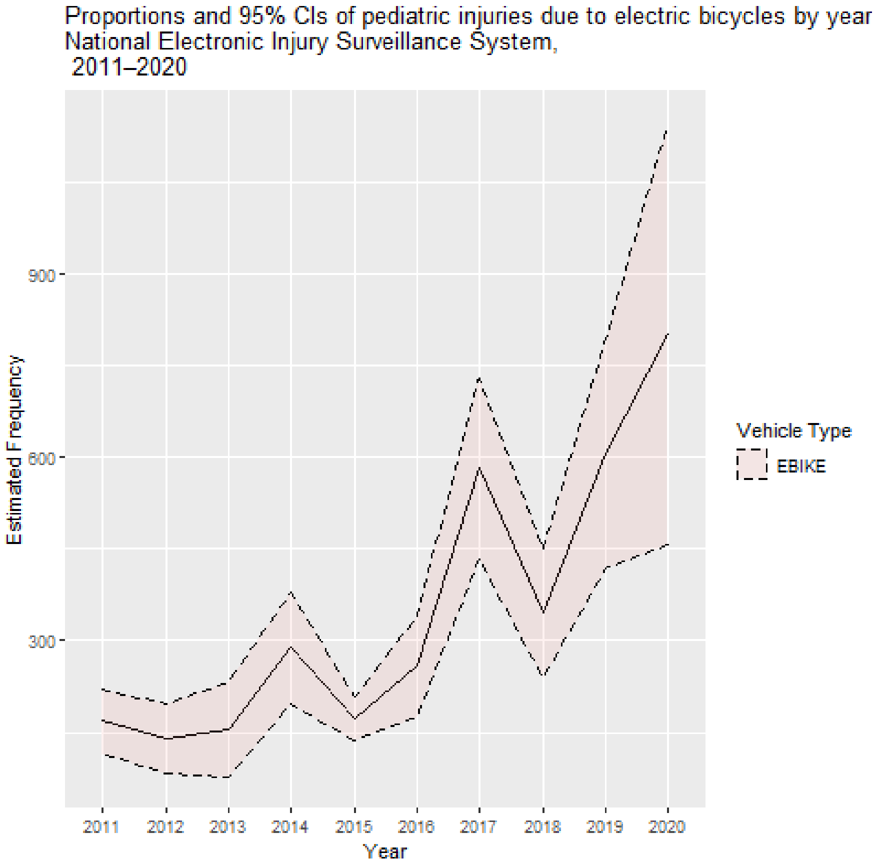
Introduction: Electric bicycles (e-bikes) are increasingly common. E-bikes can achieve higher speeds than traditional pedal bicycles and safety in children is a particular concern. Using data from the National Electronic Injury Surveillance System (NEISS) we sought to examine injuries and use of helmets for e-bike injuries among pediatric patients. We hypothesized increased incidence in 2016-2020 compared to 2011-2015.

Methods: Descriptive and bivariate inferential statistical analyses of injury site, severity, and diagnosis were performed upon NEISS estimates of pediatric e-bike injury from 2011-2020 in ages 6-18 years. Analyses were stratified by patient age and helmet usage.

Results:
3518 e-bike injuries were identified with 39.5% in ages 6-12 and 60.5% ages 13-18. Most were boys (80.9%) and 87.1% were treated and released from an emergency department, 3.9% were transferred, and 7.3% admitted. Deaths were not reported. The most common injuries were contusion (30%), fracture (24%), and concussion 4.6%. The most common primary injured area was the lower extremity 37.9% followed by the head/neck/face 32.2% and trunk 5.6%. There were more injuries from 2016-2020 compared to 2011-2015 (8.7% of injuries in NEISS category vs 19.5% in NEISS category, $p<.0001$). Of those with reported helmet status, 41.5% used a helmet and 58.50% did not.

Conclusion: E-bikes caused more injuries between 2016-2020 compared to 2011-2015. Helmet use among e-bike riders was observed infrequently and can be improved to prevent injury. This indicates that attention to e-bike safety and increasing helmet usage are important to pediatric public health.

Figure 1:


Proportions and 95% CIs of pediatric injuries due to electric bicycles by year
National Electronic Injury Surveillance System,
2011–2020
Estimated Frequency
900
600
300
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year
Vehicle Type
EBIKE

Title

Pediatric Hanging and Strangulation Injuries: an Institutional Review from a Level 1 Pediatric Trauma Center

Authors

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Disclosures

This abstract has not been previously presented and is not under consideration elsewhere in the same or substantially similar form. The above authors are qualified for authorship and have no conflicts of interest or disclosures.

Introduction: The American Academy of Pediatrics has deemed the worsening pediatric mental health crisis a national emergency. There has been a corresponding rise in the number of hangings and strangulations presenting to trauma centers. We sought to define the incidence and outcomes of these injuries to inform best practices for triage and management.

Methods: A retrospective cohort study was conducted that included all patients who presented after hanging or strangulation to a Level I Pediatric Trauma center from January 1, 2011, through December 31, 2021. Patient demographics, injury characteristics, and clinical outcomes were collected. All imaging modalities of the head and neck were individually reviewed to determine if a bony fracture or vascular injury was present.

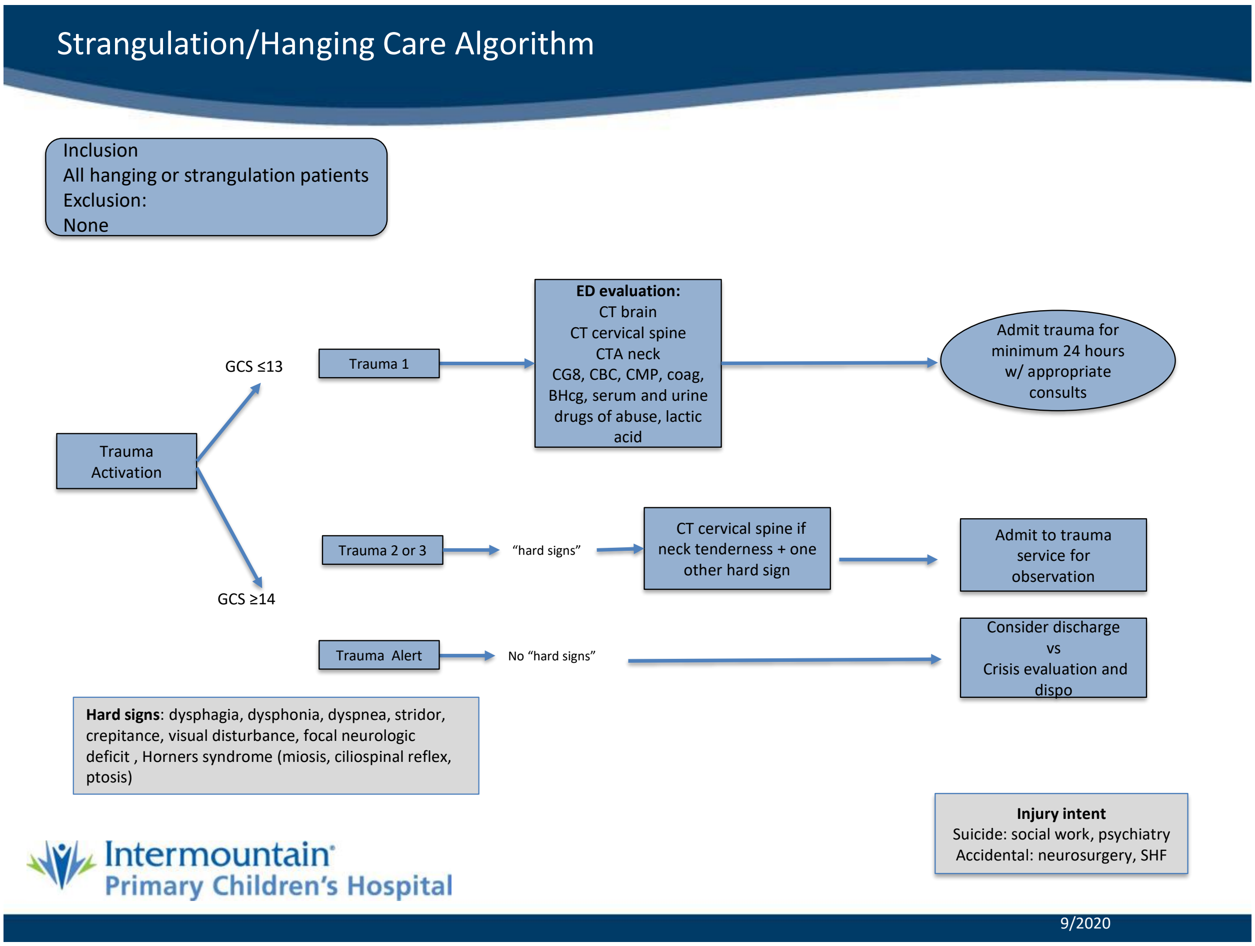
Results: Over the 11-year study period, there were a total of 128 unique encounters. Incidence increased over time, with 25.0% of all cases occurring in the last 2 years. The median age of the cohort was 13 years [range 1-17] and most patients were male (60.9%). A total of 96 cases (75%) were classified as intentional injuries, while the rest were accidental. Initial GCS in the trauma bay was skewed to the extremes: 24.7% of patients presented with a GCS of 3, while 56.7% presented with a GCS of 15. There were 76 patients (59.4%) who received imaging in the form of plain radiographs, CT, or MRI of the neck. No cervical spine fractures were identified. Two patients out of 50 who had CT angiograms of the neck had an injury: one patient with a grade I carotid injury, the other with a possible grade 2 vertebral artery injury. A total of 40 patients died

(31.3%), and all but one patient with a GCS of 3 on arrival died. No patients died that had an initial GCS of 7 or greater.

Conclusion: There were zero cervical spine fractures after a hanging or strangulation in over 10 years at a Level 1 Pediatric Trauma Center. There appears to be limited utility in cervical spine imaging in this patient population without high clinical index of suspicion and/or significant mechanism.

Words: 339

Figure 1. Current trauma protocol of management of pediatric hanging and strangulation injuries at Primary Children's Hospital (Salt Lake City, UT).



Seasonal profile of burn injuries in pediatric patients

Introduction:
Burns are the fifth leading cause of unintentional injury in children and result in roughly 100,000 admissions each year. Research has revealed seasonal burn profiles vary among adults and influence resource allocation. Similar data in children is lacking and can direct prevention strategies to target specific seasonal differences. This study examines the seasonal admission profile of pediatric burn patients at an accredited pediatric burn center in a desert climate.

Methods: The database for the regional referral burn center in Las Vegas (American Burn Association verified) was queried for all patients less than 18 years old admitted for a burn between January 2016 and December 2021. Data collection included sex, ethnicity/race, number of operations, length of stay (LOS), etiology, total body surface area (TBSA) and season.

Results:
320 patients were admitted (M=191;F=129). There was no difference in the number of admissions between seasons (Figure 1). There was a trend for children <2y to be admitted in the summer while children >5y were more often admitted in the fall. Scald burns were the most frequent cause in all seasons and significantly more common in those <10y. There was a higher number of contact (20.2%) and pavement burns (12.4%) in the summer while flame burns (23.0%) were more prevalent in the winter (Figure 1). More operations occurred in winter (31.6%) compared to spring (14.5%) (p=0.05). The LOS was highest in the winter (8.65 d, CI [5.15,12.15]).

Conclusion:
We conclude children <5y are susceptible to severe contact and pavement burns in the summer necessitating admission for medical management. Children >5y sustain flame burns in the winter requiring operations. Scald burns are the most common year round and affect children <10y. Using these results, resource allocation in hospitals and educational campaigns for prevention should be adjusted based by age and time of year.

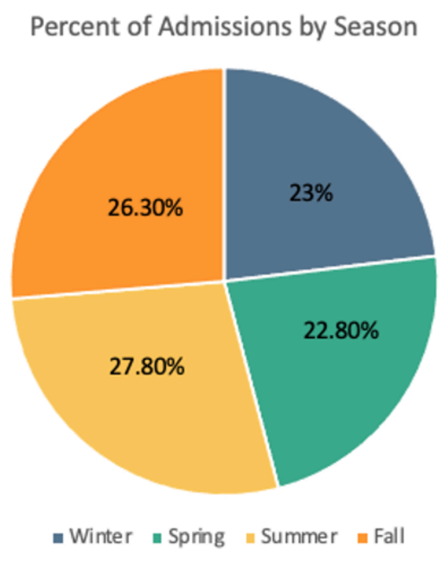


Figure 1: Percent of Pediatric Burn Hospital Admission by Season

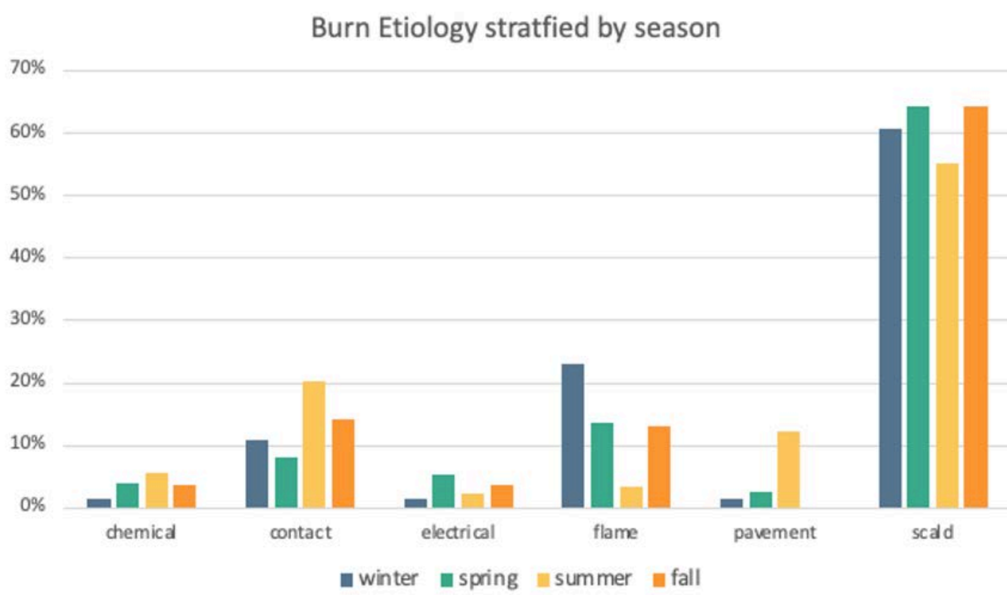


Figure 2: Burn Etiology Stratified by season by Season

Custom mini-fellowship improves care for complex pediatric orthopedic trauma

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Introduction

Pediatric patients with adult-pattern pelvic or acetabular trauma can be particularly challenging; however, few pediatric orthopedic surgeons have significant experience managing these injuries. Many pediatric trauma centers manage them with the support an adult-focused outside consultant orthopedic trauma surgeon (AOTS). We hypothesize the development of a custom trauma mini-fellowship for a pediatric orthopedic surgeon specializing in complex orthotrauma (COT) would reduce time to OR and improve pediatric care coordination versus relying on an outside consultant.

Methods

In the preintervention period, complex orthopedic injuries were managed primarily with the support of an outside consultant for COT. The intervention was the completion of a custom mini-fellowship by our pediatric orthopedic surgeon consisting of over 300 hours of mentored operative management of COT at an adult trauma center. During the postintervention period, most pediatric COT was managed by this pediatric orthopedic surgeon. A retrospective chart review was completed from January 2017-December 2021. AIS-15 injury codes and ICD-10 procedure codes were used to determine relevant injuries and procedures. Diagnostic codes for pelvis, acetabulum and hip injury were used to define complex orthopedic injury. Demographics and average time from arrival to OR were determined and analysis completed.

Results

251 pediatric patients had a pelvis, acetabulum or hip injury during the five-year study period (**Table 1**). 44 patients underwent 87 pelvis, acetabulum or hip procedures. There were twelve patients in the preintervention group and 32 patients in the postintervention group (**Table 2**). The average time from ED arrival to operative procedure in the preintervention group was 41.0 (IQR 7.7, 60.9) hours and 20.2 (IQR 11.8, 24.3) hours in the postintervention group. Preintervention, 57.9% (11/19) of procedures were performed by an AOTS compared to none postintervention, with 93.9% (62/66) being performed by the pediatric orthopedic surgeon.

Conclusion

Time to OR was reduced by 49%, nearly 21 hours, following staffing of a full-time pediatric orthopedic surgeon specializing in COT at our institution for patients with complex hip and pelvic fractures. Overall care appears comparable to preintervention with the benefits of faster

operative intervention by a trained specialist, reduced consultant costs, and improved coordination of pediatric care.

Table 1. Overall patient and injury characteristics

Variable	**Preintervention**		**Postintervention**	
	n	*%*	*n*	*%*
No. of Patients	103		148	
Average Age, Years	10.1		10.5	
Top Mechanisms of Injury				
MVC	38	36.9%	60	40.5%
PED	28	27.2%	29	19.6%
ORV	11	10.7%	27	18.2%
FALL	11	10.7%	7	4.7%
BIKE	7	6.8%	1	0.7%
OTHER	8	7.8%	24	16.2%
Transfer Status				
SCENE	62	60.2%	78	52.7%
REFER HOSPITAL	39	37.9%	63	42.6%
HOME/OTHER	2	1.9%	7	4.7%
Average Injury Severity Score (ISS)	15.3		16.7	
Operative Status of Complex Orthopedic Injuries				
Non-operative	91	88%	116	78%
Isolated Orthopedic Surgery	8	8%	27	18%
Combined Orthopedic & Trauma Surgery	4	4%	5	3%
Discharge Status				
HOME	78	75.7%	114	77.0%
Discharge from ED	14	13.6%	14	9.5%
EXPIRED	4	3.9%	7	4.7%
INPATIENT REHAB	5	4.9%	4	2.7%
OTHER	2	1.9%	9	6.1%

MVC=motor vehicle collision, PED= auto vs. pedestrian, ORV= off-road vehicle, ED=emergency department

Table 2. Complex orthopedic injury characteristics

Variable	**Preintervention**		**Postintervention**	
	n		*n*	
No. of Patients	12		32	
Patients/year	6		11	
Average Age, Years	10.3		12.1	
Average Injury Severity Score (ISS)	19.8		17.7	
Total No. of Procedures	19		66	
Pelvis/Sacrum Procedures	12	63%	42	64%
Acetabulum/Hip Procedures	7	37%	24	36%
Average Time from ED arrival to Procedure (min)	2458	IQR (461, 3652)	1210	IQR (710, 1459)
Average Time from ED arrival to Procedure (hours)	41.0	IQR (7.7, 60.9)	20.2	IQR (11.8, 24.3)
Average Hospital LOS (days)	8.7	IQR (4.9, 11.3)	11.7	IQR (4.7, 9.7)

ED=emergency department, LOS= length of stay

Title

Amusement equipment rental injuries at a single pediatric hospital from 2016-2021

Introduction

Pediatric injuries related to amusement equipment rentals are frequently treated at trauma centers with injuries ranging from fractures to traumatic brain injury. The purpose of this study was to examine injury patterns and trauma service utilization among those injured by amusement equipment rentals.

Methods

The trauma registry at a single Level 2 Pediatric Trauma Center was queried from 2016-2021 for records with ICD-10 codes: W19, W09, and W22. Patients included those less than 18 years of age who utilized trauma services or were admitted to the hospital for injuries related to stationary amusement equipment rentals. Mobile amusement equipment such as injuries on ATVs or motorized scooters were excluded. Key words and related terms such as “bounce house” or “mechanical bulls” in the patient narrative identified the specific type of rental equipment involved. Additional data not found in the trauma registry were abstracted from the electronic medical record.

Results

A total of 34 patients were identified; injuries related to mechanical bulls comprised 50% of cases, while the rest were attributed to bounce houses. Ages ranged from 3-17 years (mean = 7.65); males comprised 73% of patients and 70% identified as Hispanic or Latino (White 61.8%, African American 2.9%, Asian/Pacific Islander 2.9%, Other 32.4%). More than 60% of patients utilized trauma services with 52.9% triggering a Tier 2 activation and 8.8% requiring a trauma consult. Emergency department disposition to the operating room or intensive care unit occurred in 10 patients (29%), 17 were admitted (50%), 6 were sent home (17%), and 1 patient was transferred. One or more fractures were observed in 85% of all patients (41.2 extremity, 38.2% skull); 41% of patients were concussed.

Conclusion

Pediatric injuries often occur in or around the home. Use of amusement rental equipment in private residences introduces even more risk to this population. This case series of amusement equipment rental injuries treated at a single trauma center highlights the potential for serious injuries including traumatic brain injury. There is an opportunity for injury prevention efforts to educate parents about potential risk and how to minimize the risk of injury to their children.

GETTING aHEAD: PREVENTING OCCIPUT PRESSURE INJURIES

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This evidence-based project aims to prevent occipital pressure injuries in the clinical setting through multimodal education with nursing staff in the pediatric cardiovascular intensive care and step-down units, tertiary-level academic hospital. Cardiovascular pediatric patients are vulnerable to developing pressure injuries due to the severity of illness, vasopressor use, poor tissue perfusion, and immobility. Deficient knowledge of correct usage of pressure-reducing devices leads to increasing rates and severity of occiput pressure injuries. Evidence shows that air pressure redistribution cushions and gel cushions contribute to notable decreases in HAPI rates in ECMO patients. Fluidized positioners were found only to reduce pressure injuries when molded adequately and repositioned every two hours. However, usage is variable in clinical practice. Learners retain and practice information more effectively when taught using multimodal methods.

Methods: Evidence about the best practices for occipital pressure injury prevention and effective information dissemination were collected through CINAHL and PubMed. Pre-survey data regarding current practices on the unit was obtained. Our multimodal education approach consisted of an educational resource depicting proper use of repositional devices, PowerPoint presentation during staff meetings, and unit rounding. This was then implemented across both critical care and step-down units. Post education data was acquired through surveys to determine the intervention effectiveness.

Results: Our post-data collection showed that 57% of staff is completely comfortable in preventing occiput pressure injuries (compared to pre-intervention 34%). The occurrence of occiput pressure injuries decreased to 0 in both units after the implementation of our intervention from November 2021 to January 2022.

Conclusions: Our multimodal education has shown that staff are better informed to choose the correct pressure reducing device for the appropriate situation, increased nursing comfortability and appropriate usage of repositional devices, and no new occipital pressure injuries from November 2021-January 2022. Strengths of this project included collaboration with the Wound Care Team, strong attendance in quarterly meetings, and a culture of readiness for education. Challenges included variation with device language in literature, voluntary surveys, education

focused on nursing, not ancillary staff, and supply shortages. Recommendations are for hospital wide multimodal education of pressure device usage to prevent occipital head injuries.

Abstract for the 2022 Western Pediatric Trauma Conference

"Physicians and Firearms":
An online curriculum on firearm injury prevention in medical practice

Christina Cantwell, MD MS[1]; Deniz Cataltepe, MD MPhil[2]; Julie Parsonnet, MD[3]

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Abstract type: Best practice

Introduction: "Physicians and Firearms" is a three-part, online modular curriculum developed by medical students to address gun violence as a public health epidemic. Geared towards medical students, physicians, and other healthcare providers, this self-paced course covers epidemiology, firearm basics, and techniques to use in the clinical setting to address safe firearm storage and injury prevention.

Methods: The modules were developed by medical students across the country as a collaborative effort by Scrubs Addressing the Firearm Epidemic (SAFE) in conjunction with Stanford Medicine Educational Technology, which provided animations, graphics, and voiceover narration. SAFE is a national 501(c)(3) organization with chapters at medical schools across the country that addresses firearm violence through education, research, and support of evidence-based policies. Content was derived from primary research articles, data from the Centers for Disease Control and Prevention, and national data repositories with the objective of increasing viewers' self-confidence with counseling patients at risk of firearm violence and injury.

Results: The course is divided into three modules: "Firearm Injury Epidemiology," "Firearm Basics," and "Providers and Firearms." Each module provides a post-module quiz. The first module, "Firearm Injury Epidemiology," describes the current state of firearm injuries in the U.S. The "Firearm Basics" module defines and compares different types of firearms, patterns of injuries, and safe gun storage techniques. The third module, "Providers and Firearms," discusses practical approaches to discussing firearms with patients in the clinical setting. Each module ranges from 10 to 24 minutes for a total video run time of 47:17 minutes. Participants can enroll in the online, self-paced course for free at https://mededucation.stanford.edu/courses/physicians-and-firearms2020. An assessment of the course's impact on students is ongoing.

Conclusion: To our knowledge, this is the first standardized, online, self-paced curriculum focused on educating U.S. medical students and providers on approaches to discussing firearm violence and injury prevention with patients as it applies in the clinical setting. This course can bridge the academic gap to provide foundational knowledge of basic firearm terminology and safe storage to better equip current and future physicians to address firearm violence in the U.S.

Figures:

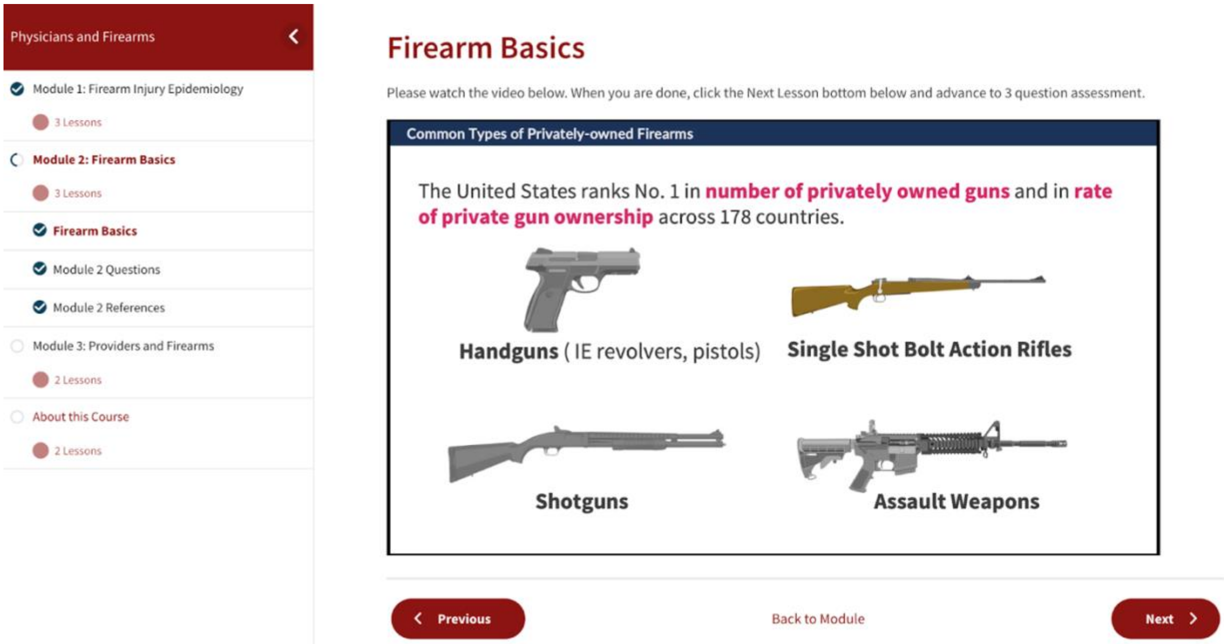


Figure 1. Participant view of self-paced online course in Module 2: "Firearm Basics," overviewing the comparison between different types of firearms.

Who knew BINGO could improve trauma knowledge? Use of an online platform for trauma education!

Sarah Schmidt MSN, RN, CCRN Clinical Education Specialist, Emergency Department, Children's Hospital Colorado

Julie Bianco MS, RN, CPEN Clinical Education Specialist, Emergency Department, Children's Hospital Colorado

Introduction: During the COIVD-19 pandemic educators were challenged with providing necessary education to staff with restrictions on in person learning, budget constraints and nurse burnout. Knowing the importance of ongoing education for a level 1 trauma designated institution, a Trauma Bingo virtual learning activity was created using the online platform Microsoft OneNote to get education into the hands of learners.

Methods: Trauma Bingo featured several teaching modalities to meet needs of individual adult learners including videos, procedure review lectures, and hands-on skills. This allowed for self-paced, self-directed education on topics the learner wanted to engage in, with the ability to complete education during unit down time. The activity was open to all RNs and EMTs working in the Emergency Department. Educators and validators were available to help assist with hands-on skill review, answer questions or troubleshoot issues with the online platform. A 5-point Likert scale was used to quantify participants' perceptions of how the experience affected knowledge and comfort level with skills applicable in the care of trauma patients.

Results: Twenty-eight staff members completed a post-event program evaluation survey to determine the overall effectiveness of this teaching strategy. The respondents' level of ED experience ranged from less than 1 year to 20 years. Of those submitting the survey, 78% of staff felt like Trauma Bingo was a valuable educational opportunity, and75% described feeling better prepared to care for a trauma patient following completion of Trauma Bingo. **Conclusion:** Development of a trauma focused online educational activity successfully provides ED staff an opportunity to actively engage in learning. Results suggest Trauma Bingo positively impacts knowledge and comfort with skills necessary to care effectively for trauma patients.

B	I	N	G	O
ASPEN Collar Placement 	Belmont Setup 	Artline Setup 	Drip Setup and Calculation 	 Deadly Triad of Trauma
Chest Tubes 	Create a "Doe" Chart and document EMS notification Epic	 Pediatric Abdominal Trauma	 Massive Transfusion Protocol	Burn Education 
Mechanical Ventilation: Intro to Pediatric Practices 	Chest Tube Scavenger Hunt 	FREE SQUARE	Blood Gas Series via Cornerstone 	Bristojet 
Set Up for intubation on a 20 kg patient 	Pelvic Stabilization 	New Concepts in Damage Control Resuscitation 	 Pediatric Traumatic Brain Injury	EZ-IO 
 Lifeflow	 Introduction to ECMO	Send a Mile Above 	Giraffe Warmer 	Trauma Documentation Scenario 

Prevention of cervical collar-associated pressure injuries

Jane Tanner NP, Gitte Larsen MD, Katie Russell MD

Introduction

The Primary Children's Hospital Trauma Service identified a high number of pressure injuries (PI) in our trauma patients associated with cervical (C)-collar use. The Trauma Quality Improvement Program review found that from July 2018 to June 2020, 13% of our teenagers with TBIs had PI as compared to all hospitals rate of 3%. Many of these were associated with C-collars, all identified during the Pediatric Intensive Care Unit (PICU) stay.

Methods

In June 2021, we created a PI prevention task force with representation from Trauma, PICU, Neurosurgery, and wound teams. We meet regularly to review PI case occurrence, identify contributing factors, and plan prevention strategies.

One identified issue was variability in approach and timing of C-spine clearance and removal of C-collars. We set a goal to have C-collars cleared within 3 days of admission. Our interventions included refinement and education of our existing C-spine clearance protocol with an emphasis on early use of MRI in patients unable to cooperate with clinical C-spine clearance exam.

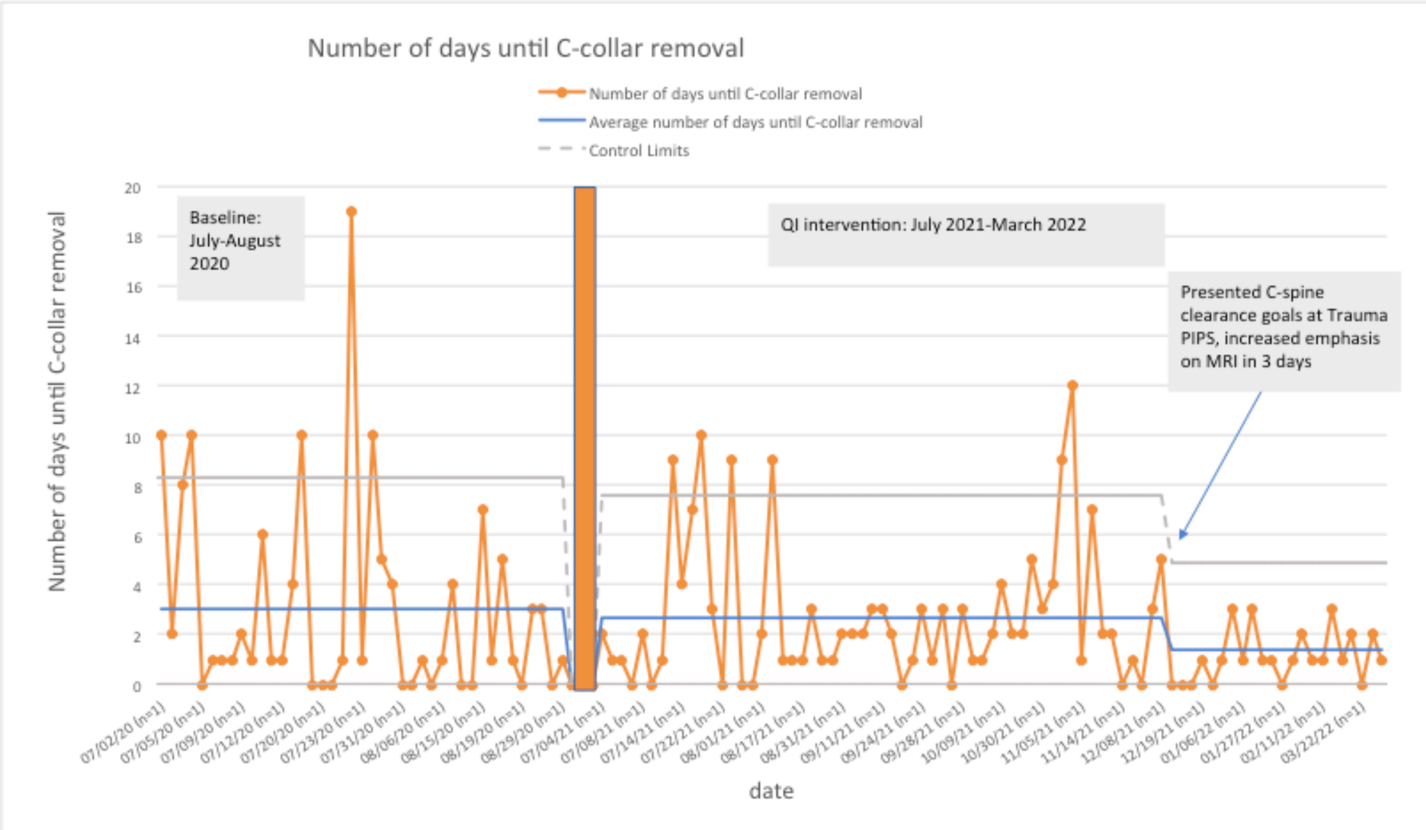
Results

We compared the time to C-spine clearance and percent of patients undergoing MRI between the pre-intervention (7/2020-8/2020, n=41) and post intervention (7/2021-3/2022, n=82) periods. In the post-intervention period, we found that our frequency of C-spine MRI use increased from 20% to 40% and our time to C-spine clearance decreased from 3 (SD 4.1) to 2.3 (SD 2.6) days. Following a presentation about the task force's specific goals during our November 2021 Trauma Process Improvement meeting and broader provider awareness, we have averaged 1.4 days to C-spine clearance from December through March 2022.

Conclusion

Additional, ongoing interventions to prevent C-collar associated PI include education and audits of proper C-collar fit and padding using a "K-card" system and the use of sandbag stabilization for patients who are chemically paralyzed or with a GCS 3T and too unstable to undergo MRI for C-spine clearance.

With these initiatives in place, we have decreased the length of time patients remain in C-collars and hope to eliminate future C-collar associated pressure injuries.



Dates	N	Average days to clearance	Use of MRI for clearance
July-August, 2020	41	3.05	8/41(20%)
July-Nov 2021	57	2.67	22/57 (39%)
Dec 2021-Mar 2022	25	1.36	11/25 (44%)

Western Pediatric Trauma Conference Abstract

A PROGRAMMING APPROACH TOWARDS ADDRESSING PEDIATRIC DROWNINGS

Tiffaney Isaacson[i], Yezan "iPod" Hassan[i], Bianca Cardiel[i], Catherine Tretiakova[ii], Jessica Wani[ii], Jodi Brigoli[iii], Brittany Baarson[iii], Roy Jedeikin[iii], and Diana Bowman[ii]
[i] Center for Family Health and Safety, Phoenix Children's Hospital (PCH), [ii] Arizona State University (ASU), and [iii] Phoenix Children's Care Network (PCCN).

INTRODUCTION: Drowning in the U.S. is endemic to the pediatric population, creating medical costs of at least $16.22 million in 2019. Among one- to four-year-olds, drowning represents the leading cause of unintentional injury death. In Arizona specifically, the drowning rate is nearly double the national rate (5.53 vs 2.82 per 100,000).[1] This study evaluates a Pediatric Drowning Prevention (PDP) pilot program on its ability to provide the tools, strategies, and education needed by pediatric providers to deliver drowning prevention education to caregivers of children in the highest risk age group.

METHODS: Evaluation of the program, which was executed March 2020 – May 2021, was accomplished by administering surveys. Participants were pediatric providers within Phoenix Children's Care Network who conduct well-child visits for one- to four-year-olds. Responses were compared and analyzed with appropriate statistical tools (Figure 1).

RESULTS: Thirty-three pediatric providers from seven practices participated in the program. Results between the surveys suggested that participants were more willing to prescribe drowning prevention education and discuss the connection between developmental milestones and drowning risk. This is especially clear between the pre- and post- survey where the increase strongly trended towards significance ($P < 0.001$).

Further analysis revealed that, after the intervention, provider messaging became more specific and was delivered more frequently (Figure 2). Participants discussed designating a supervising adult during swim time more often after the touchstone. Additionally, participants advised caregivers against taking children to the pool when they are stressed or tired as well as ensuring that children wear a United States Coast Guard approved life jacket, which looks like a vest.

The largest barrier that providers faced outside of time constraints was that competing topics were prioritized over drowning prevention. Despite this, 100% of participants believed that the PDP program increased caregiver knowledge on drownings, risks, and safety strategies. They also unanimously recommended this program for other primary care offices.

CONCLUSION: While small, the initial results of this pilot are promising. The program influenced the messaging providers used and motivated them to do so more frequently. The PDP program is continuing to enroll participants and measure efficacy and its programming should be replicated in communities nationally.

FIGURES: [Please View Next Page]

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[1] Centers for Disease Control and Prevention. (2020). Web-based injury statistics query and reporting system (WISQARS). https://www.cdc.gov/injury/wisqars/fatal.html Accessed: October 12, 2021 [search criteria: Years 2001-2019; Unintentional injury; Drowning/submersion; ages 1-4].

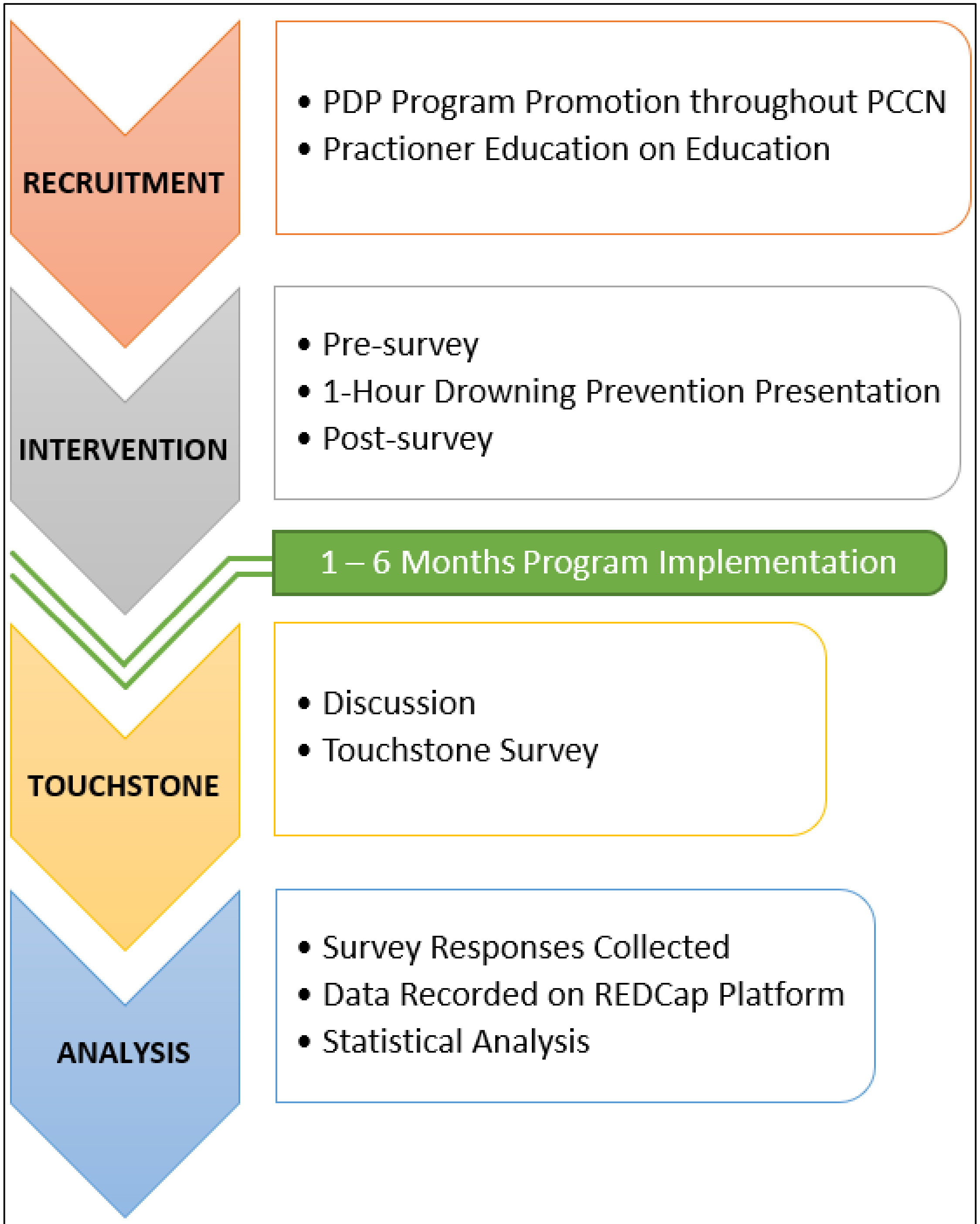

Figure 1 - Methodology

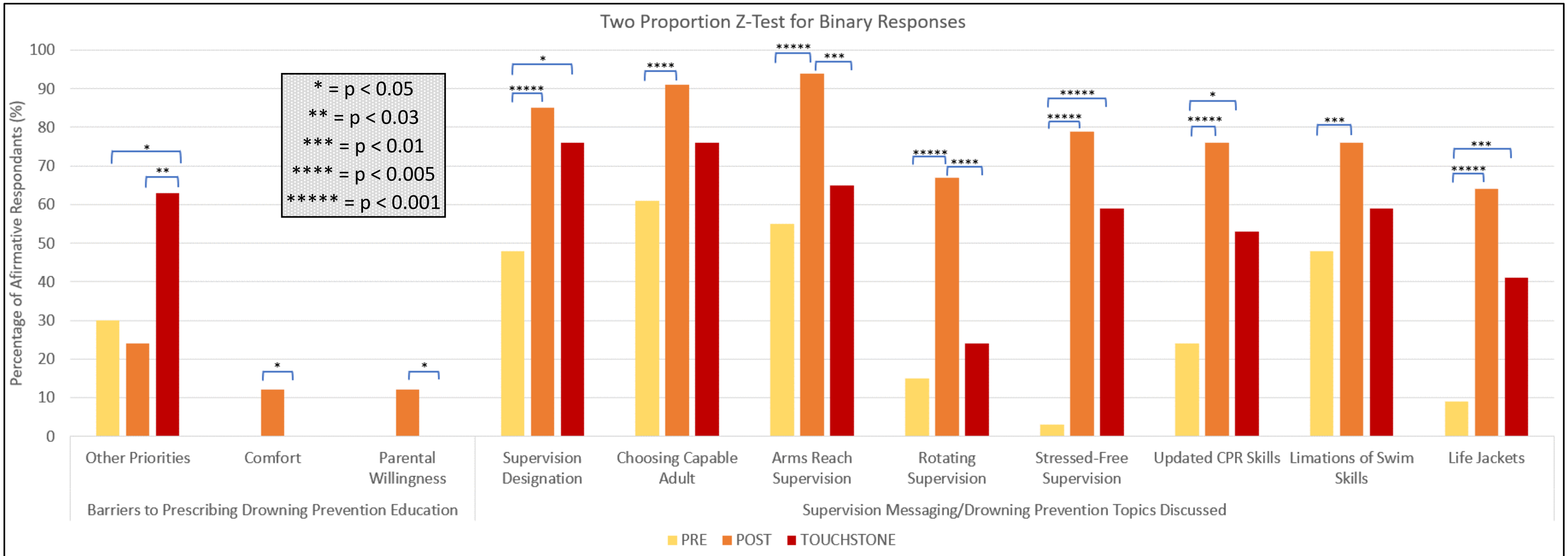

Figure 2 – Binomial Responses (Significant Results)

Improved Processes for Radiology Overreads Can Reduce Reimaging

Nicole Plouffe, MSN, RN, CEN, CPEN, TCRN, Trauma PI Nurse

W. Nathan Holmes, MD Director of Computerized Tomography, CHOC Department of Radiology, Orange

Amy Waunch, MSN, FNP, CEN, TCRN, Trauma Program Manager

CHOC Children's, Orange CA

Introduction

Pediatric patients transferred to pediatric centers from outside hospitals are prone to repeated computerized tomography (CT) imaging as a result of inadequate initial imaging or interpretation discrepancies. To reduce the risk of increased radiation to the pediatric trauma patient, a Level I Pediatric Trauma Center formalized a CT overread process for all trauma transfers who arrived with outside images.

Methods

In July 2020, the Pediatric Trauma Center created an order entry in the electronic medical record for an official interpretation of outside CT scans for trauma transfers. Prior to July, providers called radiology for an unofficial interpretation, which was not included in the medical record.

Utilizing the trauma registry, patients from outside facilities with CT scans were identified during a 12-month pre-and-post implementation period. Data included:

1. Number of outside CT scans overread by the Pediatric Radiologist.
2. Number of CT scans repeated due to poor quality imaging.
3. Number of discrepancies identified by overread.

Results

From the pre-implementation period, 52 patients with outside CT scans were transferred to the Pediatric Trauma Center. Ten percent (N=5) were reviewed by the Pediatric Radiologist, with a discrepancy rate of 60% (N=3). Additionally, 17% (N=9) required repeat CT imaging.

In the post-implementation period, the Pediatric Radiologist read 67% (N=78), with a discrepancy rate of 28% (N=22). Of the 117 CT scans, 12% required repeat imaging.

Discrepancies identified in the pre and post implementation periods were primarily related to intracranial pathology and grading of solid organ injuries.

CTs repeated at the Level 1 Pediatric Trauma Center decreased 4%.

Conclusion

By increasing the Pediatric Radiologist overread of outside CT scans, there was a reduction in reimaging. The improved process reduced radiation exposure for some patients and may have improved clinical management through more accurate diagnoses or earlier compliance with clinical practice guidelines that are imaging dependent such as solid organ injury. Additionally, the reduction in obtaining additional images added a cost benefit to the process. Future expansion of this process utilizing a cloud-based image sharing program within a trauma system could improve quality of care at both the receiving and sending centers.

Figures

Table 1: CT scan overreads of patients transferred to a Pediatric Trauma Center pre and post implementation (n=169)

Metrics	Pre	Post
Trauma patients transferred in with CT scan performed at outside hospital	52	117
Outside CT scans overread by Pediatric Radiologist	5	78
Discrepancy rate between outside radiologist interpretation and pediatric radiologist interpretation	60% (3/5)	28% (22/78)
Rate of repeat CT scans	17% (9/52)	12% (14/117)

Title:

We are open for trauma: maintaining quality trauma nursing care during a nursing strike

Authors: Melanie Stroud, MBA, RN; Brittney Bunnell, MS, CNS, RN; Michael Fong, RN, BSN

Stanford Children's Health

Introduction:

Nursing unions represent more than 230,000 nurses across the United States. According to the U.S. Bureau of Labor Statistics (BLS), representing 20.4% of RNs and 10% of LPNs/LVNs.

5000 Stanford RNs voted to strike at our ACS Verified Level 1 Adult and Pediatric Trauma Center in April, 2022 leaving only a couple of weeks for the Pediatric Trauma Program to prepare for the replacement agency nurses trauma competencies when caring for our patients.

Methods:

Nurses across the country from various unions have participated in dozens of strikes and protests during the pandemic. Giving us less than two weeks of preparation we quickly and efficiently verified training and competencies of 300 replacement nurses for ED, PICU, and Acute Care. All other hospital admissions were placed on hold, but we remained open for pediatric trauma admissions.

Communication between the pediatric trauma program and the hospital command center, determining training needs of agency nurses, verifying trauma credentials of recent care for pediatric trauma patients & Trauma Nurse Core Course with agencies were imperative steps towards assuring our patients were cared for safely. Faced with an urgent need to protect our patients from harm, we transitioned into an emergency preparedness mode with all hands on deck. Preparation for just-in time in-services, escalation of care, call schedule with our team with oversight 24/7, and access to web based and live resources were provided.

Results: Our results after one week of a nurse's strike -there were no reports of patient harm, and satisfaction expressed by unit and hospital leadership of personal relief that this advanced preparation was successful in aiding in the decrease of emotional stress for leadership and the agency nurses.

Conclusion: Very little is written in the literature around assuring safe care of pediatric trauma patients during a strike. Additional analysis and further preparation is needed. Perhaps future hospitals experiencing nurse strikes can benefit from our advanced preparation and lessons learned.

Western Pediatric Trauma Conference Abstract

1. Title: A model for timely outpatient follow-up for Pediatric Patient~~'~~s with Traumatic Brain Injuries, ~~;~~ Establishment of a ~~j~~Joint Trauma ~~-~~Neurology Outpatient Concussion Clinic

   Authors:

   Mary Maginas, Trauma Pediatric Nurse Practitioner, CHOC
   Dr. Laura Goodman, Pediatric Surgery, CHOC
   Dr. David Gibbs, Trauma Medical Director, Pediatric Surgery, CHOC

   Dr. Rachel Pearson, Pediatric Neurology, Director of Brain Injury Medicine, CHOC
   Dr. Sharief Taraman, Pediatric Neurology, CHOC
   ~~Dr. Laura Goodman, Pediatric Trauma Surgery, CHOC~~
   ~~Dr. David Gibbs, Trauma Medical Director, Pediatric Surgery, CHOC~~
   ~~Mary Maginas, Trauma Pediatric Nurse Practitioner, CHOC~~

~~2.~~ Introduction: ~~Traumatic brain injury (TBI) is the leading cause of death and disability in children.~~ It is estimated that in the United States, ~~approximately~~ Concussion accounts for approximately 750,000 pediatric ED visits per year. Concussion accounts for at ~~500,000 children ages 0–14 years are seen in emergency rooms annually for a TBI, with the highest incidence in children 0-4, followed by 15-19 years of age. Concussion accounts for at~~ least 75% of pediatric TBI, and up to 30% of ~~patient~~patients have persistent post-concussive symptoms (PPCS)

~~If not managed properly, Traumatic Brain Injuries~~TBI ~~can cause prolonged post-concussive symptoms affec~~affecting~~ting~~ return to daily activities, school~~,~~ performance, sports involvement, and mental health. ~~The creation of a~~A Trauma Concussion clinic was developed at our institution to improve access to timely concussion management, identify any patient-specific exacerbating factors and/or risk factors for PPCS, and refer patients for further follow-up and ~~N~~neuropsychological testing when needed. ~~The goal of creating this clinic is to~~Measures of success for this clinic include ~~improve~~ment in post-discharge ~~follow-up and continuity of care, improve~~ment in ~~access to care, and alleviat~~ion of~~e scheduling and long wait times in the standard Neurology Concussion Clinic.~~

~~3.~~ Methods: A trauma concussion clinic was established in coordination with the Trauma team and Neurology department in January 2021 ~~beginning in January 2021~~. ~~-~~ It is staffed by a Trauma Nurse Practitioner and Attending Neurologist who see every patient. ~~, with neurologists available if needed.~~ The inpatient Trauma team identifies admitted inpatients requiring ~~mild TBI~~ follow-up and schedules follow-up ~~appointments~~ prior to discharge from the hospital. Patients are seen within 2-4 weeks post-injury. Clinic capabilities include: ~~xx xx xx~~post-concussion symptom screening, concussion-focused exam, treatment of ~~common~~ post-concussive symptoms ~~such as headache and sleep disturbance~~, and referrals for PT, neuropsychology, and mental health when needed.

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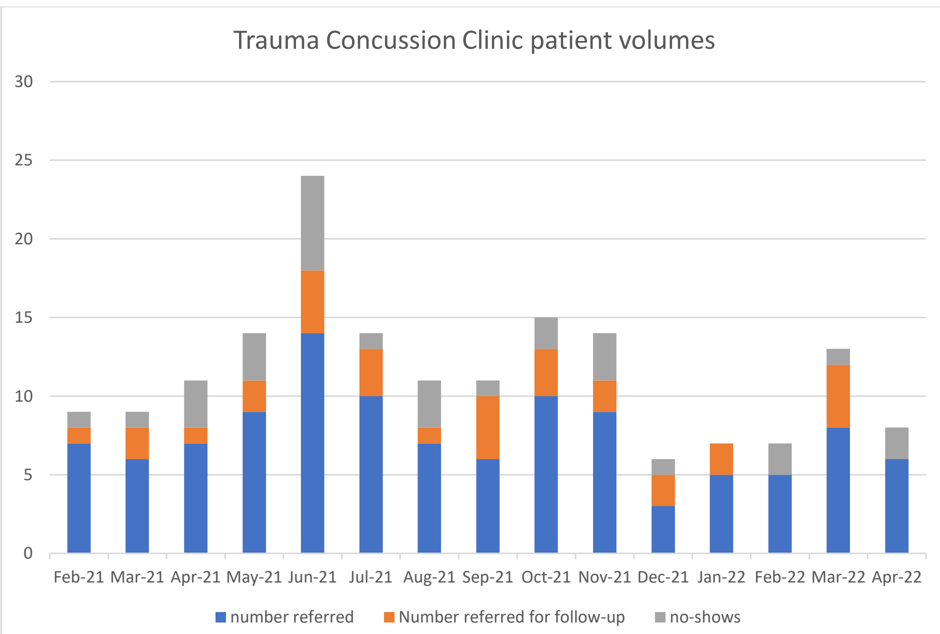
Results: In a 15-month period,142 patients with TBI were admitted to the hospital on the trauma service or received a trauma consult. Of those, 132 were identified as requiring outpatient follow-up. A small number of these patients were not seen in the clinic due to HMO insurance requiring follow-up in their home network or being seen in the general Neurology clinic. Only 8 patients were missed for follow-up. 84 patients have been seen with a no-show rate of 26%. Of those seen in the clinic, 25% percent of patients were referred to follow-up in the Multi-disciplinary Neurology Concussion clinic including Neuropsychological testing. The remaining 75% did not need further follow up.

Conclusion: The establishment of the Trauma Concussion clinic at our institution has provided an alternative avenue for TBI follow-up, identifying those who require further care and would benefit from a multi-disciplinary clinic with Neuropsychological testing. This model was developed to relieve long wait times, and address symptoms early, with the goal to reduce PPCS. Future studies on this model will evaluate the rate of PPCS in this patient population.

6.2. Figures: See below



Community Grand Rounds: Enhancing Pediatric Education and Care Practices Across the Spectrum of Care

Lana Martin, MHL, BSN; John Bealer, MD

Purpose: The purpose of the implementation of grand rounds was to extend the educational reach of pediatric expertise into regional partner hospitals and EMS agencies who transfer patients to our Level 2 trauma center. The goal was the development of pre-hospitalization transfer outreach and education. We describe initial program evaluation and outcomes for the first six months of grand rounds presentations.

Methods: A needs assessment was performed to determine how to best meet the pediatric educational inquiries with our traditional partners. A collaborative multidisciplinary planning committee was constructed, and technology solutions were defined to meet these educational demands during COVID restrictions. We created a series consisting of 2 sessions per month each lasting 60 minutes to be delivered by videoconferencing software across the region. Topics included were trauma and general pediatric care.

Results: In the first six months, we had over 2000 participants in our region, which quickly expanded to include participants from 10 states and 5 countries. Participant satisfaction was high with 96% saying they found the seminars to be valuable. The interactive nature with polling questions especially accounted for high satisfaction scores.

Conclusions: Our program has proven to elevate the level of education and positive care practices to facilitate smoother transitions for patients and families to our Level 2 trauma center. It has built stronger relationships with partner hospitals and EMS agencies. The interest across the U.S. is evidence of it's importance in helping to coordinate care in other regions.

All authors report no conflicts of interest related to this presentation.

Serving Autistic Patients: Models for Community Collaboration

Ellie Wilson, Executive Director of the Autism Society of Minnesota
Dex Tuttle, M.Ed., Injury Prevention Program Manager, Children's Minnesota

Introduction:
Led by the injury prevention program, a community partnership formed between Children's Minnesota and Autism Society of Minnesota (AuSM) to improve service to diverse autistic families. The goal of this effort was to improve the care environment in emergent and non-emergent care settings with education and tools, and to support the development and facilitation of clinical best practices for autistic pediatric patients.

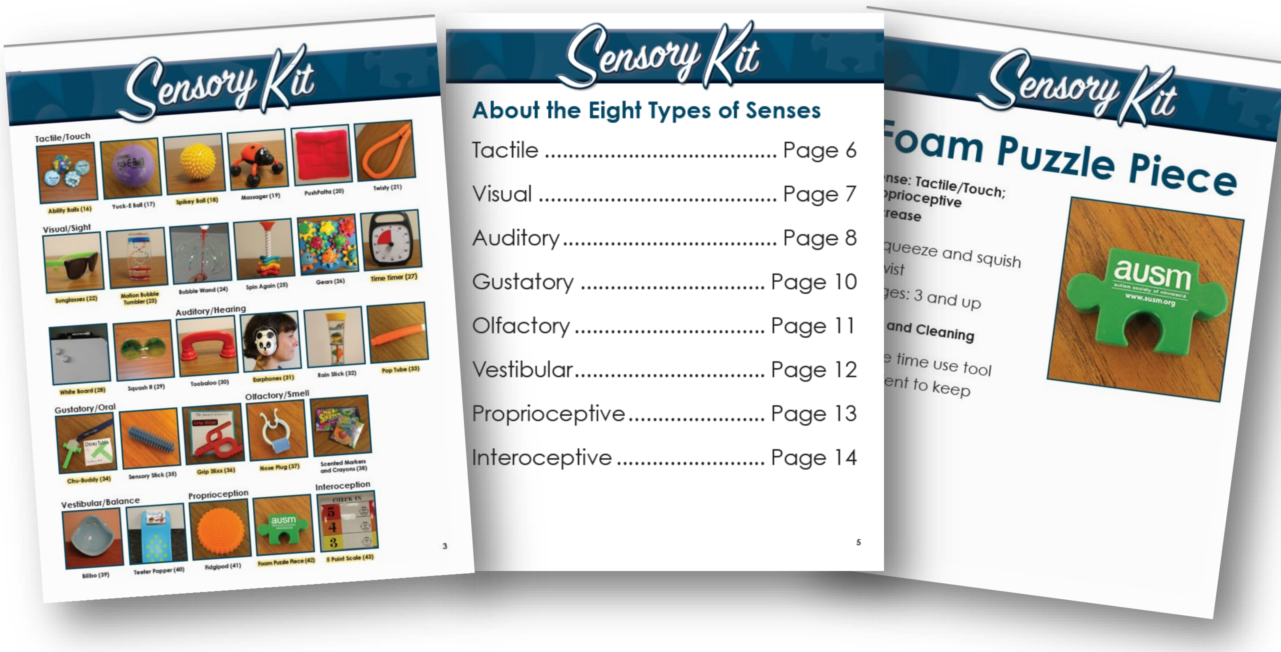
Methods and Results:
With support from the Children's Hospital Association, an interdisciplinary leadership and steering committee was formed to assess the challenges experienced by providers in caring for autistic patients across settings and to address concerns articulated by patient families. With consultation from AuSM, Children's Minnesota was able to create training for more than 15 departments (including but not limited to pre-hospital service, emergency department, critical care, and labs) regarding the recognition of autistic patient needs (even without diagnosis/disclosure), as well as practical application of proactive and reactive best practices in addressing communication and behavioral challenges. Children's Minnesota further worked with AuSM to develop sensory and communication toolkits that are available in all inpatient and outpatient departments. Collaboration also has led to the creation of social narratives for specifically identified protocols, including nitrous sedation. The partnership continues to find new impact in training, continued tool development, and community outreach.

In a survey of department staff before implementation, a total of 359 respondents indicated a feeling of competency in caring for a child with autism at 2.79 on a scale of 0-4, with 4 indicating always feeling competent. Comments by staff included mention of not having many options available, lack of safe alternate spaces for patients to be, and a lack of knowledge on calming/de-escalation strategies. Sensory kits were introduced after the initial education. Comments by staff on a post-implementation survey indicated that families appreciated the inclusivity, the availability of single-use items, and tools to prompt questions about the child's needs.

Conclusions:
Children's Minnesota injury prevention program promotes replication of this model of effective community partner engagement to improve safety and quality of care for autistic patients in pursuit of equitable care for diverse communities.

Tool kits available to all care floors to improve interactions with patients. A smaller, modified version is also available for transportation-specific interactions with families in the community.

Sensory Kit – Examples:



Title: "Video Review of Emergency Department Trauma Team Activations for Process Improvement"

Authors: K.M. Kim, F. Sterner, S. Moulton, K. Adelgais
Institution: Children's Hospital of Colorado, University of Colorado School of Medicine

Introduction:
Trauma team activations are complex, high-risk events carried out by a changing, multidisciplinary team that may be challenged by varying communication styles, infrequent use of equipment, and lack of shared mental model. Trauma video recordings (TVR) present an opportunity to identify actionable areas for trauma process improvement (PI) and continuing education.

Methods:
This prospective observational study of a TVR program was conducted at a level 1 American College of Surgeons (ACS) verified pediatric trauma center, where video recordings of trauma team activations are captured by a continuous, HIPPA compliant video recording system. Videos meeting inclusion criteria (highest level activations, deaths and trauma team request) are reviewed weekly by Pediatric Emergency Medicine (PEM) physicians, Pediatric Emergency Department (PED) nurses, and pediatric trauma surgeons. A standardized survey is used to identify systemic issues and track improvement. Opportunities for improvement or feedback are noted and included in trauma team PI/QI efforts and used to provide individual feedback as appropriate.

Results:
Since February 2021, 76 trauma activations have been reviewed, representing 30% of all trauma activations at the study site. Median attendance at each session was 7 (PEM physicians, n=5; trauma surgeons, n=1; PED nurses, n=2). We identified several opportunities for improvement not previously identified in prior PI/QI efforts:

1) Maintenance of inline cervical spine immobilization during patient movements
2) Closed-loop and team communication
3) Timely location and access to equipment for low frequency procedures, including chest tube tray and thoracotomy equipment
4) Timely recognition of need for blood products for management of ongoing hemorrhage

Conclusions:
TVR that is guided by a standardized survey helps to identify errors in omission and/or commission. It can be used to identify system and process issues, many of which can be addressed and overcome with good communication. It allows individuals to assess and gain feedback on their performance and is a valuable component of a mature trauma PI program. Future work will include review of survey criteria and inclusion of TVR findings in PI metrics.